RADIATION CENTER

Oregon State University

100 Radiation Center
Corvallis, Oregon
97331-5903

Telephone
541-737 2341

Fax
541-737-0480

October 28, 2002

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

Reference: Oregon State University TRIGA Reactor (OSTR), Docket No. 50-243, License No. R-106

In accordance with section 6.7.e of the OSTR Technical Specifications, we are hereby submitting the Oregon State University Radiation Center and TRIGA Reactor Annual Report for the period July 1, 2001 through June 30, 2002.

The 2001-2002 Annual Report continues the pattern established over the past few years by including information about the entire Radiation Center rather than concentrating primarily on the reactor. Because the report addresses a number of different interests, it is rather lengthy, but we have incorporated a short executive summary which highlights the Center's activities and accomplishments over the past year.

The executive summary indicates that the Radiation Center has maintained its high degree of productivity this past year. We hope that you will find the current report to be informative and interesting. Should there be any questions, please let me know.

Sincerely,

Andrew C. Klein
Director

Enclosure

A020
A001

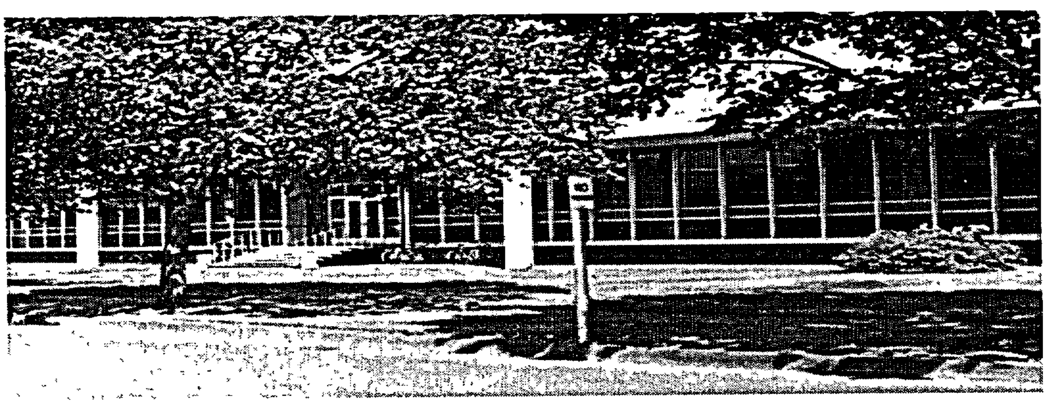
cc w/enclosure:

Mr. Al Adams, Jr., Senior Project Manager, USNRC, MS O11 B20, Washington, DC 20555-0001
Mr. Craig Bassett, USNRC, 61 Forsyth St. SW, Ste. 23T85, Atlanta, GA 30303
Mr. Pat Madden, USNRC, One White Flint North, MS 12 D1, Rockville, MD 20852

cc w/out enclosure:

D. Stewart-Smith, Oregon Office of Energy
J. C. Ringle, Chairman, OSTR Reactor Operations Committee
G. M. Wachs, OSTR Reactor Supervisor, OSU
S. R. Reese, OSTR Reactor Administrator, OSU
S. A. Menn, Senior Health Physicist, OSU

Oregon State University Radiation Center and TRIGA Reactor



Annual Report

July 1, 2001 - June 30, 2002

Annual Report of the Oregon State University Radiation Center and TRIGA Reactor

July 1, 2001 - June 30, 2002

To satisfy the requirements of:

A. U.S. Nuclear Regulatory Commission, License No. R-106 (Docket No. 50-243), Technical Specification 6.7(e).

B. Task Order No. 3, under Subcontract No. C84-110499 (DE-AC07-76ER01953) for University Reactor Fuel Assistance-AR-67-88, issued by EG&G Idaho, Inc.

C. Oregon Office of Energy, OOE Rule No. 345-030-010.

Edited by:

A. C. Klein, Director

With contributions from:

A. C. Klein, Director
K. M. Brock, Senior Health Physicist
S. C. Campbell, Business Manager
M. R. Conrady, Analytical Support Manager
J. E. Darrough, Health Physicist
G.M. Wachs, Reactor Supervisor
R. A. Keen, Office Coordinator
S. A. Menn, Health Physicist
S. R. Reese, Reactor Administrator
L. J. Robinson, Word Processor
S. P. Smith, Scientific Instrument Technician
J. M. Stueve, Office Coordinator

Submitted by:

A. C. Klein
Director, Radiation Center

Radiation Center
Oregon State University
Corvallis, Oregon 97331-5903
Telephone: (541) 737-2341
Fax: (541) 737-0480

October 2002

Annual Report of the
Oregon State University
Radiation Center and TRIGA Reactor

Table of Contents

Page

PART I - OVERVIEW

A. Acknowledgements I-1
B. Executive Summary I-1
C. Introduction I-2
D. Overview of the Radiation Center I-3
E. Summary of Environmental and Radiation Protection Data I-4
1. Liquid Effluents Released I-4
2. Liquid Waste Generated and Transferred I-4
3. Airborne Effluents Released I-5
4. Solid Waste Released I-5
5. Radiation Exposure Received by Personnel I-6
6. Number of Routine Onsite and Offsite Monitoring Measurements and Samples I-7
F. History I-8

PART II - PEOPLE

A. Professional and Research Faculty II-1
B. Visiting Scientists and Special Trainees II-5
C. OSU Graduate Students II-5
D. Business, Administrative and Clerical Staff II-6
E. Reactor Operations Staff II-6
F. Radiation Protection Staff II-6
G. Scientific Support Staff II-7
H. OSU Radiation Safety Office Staff II-7
I. Committees II-7
1. Reactor Operations Committee II-7
2. Radiation Safety Committee II-8
3. Radiation Center Safety Committee II-8

Page

PART III - FACILITIES

A. Research Reactor III-1
  1. Description III-1
  2. Utilization III-2
    a. Instruction III-2
    b. Research III-3
B. Analytical Equipment III-3
  1. Description III-3
  2. Utilization III-3
C. Radioisotope Irradiation Sources III-4
  1. Description III-4
  2. Utilization III-4
D. Laboratories and Classrooms III-4
  1. Description III-4
  2. Utilization III-5
E. Instrument Repair and Calibration Facility III-5
  1. Description III-5
  2. Utilization III-6
F. Libraries III-6
  1. Description III-6
  2. Utilization III-7

PART IV - REACTOR

A. Operating Statistics IV-1
B. Experiments Performed IV-1
  1. Approved Experiments IV-1
  2. Inactive Experiments IV-2
C. Unplanned Shutdowns IV-3
D. Changes to the OSTR Facility, to Reactor Procedures, and to Reactor Experiments Performed Pursuant to 10 CFR 50.59 .... IV-3
  1. 10 CFR 50.59 Changes to the Reactor Facility IV-3
  2. 10 CFR 50.59 Changes to Reactor Procedures IV-6
  3. 10 CFR 50.59 Changes to Reactor Experiments IV-7
E. Surveillance and Maintenance IV-7
  1. Non-Routine Maintenance IV-7
  2. Routine Surveillance and Maintenance IV-8
F. Reportable Occurrences IV-8

Page

PART V - PROTECTION

A. Introduction V-1
B. Environmental Releases V-1
1. Liquid Effluents Released V-2
2. Airborne Effluents Released V-2
3. Solid Waste Released V-3
C. Personnel Doses V-3
D. Facility Survey Data V-4
1. Area Radiation Dosimeters V-5
2. Routine Radiation and Contamination Surveys V-5
E. Environmental Survey Data V-6
1. Gamma Radiation Monitoring V-6
2. Soil, Water, and Vegetation Surveys V-7
F. Radioactive Material Shipments V-8
G. References V-9

PART VI - WORK

A. Summary VI-1
B. Teaching VI-1
C. Research and Service VI-1
1. Neutron Activation Analysis VI-2
2. Forensic Studies VI-2
3. Irradiations VI-3
4. Radiological Emergency Response Services VI-3
5. Training and Instruction VI-3
6. Radiation Protection Services VI-4
7. Radiological Instrument Repair and Calibration VI-4
8. Consultation VI-5
9. Public Relations VI-5

PART VII - WORDS

A. Publications in Print VII-1
B. Documents Submitted for Publication VII-12
C. Documents in Preparation VII-15
D. Theses and Student Project Reports VII-17
E. Presentations VII-19

LIST OF TABLES

Table	Title	Page
III.A.1	OSU Courses Using the OSTR	III-8
III.A.2	OSTR Teaching Hours	III-9
III.A.3	OSTR Research Hours	III-10
III.B.1	Radiation Center Spectrometry Systems: Gamma, Low Energy Photon, Alpha	III-11
III.B.2	Radiation Center Proportional Counting Systems	III-12
III.B.3	Thermoluminescent Dosimeter Systems	III-13
III.C.1	Gammacell 220 ^{60}Co Irradiator Use	III-14
III.D.1	Student Enrollment in Nuclear Engineering, Radiation Health Physics and Nuclear Science Courses Which Are Taught or Partially Taught at the Radiation Center	III-15
IV.A.1	OSTR Operating Statistics (Using the FLIP Fuel Core)	IV-9
IV.A.2	OSTR Operating Statistics with the Original (20% Enriched) Standard TRIGA Fuel Core	IV-12
IV.A.3	Present OSTR Operating Statistics	IV-13
IV.A.4	OSTR Use Time in Terms of Specific Use Categories	IV-14
IV.A.5	OSTR Multiple Use Time	IV-15
IV.B.1	Use of OSTR Reactor Experiments	IV-16
IV.C.1	Unplanned Reactor Shutdowns and Scrams	IV-17
V.A.1	Radiation Protection Program Requirements and Frequencies	V-10

LIST OF TABLES (Continued)

Table	Title	Page
V.B.1.a	Monthly Summary of Liquid Effluent Releases to the Sanitary Sewer	V-11
V.B.1.b	Annual Summary of Liquid Waste Generated and Transferred	V-12
V.B.2	Monthly Summary of Gaseous Effluent Releases	V-13
V.B.3	Annual Summary of Solid Waste Generated and Transferred	V-14
V.C.1	Annual Summary of Personnel Radiation Doses Received	V-15
V.D.1	Total Dose Equivalent Recorded on Area Dosimeters Located Within the TRIGA Reactor Facility	V-16
V.D.2	Total Dose Equivalent Recorded on Area Dosimeters Located Within the Radiation Center	V-17
V.D.3	Annual Summary of Radiation Levels and Contamination Levels Observed Within the Reactor Facility and Radiation Center During Routine Radiation Surveys	V-19
V.E.1	Total Dose Equivalent at the TRIGA Reactor Facility Fence	V-20
V.E.2	Total Dose Equivalent at the Off-Site Gamma Radiation Monitoring Stations	V-21
V.E.3	Annual Average Concentration of the Total Net Beta Radioactivity (Minus ^3H) for Environmental Soil, Water, and Vegetation Samples	V-22
V.E.4	Average LLD Concentration and Range of LLD Values for Soil, Water and Vegetation Samples	V-23
V.F.1	Annual Summary of Radioactive Material Shipments Originating From the TRIGA Reactor Facility's NRC License R-106	V-24

LIST OF TABLES (Continued)

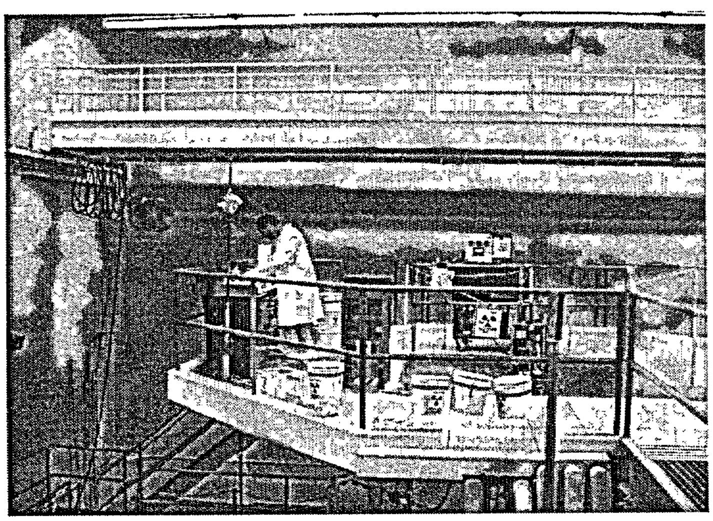
Table	Title	Page
V.F.2	Annual Summary of Radioactive Material Shipments Originating From the Radiation Center's State of Oregon License ORE 90005	V-26
V.F.3	Annual Summary of Radioactive Material Shipments Exported Under NRC General License 10 CFR 110.23	V-28
VI.C.1	Institutions and Agencies Which Utilized the Radiation Center	VI-6
VI.C.2	Graduate Student Research Which Utilized the Radiation Center	VI-12
VI.C.3	Listing of Major Research and Service Projects Performed or in Progress at the Radiation Center and Their Funding Agencies	VI-18
VI.C.4	Summary of the Types of Radiological Instrumentation Calibrated to Support the OSU TRIGA Reactor and the Radiation Center	IV-39
VI.C.5	Summary of Radiological Instrumentation Calibrated to Support Other OSU Departments and Other Agencies	VI-40
VI.F.1	Summary of Visitors to the Radiation Center	VI-41

LIST OF FIGURES

Figure	Title	Page
IV.E.1	Monthly Surveillance and Maintenance (Sample Form)	IV-18
IV.E.2	Quarterly Surveillance and Maintenance (Sample Form)	IV-19
IV.E.3	Semi-Annual Surveillance and Maintenance (Sample Form)	IV-21
IV.E.4	Annual Surveillance and Maintenance (Sample Form)	IV-23
V.E.1	Monitoring Stations for the OSU TRIGA Reactor	V-29

Part I

Overview



Part I

OVERVIEW

A. Acknowledgments

Many individuals and organizations help the Radiation Center succeed, and in recognition of this, the staff of the Oregon State University (OSU) Radiation Center and TRIGA Reactor (OSTR) would like to extend its appreciation to all of those who contributed to the information and events contained in this report: to the University administration; to those who provided our funding, particularly the U. S. Department of Energy (USDOE) and the State of Oregon; to our regulators; to the researchers, the students, and others who used the Radiation Center facilities; to OSU Facilities Services; and to OSU Department of Public Safety and the Oregon State Police. We most earnestly say, "Thank you."

The Center would not be able to accomplish all that is shown in this report without the diligent efforts of all of its staff who have all worked hard. It is to their credit that we have managed to improve our level and quality of service. To each one,"Thank you."

Putting this report together each year is a major effort for several people. Only those who have been involved can fully understand what a great job Joan Stueve and Eralee Jordan have done in the data-gathering, organization, and keyboarding of this Annual Report. Thanks, Joan and Eralee! In addition, Erin Cimbri provided significant help in converting Access database information into word processor documents. Thanks, Erin!

B. Executive Summary

In October 2002, A. C. Klein assumed the position of Director of the Radiation Center and is officially authorizing this edition of the annual report following the retirement of S. E. Binney. A. D. Hall resigned the Reactor Supervisor position shortly after the reporting period began and G. M. Wachs assumed the Reactor Supervisor Position for the duration of the time covered by this report.

The data from this reporting year show that the use of the Radiation Center and OSTR has continued to grow in many areas.

The Radiation Center supported 94 different courses this year, mostly in the Department of Nuclear Engineering. About one-quarter of these courses involved the OSTR. The number of OSTR hours used for academic courses and training was 724, while 2145 hours were used for research projects. Eighty-one percent of the OSTR research hours were in support of off-campus research projects, which reflects the increasing wider use of the OSTR nationally and internationally. Radiation Center users published 96 articles this year, with 22 more submitted for publication. There were also 15 theses completed and 34 presentations made by Radiation Center users. The number of samples irradiated in the reactor during this reporting period was 6660. Funded OSTR use hours comprised 100 % of the research use. This is consistent with the move to a more full cost recovery basis for services provided by the Center. The OSTR continues to be the facility of choice for many of the $^{39}Ar/^{40}Ar$ and fission track geochronology laboratories around the world.

Personnel at the Radiation Center conducted 111 tours of the facility, accommodating 1,425 visitors. The visitors included elementary, middle school, high school, and college students; relatives and friends; faculty; current and prospective clients; national laboratory and industrial scientists and engineers; and state, federal and international officials. The Radiation Center is a significant positive attraction on campus because visitors leave with a good impression of the facility and of Oregon State University.

Research projects of personnel housed in the Radiation Center totaled approximately $2.5 million for this year.

The Radiation Center projects database continues to provide a useful way of tracking the many different aspects of work at the facility. The number of projects supported this year was 134. Reactor projects comprised 63% of all projects. The total research supported by the Radiation Center, based on 40 user responses, was $3,894,218. The actual total is likely considerably higher. This year the Radiation Center provided service to research faculty and students from 96 different institutions, 54% of which were from other states and 15% of which were from outside the U. S. and Canada. So while the Center's primary mission is local, it is also a facility with a national and international clientele.

The Radiation Center web site provides an easy way for potential users to evaluate the Center's facilities and capabilities as well as to apply for a project and check use charges. The address is: http://www.ne.orst.edu/facilities/radiation_center.

C. Introduction

The current annual report of the Oregon State University Radiation Center and TRIGA Reactor follows the usual format by including information relating to the entire Radiation Center rather than just the reactor. However, the information is still presented in such a manner that data on the reactor may be examined separately, if desired. It should be noted that all annual data given in this report cover the period from July 1, 2001 through June 30, 2002. Cumulative reactor operating data in this report relate only to the FLIP-fueled core. This covers the period from August 1, 1976 through

June 30, 2002. For a summary of data on the reactor's original 20% enriched core, the reader is referred to Table IV.A.2 in Part IV of this report or to the 1976-77 Annual Report if a more comprehensive review is needed.

In addition to providing general information about the activities of the Radiation Center, this report is designed to meet the reporting requirements of the U. S. Nuclear Regulatory Commission, the U. S. Department of Energy, and the Oregon Office of Energy. Because of this, the report is divided into several distinct parts so that the reader may easily find the sections of interest.

D. Overview of the Radiation Center

The Radiation Center is a unique facility which serves the entire OSU campus, all other institutions within the Oregon University System, and many other universities and organizations throughout the nation and the world. The Center also regularly provides special services to state and federal agencies, particularly agencies dealing with law enforcement, energy, health, and environmental quality, and renders assistance to Oregon industry. In addition, the Radiation Center provides permanent office and laboratory space for the OSU Department of Nuclear Engineering, the OSU Radiation Safety Office, the OSU Institute of Nuclear Science and Engineering and Radiation Health Physics, and for the OSU nuclear chemistry, radiation chemistry, geochemistry and cosmochemistry programs. *There is no other university facility with the combined capabilities of the OSU Radiation Center in the western half of the United States.*

Located in the Radiation Center are major items of specialized equipment and unique teaching and research facilities. They include a TRIGA Mark II research nuclear reactor; a ^{60}Co gamma irradiator; a large number of state-of-the art computer-based gamma radiation spectrometers and associated germanium detectors; and a variety of instruments for radiation measurements and monitoring. Specialized facilities for radiation work include teaching and research laboratories with instrumentation and related equipment for performing neutron activation analysis and radiotracer studies; laboratories for plant experiments involving radioactivity; a facility for repair and calibration of radiation protection instrumentation; and facilities for packaging radioactive materials for shipment to national and international destinations.

A major non-nuclear facility housed in the Radiation Center is the one-quarter scale thermal hydraulic advanced plant experimental (APEX) test facility for the Westinghouse AP600 reactor design. The AP600 is a next-generation nuclear reactor design which incorporates many passive safety features as well as considerably simplified plant systems and equipment. APEX operates at pressures up to 400 psia and temperatures up to 450°F using electrical heaters instead of nuclear fuel. All major components of the AP600 are included in APEX and all systems are appropriately scaled to enable the experimental measurements to be used for safety evaluations and licensing of the full scale plant. This world-class facility meets exacting quality assurance criteria to provide assurance of safety as well as validity of the test results.

Also housed in the Radiation Center is the Advanced Thermal Hydraulics Research Laboratory, which is used for state-of-the-art two-phase flow experiments, and the Nuclear Engineering Scientific Computing Laboratory.

The Radiation Center staff regularly provides direct support and assistance to OSU teaching and research programs. Areas of expertise commonly involved in such efforts include nuclear engineering, nuclear and radiation chemistry, neutron activation analysis, radiation effects on biological systems, radiation dosimetry, environmental radioactivity, production of short-lived radioisotopes, radiation shielding, nuclear instrumentation, emergency response, transportation of radioactive materials, instrument calibration, radiation health physics, radioactive waste disposal, and other related areas.

In addition to formal academic and research support, the Center's staff provides a wide variety of other services including public tours and instructional programs, and professional consultation associated with the feasibility, design, safety, and execution of experiments using radiation and radioactive materials.

E. Summary of Environmental and Radiation Protection Data

1. Liquid Effluents Released (See Table V.B.1.a)

a.	Total estimated quantity of radioactivity released (to the sanitary sewer)[(1) (2)]	none
b.	Detectable radionuclides in the liquid waste	none
c.	Estimated average concentration of released radioactive material at the point of release	none
d.	Percent of applicable monthly average concentration for released liquid radioactive material at the point of release	none
e.	Total volume of liquid effluent released, including diluent[(3)]	4.308 gallons

2. Liquid Waste Generated and Transferred (See Table V.B.1.b)

a.	Volume of liquid waste packaged[(4)]	30 gallons
b.	Detectable radionuclides in the waste	^{3}H, ^{32}P, ^{59}Fe ^{65}Zn, ^{86}Rb

c. Total quantity of radioactivity in the waste 5.52×10^{-3} Ci

---

(1) OSU has implemented a policy to reduce radioactive wastes disposed to the sanitary sewer to the absolute minimum.

(2) The OSU operational policy is to subtract only detector background from the water analysis data and not background radioactivity in the Corvallis city water.

(3) Total volume of effluent plus diluent does not take into consideration the additional mixing with the over 250,000 gallons per year of liquids and sewage normally discharged by the Radiation Center complex into the same sanitary sewer system.

(4) TRIGA and Radiation Center liquid waste is picked up by the Radiation Safety Office for transfer to its waste processing facility for solidification and final packaging

3. Airborne Effluents Released (See Table V.B.2)

a.	Total estimated quantity of radioactivity released	2.71 Ci
b.	Detectable radionuclides in the gaseous waste(1)	^{41}Ar ($t_{1/2}$ = 1.83 hr)
c.	Estimated average atmospheric diluted concentration of ^{41}Ar at the point of release	1.84×10^{-8} µCi ml^{-1}
d.	Percent of applicable monthly average concentration for diluted concentration of ^{41}Ar at the point of release	0.46%
e.	Total estimated release of radioactivity in particulate form with half lives greater than 8 days(2)	None

4. Solid Waste Released (See Table V.B.3)

a.	Total amount of solid waste packaged and disposed of	44.5 ft^3
b.	Detectable radionuclides in the solid waste	^{3}H, ^{14}C, ^{46}Sc, ^{47}Sc, ^{54}Mn, ^{58}Co, ^{60}Co, ^{22}Na, ^{59}Fe, ^{90}Sr, ^{181}I, ^{137}Cs, ^{238}U, ^{75}Se, ^{89}Rb,

c. Total radioactivity in the solid waste 5.2×10^{-2} Ci

---

(1) Routine gamma spectroscopy analysis of the gaseous radioactivity in the stack discharge indicated that it was all ^{41}Ar.

(2) Evaluation of the detectable particulate radioactivity in the stack discharge confirmed its origin as naturally occurring radon daughter products, predominantly ^{214}Pb and ^{214}Bi, which are not associated with reactor operations.

5. Radiation Exposure Received by Personnel (See Table V.C.1)

a. Facility Operating Personnel (mrem)

(1)	Average whole body	8
(2)	Average extremities	17
(3)	Maximum whole body	63
(4)	Maximum extremities	549

b. Key Facility Research Personnel

(1)	Average whole body	0
(2)	Average extremities	<1
(3)	Maximum whole body	0
(4)	Maximum extremities	24

c. Facilities Services Maintenance Personnel

(1)	Average whole body	<1
(2)	Maximum whole body	10

d. Class Students

(1)	Average whole body	<1
(2)	Average extremities	<1
(3)	Maximum whole body	23
(4)	Maximum extremities	107

e. Campus Police and Security Personnel

(1)	Average whole body	<1

(2) Maximum whole body 12

f. Visitors

(1) Average whole body <1
(2) Maximum whole body 8

6. Number of Routine Onsite and Offsite Monitoring Measurements and Samples

a. Facility Survey Data

(1) Area Radiation Dosimeters (See Table V.D.1)

(a) Beta-gamma dosimeter measurements 68
(b) Neutron dosimeter measurements 68

(2) Radiation and Contamination Survey ~5000 measurements (See Table V.D.3)

b. Environmental Survey Data

(1) Gamma Radiation Monitoring (See Tables V.E.1 and V.E.2)

(a) Onsite monitoring
-- OSU TLD monitors 108
-- ICN TLD monitors 108
-- Monthly μrem h^{-1} measurements 108

(b) Offsite monitoring
-- OSU TLD monitors 240
-- ICN TLD monitors 144
-- Monthly μrem h^{-1} measurements 240

(2) Soil, Water and Vegetation Surveys (See Table V.E.3)

(a) Soil samples 16
(b) Water samples 13
(c) Vegetation samples 56

F. History

A brief chronology of the key dates and events in the history of the OSU Radiation Center and the TRIGA reactor is given below:

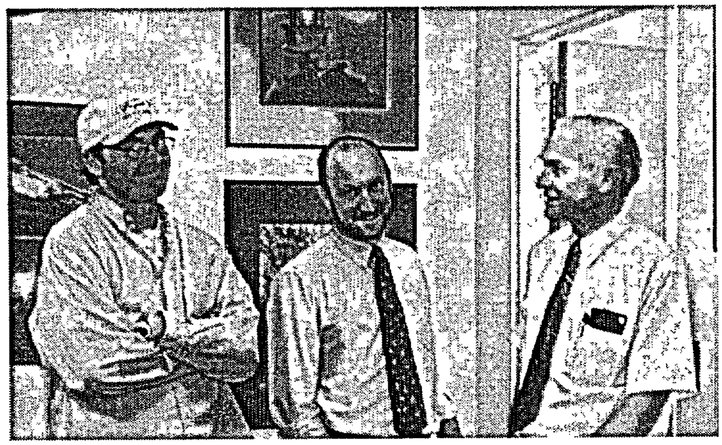
June 1964	Completion of the first phase of the Radiation Center, consisting of 32,397 square feet of office and laboratory space, under the direction of founding Director, C. H. Wang.
July 1964	Transfer of the 0.1 W AGN 201 reactor to the Radiation Center. This reactor was initially housed in the Department of Mechanical Engineering and first went critical in January, 1959.
October 1966	Completion of the second phase of the Radiation Center, consisting of 9,956 square feet of space for the TRIGA reactor and associated laboratories and offices.
March 1967	Initial criticality of the Oregon State TRIGA Reactor (OSTR). The reactor was licensed to operate at a maximum steady state power level of 250 kW and was fueled with 20% enriched fuel.
October 1967	Formal dedication of the Radiation Center.
August 1969	OSTR licensed to operate at a maximum steady state power of 1 MW, but could do so only for short periods of time due to lack of cooling capacity.
June 1971	OSTR cooling capacity upgraded to allow continuous operation at 1 MW.
April 1972	OSTR Site Certificate issued by the Oregon Energy Facility Siting Council.
September 1972	OSTR area fence installed.
December 1974	AGN-201 reactor permanently shut down.
March 1976	Completion of 1600 square feet of additional space to accommodate the rapidly expanding nuclear engineering program.
July 1976	OSTR refueled with 70% enriched FLIP fuel.

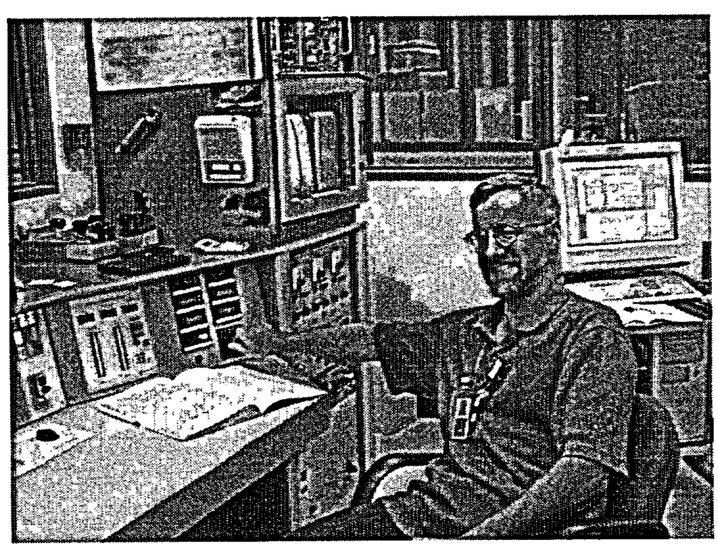
July 1977	Completion of a second 1600 square feet of space to bring the Radiation Center complex to a total of 45,553 square feet.
January 1980	Major upgrade of the electronics in the OSTR control console.
July 1980	AGN-201 reactor decommissioned and space released for unrestricted use.
June 1982	Shipment of the original 20% enriched OSTR fuel to Westinghouse Hanford Company.
December 1984	C. H. Wang retired as director. C. V. Smith became new director.
August 1986	Director C. V. Smith left to become Chancellor of the University of Wisconsin-Milwaukee. A. G. Johnson became new Director.
December 1988	AGN-201 components transferred to Idaho State University for use in their AGN-201 reactor program.
December 1989	OSTR licensed power increased to 1.1 MW.
June 1990	Installation of a 7000 Ci ^{60}Co Gammacell irradiator.
March 1992	25th anniversary of the OSTR initial criticality.
November 1992	Start of APEX plant construction.
June 1994	Retirement of Director A. G. Johnson. B. Dodd became new Director.
August 1994	APEX inauguration ceremony.
August 1995	Major external refurbishment: new roof, complete repaint, rebuilt parking lot, addition of landscaping and lighting.
September 1998	B. Dodd left on a leave of absence to the International Atomic Energy Agency. S. E. Binney became new Director.
January 1999	Installation of the Argon Production Facility in the OSTR.
April 1999	Completion of ATHRL facility brings the Radiation Center complex to a total of 47,198 square feet.

July 2002	S. E. Binney retired. J. F. Higginbotham became interim director.
October 2002	A. C. Klein became new director.

Part II

People





Part II

PEOPLE

This part contains a listing of all people who were residents of the Radiation Center or who worked a significant amount of time at the Center during this reporting period. Sections A, B, and C list the academic staff, trainees, and students, while sections D through G list the Radiation Center's operating staff. Section H shows the OSU Radiation Safety Office staff, and section I provides the composition of committees involving Center personnel.

It should be noted that not all of the faculty and students who used the Radiation Center for their teaching and research are listed in this part. Summary information on the number of people involved is given in Table VI.C.1, while individual names and projects are listed in Tables VI.C.2 and VI.C.3.

A. Professional and Research Faculty

*Binney, Stephen E.
Director, Radiation Center
Director, Institute of Nuclear Science and Engineering
Professor
Nuclear Engineering and Radiation Health Physics

*Brock, Kathryn M.
Faculty Research Assistant
Health Physicist

*Conrady, Michael R.
Faculty Research Assistant
Analytical Support Manager

Craig, A. Morrie
Professor
College of Veterinary Medicine

Daniels, Malcolm
Professor Emeritus
Chemistry

---

* OSTR users for research and/or teaching.

Groome, John T.
Faculty Research Assistant
ATHRL Facility Operations Manager
Nuclear Engineering

Gunderson, Chris E.
Faculty Research Assistant
ATHRL Facility Operator/Test Engineer
Nuclear Engineering

Haggerty, Roy
Assistant Professor
Geosciences

Hamby, David
Associate Professor
Nuclear Engineering

Hart, Lucas P.
Faculty Research Associate
Chemistry

Harvey, Richard
Faculty Research Assistant
Nuclear Engineering

*Higginbotham, Jack F.
Chairman, Reactor Operations Committee
Professor
Nuclear Engineering and Radiation Health Physics

*Higley, Kathryn A.
Associate Professor
Nuclear Engineering and Radiation Health Physics

Johnson, Arthur G.
Director Emeritus, Radiation Center
Professor Emeritus
Nuclear Engineering and Radiation Health Physics

---

* OSTR users for research and/or teaching.

Klein, Andrew C.
Department Head, Department of Nuclear Engineering
Director, Oregon Space Grant Program
Professor
Nuclear Engineering

*Krane, Kenneth S.
Professor
Physics

Krebs, Rolf
Faculty Research Associate
Crop and Soil Science

Lafi, Abd Y.
Assistant Professor Senior Research
ATHRL Research Analyst
Nuclear Engineering

*Loveland, Walter D.
Professor
Chemistry

*Meredith, Charlotte C.
Faculty Research Assistant
College of Oceanic and Atmospheric Sciences

Mommer, Niels K.
Faculty Research Associate
Physics

*Palmer, Todd S.
Associate Professor
Nuclear Engineering

*Pastorek, Christine
Senior Instructor
Chemistry

Popovich, Milosh
Vice President Emeritus

* OSTR users for research and/or teaching.

*Prahl, Frederick G.
Professor
College of Oceanic and Atmospheric Sciences

Reyes, Jr., José N.
ATHRL Principal Investigator
Professor
Nuclear Engineering

Ringle, John C.
Professor Emeritus
Nuclear Engineering
Robinson, Alan H.
Department Head Emeritus
Nuclear Engineering

*Schmitt, Roman A.
Professor Emeritus
Chemistry

*Schütfort, Erwin G.
Faculty Research Assistant
Project Manager

*Sullivan, Barbara E.
Faculty Research Assistant
College of Oceanic and Atmospheric Sciences

Wang, Chih H.
Director Emeritus, Radiation Center
Professor Emeritus
Nuclear Engineering

Young, Roy A.
Professor Emeritus
Botany and Plant Pathology

---

* OSTR users for research and/or teaching.

B. Visiting Scientists and Special Trainees

Name	*Field (Affiliation)*	*Advisor or Research Program Director*
Cloughsey, Michael	ASE Summer Student	W. D. Loveland
Gallant, Aaron	Saturday Academy Mentorship Program Crescent Valley High School Corvallis, Oregon	W. D. Loveland
Nicholas Myers	ASE Summer Student	W. D. Loveland
Rouki, Chariklia	Visiting Scientist, Chemistry	W. D. Loveland
Peterson, Don	Postdoctoral Assistant, Chemistry	W. D. Loveland

C. OSU Graduate Students

Name	*Degree Program*	*Field*	*Advisor*
Abel, Kent	MS	Nuclear Engineering	J. N. Reyes
Antoine, Stephanie	MS	Nuclear Engineering	R. N. Reyes
Bak, Michael	MS	Radiation Health Physics	K. A. Higley
*Bergman, Joshua J.	MS	Radiation Health Physics	S. E. Binney
Bittle, Whitney	MS	Nuclear Engineering	T. S. Palmer
Buchholz, Matthew	MS	Radiation Health Physics	J. F. Higginbotham
Coleman, Joseph	MS	Radiation Health Physics	D. M. Hamby
Duffy, William	MS	Radiation Health Physics	K. A. Higley
Hart, Kevin	MS	Radiation Health Physics	K. A. Higley
Haugh, Brandon	MS	Nuclear Engineering	J. N. Reyes
Huang, Zhongliang	PhD	Nuclear Chemistry	W. D. Loveland
Kim, Kang Seog	PhD	Nuclear Engineering	T. S. Palmer
Kincaid, Kevin	MS	Nuclear Engineering	J. N. Reyes
Kriss, Aaron	PhD	Radiation Health Physics	D. M. Hamby
Moss, Stephen C.	MS	Radiation Health Physics	K. A. Higley
Napier, Bruce	PhD	Radiation Health Physics	D. M. Hamby
Nes, Elena	MS	Radiation Health Physics	K. A. Higley
Nes, Razvan	MS	Nuclear Engineering	T. S. Palmer
Mallory, Stacy	MS	Radiation Health Physics	D. M. Hamby
Rains, Bruce	MS	Nuclear Engineering	T. S. Palmer
Ralph, Benjamin	MS	Nuclear Engineering	J. N. Reyes

* OSTR users for research and/or teaching.

Rock, Mollie	MS	Radiation Health Physics	D. M. Hamby
Saiyut, Kittiphong	PhD	Nuclear Engineering	J. F. Higginbotham
Stringham, Michael	MS	Nuclear Engineering	T. S. Palmer
Tang, Hong	PhD	Nuclear Engineering	Q. Wu
Villamar, Glenda	MS	Radiation Health Physics	K. A. Higley
Welter, Kent B.	PhD	Nuclear Engineering	T. S. Palmer
Wiltman, Timothy	MS	Nuclear Engineering	T. S. Palmer
Yao, You	PhD	Nuclear Engineering	Q. Wu
Yoo, Yeon-Jong	PhD	Nuclear Engineering	J. N. Reyes
Young, Eric	MS	Nuclear Engineering	J. N. Reyes

D. Business, Administrative and Clerical Staff

Director, Radiation Center .... S. E. Binney
Business Manager .... S. C. Campbell
Office Coordinator .... J. M. Stueve
Office Specialists .... E. D. Jordan
Custodian .... E. Cimbri
Office Coordinator (Nuclear Engineering) .... R. A. Keen
Word Processing Technician (Nuclear Engineering) .... L. J. Robinson
Word Processing Technician (ATHRL – Nuclear Engineering) .... T. L. Culver

E. Reactor Operations Staff

Principal Security Officer .... S. E. Binney
Reactor Administrator .... S. R. Reese
Reactor Supervisor, Senior Reactor Operator .... G. M. Wachs
Senior Reactor Operator .... S. P. Smith
S. T. Keller
J. F. Higginbotham
Reactor Operator .... N. A. Carstens
J. A. Ammon
M. A. Minton

F. Radiation Protection Staff

Senior Health Physicist .... K. M. Brock
Health Physicist .... S. A. Menn
Health Physicist .... J. E. Darrough
Health Physicist .... J. J. Bergman

Health Physics Monitors (Students) . . . . M. Cheyne
K. Fenton
M. Hackett
M. Helie
C. Hepler
J. Wallace

G. Scientific Support Staff

Analytical Support Manager . . . . M. R. Conrady
Projects Manager . . . . E. G. Schütfort
Neutron Activation Analysis Technicians (Students) . . . . S. Antoine
E. Nes
R. Nes
A. Saptura
Scientific Instrument Technician . . . . S. P. Smith
Nuclear Instrumentation Support . . . . Z. Kenney

H. OSU Radiation Safety Office Staff

Radiation Safety Officer . . . . R. H. Farmer
Assistant Radiation Safety Officers . . . . D. L. Harlan
M. E. Bartlett
Office Manager . . . . K. L. Miller
Lab Technician . . . . P. A. Schoonover
Student Technicians . . . . W. Duffy
A. Maple
M. Rock
B. Brumm

I. Committees

1. Reactor Operations Committee

Name	*Affiliation*
J. F. Higginbotham, Chair	Nuclear Engineering
S. E. Binney	Radiation Center and Nuclear Engineering
G. M. Wachs	Radiation Center
A. C. Klein	Nuclear Engineering

K. M. Brock	Radiation Center
W. J. Richards	McClellan Nuclear Radiation Center
J. C. Ringle	Nuclear Engineering
S. R. Reese	Radiation Center and Nuclear Engineering
M. H. Schuyler	Chemistry
W. H. Warnes	Mechanical Engineering

2. Radiation Safety Committee (OSU)

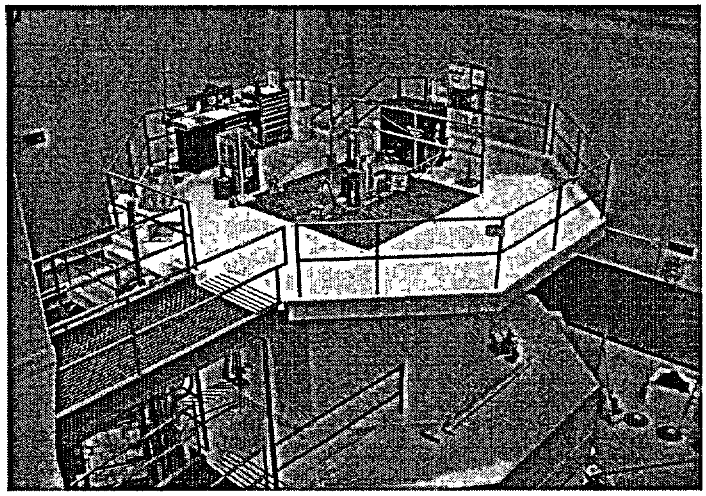
Name	*Affiliation*
T. Dreher, Chair	Microbiology
J. Higginbotham, Vice Chair	Nuclear Engineering
R. Farmer, Secretary and RSO	Radiation Safety Office
R. Collier	Oceanic and Atmospheric Science
B. Francis	Environmental Health and Safety
M. Leid	Pharmacy
C. Snow	Exercise and Sport Science
J. Steiner	USDA-ARS/Crop and Soil Science
K. Ahern	Biochemistry/Biophysics
T. Wolpert	Botany and Plant Pathology

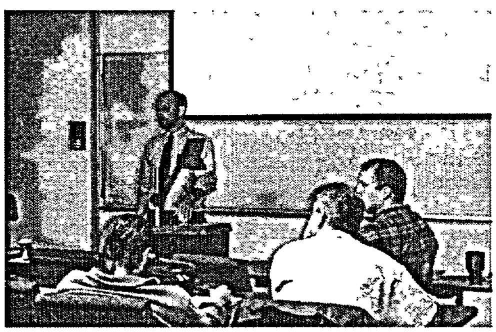
3. Radiation Center Safety Committee

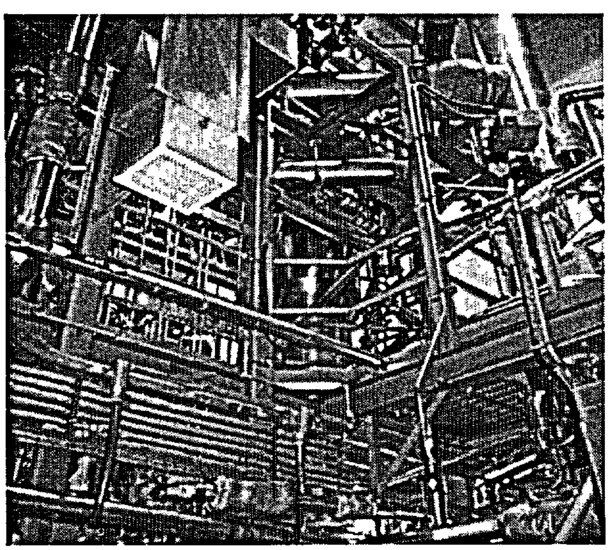
Name	*Affiliation*
W. D. Loveland, Chair	Chemistry
K. M. Brock	Radiation Center
M. R. Conrady	Radiation Center
J. T. Groome	Nuclear Engineering
J. F. Higginbotham	Nuclear Engineering
K. L. Miller	Radiation Safety

Part III

Facilities







Part III

FACILITIES

A. Research Reactor

1. Description

The Oregon State University TRIGA Reactor (OSTR) is a water-cooled, swimming pool type of research reactor which uses uranium/zirconium hydride fuel elements in a circular grid array. The reactor core is surrounded by a ring of graphite which serves to reflect neutrons back into the core. The core is situated near the bottom of a 22-foot deep water-filled tank, and the tank is surrounded by a concrete bioshield which acts as a radiation shield and structural support.

The reactor is licensed by the U.S. Nuclear Regulatory Commission to operate at a maximum steady state power of 1.1 MW and can also be pulsed up to a peak power of about 2500 MW.

The OSTR has a number of different irradiation facilities including a pneumatic transfer tube, a rotating rack, a thermal column, four beam ports, five sample holding (dummy) fuel elements for special in-core irradiations, an in-core irradiation tube, and a cadmium-lined in-core irradiation tube for experiments requiring a high energy neutron flux. The OSTR also has an Argon Irradiation Facility for the production of ^{41}Ar.

The **pneumatic transfer facility** enables samples to be inserted and removed from the core in four to five seconds. Consequently this facility is normally used for neutron activation analysis involving short-lived radionuclides. On the other hand, the **rotating rack** is used for much longer irradiation of samples (e.g., hours). The rack consists of a circular array of 40 tubular positions, each of which can hold two sample tubes. Rotation of the rack ensures that each sample will receive an identical irradiation.

The reactor's **thermal column** consists of a large stack of graphite blocks which slows down neutrons from the reactor core in order to increase thermal neutron activation of samples. Over 99% of the neutrons in the thermal column are thermal neutrons. Graphite blocks are removed from the thermal column to enable samples to be positioned inside for irradiation.

The **beam ports** are tubular penetrations in the reactor's main concrete shield which enable neutron and gamma radiation to stream from the core when a beam port's shield plugs are removed. One of the beam ports contains the **Argon Production Facility** for production of curie levels of ^{41}Ar. The other beam ports are available for a variety of experiments.

If samples which are to be irradiated require a large neutron fluence, especially from higher energy neutrons, they may be inserted into a **dummy fuel element.** This device will then be placed into one of the core's inner grid positions which would normally be occupied by a fuel element. Similarly samples can be placed in the **in-core irradiation tube (ICIT)** which can be inserted in the same core location.

The **cadmium-lined in-core irradiation tube (CLICIT)** enables samples to be irradiated in a high flux region near the center of the core. The cadmium lining in the facility eliminates thermal neutrons and thus permits sample exposure to higher energy neutrons only. The cadmium-lined end of this air-filled aluminum irradiation tube is inserted into an inner grid position of the reactor core which would normally be occupied by a fuel element. It is the same as the ICIT except for the presence of the cadmium lining.

2. Utilization

The two main uses of the OSTR are instruction and research. During this reporting period, the reactor was in use an average of 40 hours during a typical work week.

a. Instruction

Instructional use of the reactor is twofold. First, it is used significantly for classes in Nuclear Engineering, Radiation Health Physics, and Chemistry at both the graduate and undergraduate levels to demonstrate numerous principles which have been presented in the classroom. Basic neutron behavior is the same in small reactors as it is in large power reactors, and many demonstrations and instructional experiments can be performed using the OSTR which cannot be carried out with a commercial power reactor. Shorter-term demonstration experiments are also performed for many undergraduate students in Physics, Chemistry, and Biology classes, as well as for visitors from other universities and colleges, from high schools, and from public groups.

The second instructional application of the OSTR involves education of reactor operators, operations managers, and health physicists. The OSTR is in a unique position to provide such education since curricula must include hands-on experience at an operating reactor and in associated laboratories. The many types of educational programs that the Radiation Center provides are more fully described in Part VI (Section VI.C.5) of this report.

During this reporting period the OSTR accommodated 24 different OSU academic classes and other academic programs. In addition, portions of classes from other Oregon universities were also supported by the OSTR. The OSU teaching and training programs utilized 724 hours of reactor time. Tables III.A.1 and III.A.2, as well as Table III.D.1, provide detailed information on the use of the OSTR for instruction and training.

b. Research

The OSTR is a unique and valuable tool for a wide variety of research applications and serves as an excellent source of neutrons and/or gamma radiation. The most commonly used experimental technique requiring reactor use is instrumental neutron activation analysis (INAA). This is a particularly sensitive method of elemental analysis which is described in more detail in Part VI (Section VI.C.1). Part III.B provides a listing of equipment used in INAA at the Radiation Center.

The OSTR's irradiation facilities provide a wide range of neutron flux levels and neutron flux qualities which are sufficient to meet the needs of most researchers. This is true not only for INAA, but also for other experimental purposes such as the $^{39}Ar/^{40}Ar$ ratio and fission track methods of age dating samples.

During this reporting period, the OSTR accommodated 50 funded and 8 unfunded research projects. Details of the reactor's use specifically for research are given in Table III.A.3. Additional information regarding reactor use for research, thesis, and service can be found in Tables VI.C.1 through VI.C.3. In Table VI.C.1 OSTR use is indicated with an asterisk.

B. Analytical Equipment

1. Description

The Radiation Center has a large variety of radiation detection instrumentation. This equipment is upgraded as necessary, especially the gamma ray spectrometers with their associated computers and germanium detectors. During the previous year four new germanium detectors and six digital multichannel analyzers were purchased. Tables III.B.1 through III.B.3 provide a brief listing of laboratory counting devices present at the Center. Additional equipment for classroom use and an extensive inventory of portable radiation detection instrumentation are also available.

2. Utilization

Radiation Center nuclear instrumentation receives intensive use in both teaching and research applications. In addition, service projects also use these systems and the combined use often results in 24-hour per day schedules for many of the analytical instruments. Use of Radiation Center equipment extends beyond that located at the Center and instrumentation may be made available on a loan basis to OSU researchers in other departments.

C. Radioisotope Irradiation Sources

1. Description

The Radiation Center is equipped with a 1,644 curie (as of 7/27/01) Gammacell 220 ^{60}Co irradiator which is capable of delivering high doses of gamma radiation over a range of dose rates to a variety of materials.

Typically, the irradiator is used by researchers wishing to perform mutation and other biological effects studies; studies in the area of radiation chemistry; dosimeter testing; sterilization of food materials, soils, sediments, biological specimen, and other media; gamma radiation damage studies; and other such applications. In addition to the ^{60}Co irradiator, the Center is also equipped with a variety of smaller ^{60}Co, ^{137}Cs, ^{226}Ra, plutonium-beryllium, and other isotopic sealed sources of various radioactivity levels which are available for use as irradiation sources.

2. Utilization

During this reporting period there was a diverse group of projects using the ^{60}Co irradiator. These projects included the irradiation of a variety of biological materials including different types of seeds. In addition, the irradiator was used for sterilization of several media and the evaluation of the radiation effects on different materials. Table III.C.1 provides use data for the Gammacell 220 irradiator.

D. Laboratories and Classrooms

1. Description

The Radiation Center is equipped with a number of different radioactive material laboratories designed to accommodate research projects and classes offered by various OSU academic departments or off-campus groups.

Instructional facilities available at the Center include a laboratory especially equipped for teaching radiochemistry and a nuclear instrumentation teaching laboratory equipped with modular sets of counting equipment which can be configured to accommodate a variety of experiments involving the measurement of many types of radiation. The Center also has four student computer rooms equipped with a large number of personal computers and UNIX workstations.

In addition to these dedicated instructional facilities, many other research laboratories and pieces of specialized equipment are regularly used for teaching. In particular, classes are routinely given access to gamma spectrometry equipment located in Center laboratories. A number of classes also regularly use the OSTR and the Reactor Bay as an integral part of their instructional coursework.

There are two classrooms in the Radiation Center which are capable of holding about 35 and 18 students, respectively. In addition, there are two smaller conference rooms and a library that are suitable for graduate classes and thesis examinations. As a service to the student body, the Radiation Center also provides an office area for the student chapters of the American Nuclear Society and the Health Physics Society.

This reporting period saw continued high utilization of the Radiation Center's thermal hydraulics laboratory. This laboratory is being used by Nuclear Engineering faculty member to accommodate a one-quarter scale model of the Palisades Nuclear Power reactor. The multi-million dollar advanced plant experimental (APEX) facility was fully utilized by the U. S. Nuclear Regulatory Commission to provide licensing data and to test safety systems in "beyond design basis" accidents. The fully scaled, integral model APEX facility uses electrical heating elements to simulate the fuel elements, operates at 450°F and 400 psia, and responds at twice real time. It is the *only* facility of its type in the world and is owned by the U. S. Department of Energy and operated by OSU. In addition, a new building, the Air-water Test Loop for Advanced Thermal-hydraulics Studies (ATLATS), was constructed next to the Reactor Building in 1998. Two-phase flow experiments are conducted in the ATLATS. Together APEX and ATLATS comprise the Advanced Thermal Hydraulics Research Laboratory (ATHRL).

2. Utilization

All of the laboratories and classrooms are used extensively during the academic year. For example, a listing of 119 courses accommodated at the Radiation Center during this reporting period along with their enrollments is given in Table III.D.1.

E. Instrument Repair and Calibration Facility

1. Description

The Radiation Center has a facility for the repair and calibration of essentially all types of radiation monitoring instrumentation. This includes instruments for the detection and measurement of alpha, beta, gamma, and neutron radiation. It encompasses both high range instruments for measuring intense radiation fields and low range instruments used to measure environmental levels of radioactivity. The Center's instrument calibration capability is described more completely in Section VI.C.7 of this report.

2. Utilization

The Center's instrument repair and calibration facility is used regularly throughout the year and is absolutely essential to the continued operation of the many different programs carried out at the Center. In addition, the absence of any comparable facility in the state has led to a greatly expanded instrument calibration program for the Center, including *calibration of essentially all radiation detection instruments used by state and federal agencies in the state of Oregon.* This includes instruments used on the OSU campus and all other institutions in the Oregon University System, plus instruments from the Oregon Health Division's Radiation Protection Services, the Oregon Office of Energy, the Oregon Public Utilities Commission, the Oregon Health Sciences University, the Army Corps of Engineers, and the U. S. Environmental Protection Agency. Additional information regarding instrument repair and calibration efforts is given in Tables VI.C.4, VI.C.5, and VI.C.6.

F. Library

1. Description

The Radiation Center has a library containing significant collections of texts, research reports, and videotapes relating to nuclear science, nuclear engineering, and radiation protection.

The Radiation Center is also a regular recipient of a great variety of publications from commercial publishers in the nuclear field, from many of the professional nuclear societies, from the U. S. Department of Energy, the U. S. Nuclear Regulatory Commission, and other federal agencies. Therefore, the Center library maintains a current collection of leading nuclear research and regulatory documentation. In addition, the Center has a collection over 50 sets of nuclear power reactor Safety Analysis Reports and Environmental Reports specifically prepared by utilities for their facilities.

The Center maintains an up-to-date set of reports from such organizations as the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, and the International Commission on Radiological Units. Sets of the current U.S. Code of Federal Regulations for the U.S. Nuclear Regulatory Commission, the U.S. Department of Transportation, and other appropriate federal agencies, plus regulations of various state regulatory agencies are also available at the Center.

The Radiation Center videotape library has over one hundred tapes on nuclear engineering, radiation protection, and radiological emergency response topics. In addition, the Radiation Center uses videotapes for most of the technical orientations which are required for personnel working with radiation and radioactive materials. These tapes are produced, recorded, and edited by

Radiation Center staff, using the Center's videotape equipment and the facilities of the OSU Communication Media Center.

2. Utilization

The Radiation Center library is used mainly to provide reference material on an as-needed basis. It receives extensive use during the academic year. In addition, the orientation videotapes are used intensively during the beginning of each term and periodically thereafter.

Table III.A.1

OSU Courses Using the OSTR

Course Number	Course Name
NE 482	Applied Radiation Safety
GEO 330	Environmental Conservation
Chem 462	Experimental Chemistry II
Chem 222	General Chemistry
Chem 225H	Honors General Chemistry
NE 114	Introduction to Nuclear Engineering and Radiation Health Physics
NE 451	Neutronic Analysis and Lab I
NE 452/552	Neutronic Analysis and Lab II
NE 453/553	Neutronic Analysis and Lab III
NE 116	Nuclear Engineering
NE 236	Nuclear Radiation Detection and Instrumentation
Chem 419/519	Radioactive Tracer Methods
NE 122	Reactor Kinetics
Advanced Physics Class	REU Physics students
SMILE	Science and Math Investigative Learning Experiences
Adventures in Learning	Visiting Students

Table III.A.2

OSTR Teaching Hours

Description	Annual Values (hours)	Cumulative Values for FLIP Core (hours)
Departmental		
Adventures in Learning	2.1	
Chemistry	23.8	
Engineering Science	0 5	
Geosciences[(1)]	1.2	
Nuclear Engineering	19.4	
Physics	1.5	
SMILE	1.3	
Departmental Total	49.8	7,658
Special Classes and Projects[(2)]		
Crescent Valley High School – AP Physics	6.0	
Department of Science	3.2	
Groups or Organizations from Educational Institutions	0.2	
Liberty Christian High School	0.7	
Reactor Staff	0.6	
Reactor Staff Use	30.1	
Operator License Training	633.0	
Student Recruitment Tours	0.0	
University of California at Berkeley Nuclear Engineering	0.2	
Special Classes and Projects Total	674	5,848
TOTAL TEACHING HOURS[(3,4,5)]	724	13,506

(1) Some use hours by these departments are not shown under "Teaching Hours," but are reflected under Thesis Research, both funded and unfunded.

(2) A variety of educational classes were conducted which involved one-time meetings for orientation or support purposes. These included: high school science classes, new student programs support, community college classes, and classes from other universities. In addition, this category includes 633 hours of reactor operator training

(3) See Table III.D.1 for classes and student enrollment.

(4) See Table IV.A.5 for a summary of all multiple reactor use.

(5) Total teaching hours reflect all the time the reactor was in use for teaching, and because of this the total hours include time the reactor itself may not actually have been in operation

Table III.A.3

OSTR Research Hours

Types of Research	Annual Values (hours)	Cumulative Values for FLIP Core (hours)
OSU Research	420	9,109
Off-Campus Research	1,726	17,384
TOTAL RESEARCH HOURS[(1)]	2,145	26,493

(1) Total research hours statistics:

(a) 100% (2145 hours) of the total research hours were user-funded by federal, state, or other organizations.

(b) 0% of the total research hours were user-unfunded studies in support of graduate thesis research or other academic investigations. Reactor costs for this research were absorbed (funded) by the OSU Radiation Center.

Table III.B.1

Radiation Center Spectrometry Systems:
Gamma, Low Energy Photon, Alpha

Room	System	Rel. Effic. (%)
B100	EG&G Ortec D-Spec MCA, HPGe	26.8
B100	EG&G Ortec D-Spec MCA, HPGe	38.2
B100	EG&G Ortec D-Spec MCA, HPGe	33.6
B100	EG&G Ortec D-Spec MCA, HPGe	28.6
B125	EG&G Ortec D-Spec MCA, HPGe	24.2%
D102	EG&G Ortec D-Spec MCA, HPGe	28.5%
B100	EG&G Ortec Adcam 8k-MCA, PGT LEP	N/A
B100	EG&G Ortec Adcam 8k-MCA, EG&G Ortec LEP	N/A
B100	EG&G Ortec Adcam 8K-MCA, HPGE	29.0
D102	EG&G Ortec Adcam 8K-MCA, HPGE	27.6%
C120	EG&G Ortec Ace 4k-MCA, NaI(Tl) 3x3	N/A
A146	EG&G Ortec Ace 4k-MCA, 576A Alpha Spectrometer	N/A

Table III.B.2

Radiation Center Proportional Counting Systems

Room	System
A124	NMC AC5 84
A138	Protean MPC 9400
A138	Tennelec LB 5100 Auto Counting System w/IBM PC

Table III.B.3

Thermoluminescent Dosimeter Systems

Room	System
A132	Harshaw Model 2000

Table III.C.1

Gammacell 220 ^{60}Co Irradiator Use
(1893 Ci: 7/1/00)

Purpose of Irradiation	Samples	Dose Range (rads)	Number of Irradiations	Use Time (hours)
Sterilization	albumin, medical devices, chambers, bioflex strips, hamster cells, nutrients, patches syringes, wood, soil, tissue, plastic tubes,	1.6×10^6 to 3.0×10^6	37	1,074
Material Evaluation	gems, minerals,	5.0×10^4 to 9×10^6	2	166
Botanical Studies	bean seeds	5.0×10^3 to 8.0×10^4	10	3
TOTALS			49	1243

Table III.D.1

Student Enrollment in Nuclear Engineering, Radiation Health Physics and Nuclear Science Courses Which Are Taught or Partially Taught at the Radiation Center

Course	Credit	Course Title	Number of Students			
			Fall 2001	Winter 2002	Spring 2002	Summer 2002
Nuclear Engineering Department Courses						
NE/RHP114*	2	Introduction to Nuclear Engineering and Radiation Health Physics	15	--	--	--
NE/RHP115	2	Introduction to Nuclear Engineering and Radiation Health Physics	--	17	--	--
NE/RHP116	2	Introduction to Nuclear Engineering and Radiation Health Physics	--	--	15	--
NE/RHP234	4	Nuclear and Radiation Physics I	20	--	--	--
NE/RHP235	4	Nuclear and Radiation Physics II	--	21	--	--
NE/RHP236*	4	Nuclear Radiation Detection and Instrumentation	--	--	18	--
NE319	3	Societal Aspects of Nuclear Technology	--	--	53	--
NE/RHP401	1-16	Research	--	1	1	--
NE405H	1-16	R&C/Used Nuclear Fuel: Garbage or Gold	--	--	4	--
NE405	1-16	Reading and Conference	--	--	--	--
RHP405	1-16	Reading and Conference	--	--	--	--
NE/RHP406	1-16	Projects	--	--	4	--
NE/RHP407	1	Nuclear Engineering Seminar	11	13	17	--
NE/RHP410	1-12	Internship	2	--	1	1
NE415	2	Nuclear Rules and Regulations	--	--	--	--
RHP415	2	Nuclear Rules and Regulations	--	--	--	--
NE450	3	ST/ Nuclear Medicine	--	--	--	--
NE451	4	Neutronic Analysis and Lab I	4	--	--	--
NE452	4	Neutronic Analysis and Lab II	--	5	--	--
NE453	4	Neutronic Analysis and Lab III	--	--	5	--

ST = Special Topics
* = OSTR used occasionally for demonstration and/or experiments.
** = OSTR used heavily.

Table III.D.1 (continued)

Student Enrollment in Nuclear Engineering, Radiation Health Physics and Nuclear Science Courses Which Are Taught or Partially Taught at the Radiation Center

NE457**	3	Nuclear Reactor Laboratory	--	--	--	--
NE467	4	Nuclear Reactor Thermal Hydraulics	6	--	--	--
NE474	4	Nuclear Systems Design I	--	5	--	--
NE475	4	Nuclear Systems Design II	--	--	5	--
NE479	1-4	Individual Design Project	--	--	--	--
RHP479	1-4	Individual Design Project	--	--	--	--
RHP480	1-3	Field Practice in Radiation Protection	1	--	--	--
NE/RHP481	4	Radiation Protection	12	--	--	--
NE/RHP482*	4	Applied Radiation Safety	--	23	--	--
RHP483	4	Radiation Biology	--	8	--	--
RHP487	3	Radiation Biology	--	--	--	--
RHP488	3	Radioecology	--	--	--	--
NE/RHP490	4	Radiation Dosimetry	--	--	14	--
RHP493	3	Non-reactor Radiation Protection	--	--	--	--
NE499	1-16	St/Environmental Aspects Nuclear Systems	--	--	--	--
RHP499	1-16	St/Envrionmental Aspects Nuclear Systems	--	--	--	--
NE501	1-16	Research	--	1	--	--
RHP501	1-16	Research	1	--	1	--
NE503	1	Thesis	7	6	6	--
RHP503	1	Thesis	6	3	2	2
NE/RHP505	1-16	Reading and Conference	--	--	--	2
NE/RHP506	1-16	Projects	1	--	--	--
NE/RHP507/ 607	1	Nuclear Engineering Seminar	9	6	7	--
NE507	1	Sem/Management of Mixed Waste	--	--	--	--
NE/RHP510	1-12	Internship	1	--	--	--

ST = Special Topics
* = OSTR used occasionally for demonstration and/or experiments.
** = OSTR used heavily.

Table III.D.1 (continued)

Student Enrollment in Nuclear Engineering, Radiation Health Physics and Nuclear Science Courses Which Are Taught or Partially Taught at the Radiation Center

NE515	2	Nuclear Rules and Regulations	--	--	--	--
RHP515	2	Nuclear Rules and Regulations	--	--	--	--
NE526	3	Computational Methods for Nuclear Reactors	--	1	--	--
NE/RHP535	3	Nuclear Radiation Shielding	--	--	9	--
NE/RHP539	3	ST/Nuclear Physics for Engineers and Scientists	--	--	--	--
NE/RHP543	3	Hi-Level Radioactive Waste Management	--	--	6	--
NE549	3	Low Level Waste	--	--	--	--
RHP549	3	Low Level Waste	--	--	--	--
NE550	3	Nuclear Medicine	--	--	--	--
NE551	4	Neutronic Analysis and Lab I	4	--	--	--
NE552	4	Neutronic Analysis and Lab II	--	2	--	--
NE553	4	Neutronic Analysis and Lab III	--	--	2	--
NE557**	3	Nuclear Reactor Laboratory	--	--	--	--
NE559	1	ST/Nuclear Reactor Analysis: Criticality Safety	--	--	--	--
NE567	4	Advanced Nuclear Reactor Thermal Hydraulics	3	--	--	--
NE568	3	Nuclear Reactor Safety	--	--	7	--
NE569	1-3	ST/Thermal Hydraulic Instumentation	8	--	--	--
NE574	4	Nuclear Systems Design I	--	2	--	--
NE575	4	Nuclear Systems Design II	--	--	2	--
RHP580	1-3	Field Practice in Radiation Protection	2	--	--	--
NE/RHP581	4	Radiation Protection	9	--	--	--
NE /RHP582*	4	Applied Radiation Safety	--	6	--	--
RHP583	4	Radiation Biology	--	5	--	--

ST = Special Topics
* = OSTR used occasionally for demonstration and/or experiments.
** = OSTR used heavily.

Table III.D.1 (continued)

Student Enrollment in Nuclear Engineering, Radiation Health Physics and Nuclear Science Courses Which Are Taught or Partially Taught at the Radiation Center

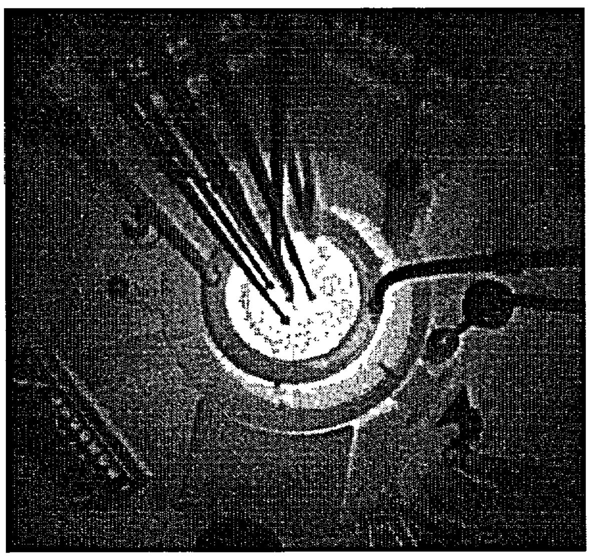
NE585	3	Environmental Aspects Nuclear Systems	--	--	--	--
RHP585	3	Environmental Aspects Nuclear Systems	--	--	--	--
NE586	3	Advanced Radiation Dosimetry	--	--	--	--
RHP586	3	Advanced Radiation Dosimetry	--	--	--	--
RHP588	3	Radioecology	--	--	--	--
RHP589	1-3	ST/Radiation Protection and Risk Assessment	--	--	5	--
NE/RHP590	4	Radiation Dosimetry	--	--	7	--
RHP593	3	Non-Reactor Radiation Protection	--	--	4	--
NE599	1	ST/Principles of Nuclear Medicine	--	--	--	--
NE601	1-16	Research	--	--	--	--
RHP601	1-16	Research	--	--	--	--
NE603	1-16	Thesis	5	7	6	1
RHP603	1-163	Thesis	2	2	4	--
NE605	1-16	Reading and Conference	--	--	--	--
RHP605	1-16	Reading and Conference	--	--	--	--
RHP610	1-12	Internship	--	--	--	--
NE654	3	Neutron Transport Theory	--	9	--	--
NE667	3	Advanced Thermal Hydraulics	--	--	--	--
Courses from Other Departments						
CH222*	5	General Chemistry (Science Majors)	--	426	--	--
CH225H	5	Honors General Chemistry	--	20	--	--
CH462*	3	Experimental Chemistry II Laboratory	--	27	--	--
ENGR331	4	Momentum, Energy and Mass Transfer	--	47	--	--
GEO300	3	Environmental Conservation	10	--	--	--
PH202	5	General Physics	12	--	--	--
Courses from Other Institutions						
ENGR111	COCC	Engineering	22	--	--	--
GS 105	LBCC	General Science	29	23	27	--

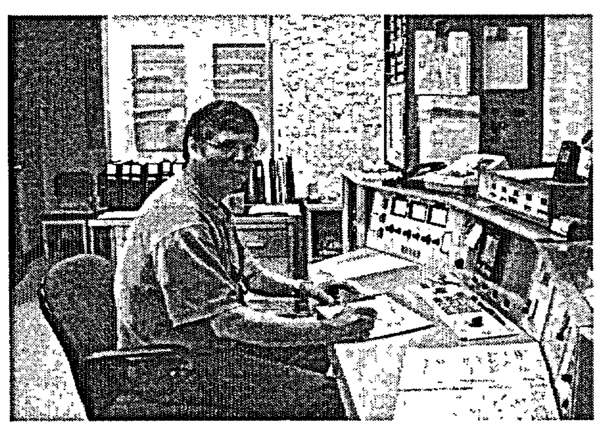
NOTE:
This table does not include the thesis courses from other OSU departments (see Table VI.C 2)

ST = Special Topics
* = OSTR used occasionally for demonstration and/or experiments.
** = OSTR used heavily.

Part IV

Reactor





Part IV

REACTOR

A. Operating Statistics

Operating data by individual category are given in Table IV.A.1 and annual energy production is plotted in Figure IV.A.1. Table IV.A.2 is included mainly for reference and summarizes the operating statistics for the original 20% enriched fuel.

Thermal energy generated in the reactor during this reporting period was 38.2 megawatt days (MWD). The cumulative thermal energy generated by the FLIP core now totals 985.9MWD from August 1, 1976 through June 30, 2002. Reactor use time(1) averaged 88.0% of the normal nine-hour, five-day per week schedule. Tables IV.A.3 through IV.A.5 detail the operating statistics applicable to this reporting period.

A single fuel element was removed from the core to increase calculated Shutdown Margin which was approaching the TS limit of $0.57 while in a Dummy/ICIT core configuration. 10CFR50.59 safety evaluation 01-09 analyzes the decrease in core reactivity of $0.22 by the removal of fuel element #8414 from core position F28.

(1) Reactor use time includes hours the reactor was critical or unavailable to irradiate samples due to startup/shutdown checks and operating maintenance.

B. Experiments Performed

1. Approved Experiments

During the current reporting period there were seven approved reactor experiments, listed below, available for use in reactor-related programs.

A-1	Normal TRIGA Operation (No Sample Irradiation).
B-3	Irradiation of Materials in the Standard OSTR Irradiation Facilities.
B-11	Irradiation of Materials Involving Specific Quantities of Uranium and Thorium in the Standard OSTR Irradiation Facilities.
B-12	Exploratory Experiments.
B-23	Studies Using TRIGA Thermal Column.
B-29	Reactivity Worth of Fuel.
B-30	NAA of Jet, Diesel, and Furnace Fuels.
B-31	TRIGA Flux Mapping.

B-32 Argon Production Facility

Of the approved experiments on the active list, six were used during the reporting period. A tabulation of information relating to reactor experiment use is given in Table IV.B.1 and includes a listing of the experiments which were used, how often each was used, and the general purpose of the use.

2. Inactive Experiments

Presently 32 experiments are in the inactive file. This consists of experiments which have been performed in the past and may be reactivated. Many of these experiments are now performed under the more general experiments listed in the previous section. The following list identifies these 32 inactive experiments.

A-2 Measurement of Reactor Power Level via Mn Activation.

A-3 Measurement of Cd Ratios for Mn, In, and Au in Rotating Rack.

A-4 Neutron Flux Measurements in TRIGA.

A-5 Copper Wire Irradiation.

A-6 In-core Irradiation of LiF Crystals.

A-7 Investigation of TRIGA's Reactor Bath Water Temperature Coefficient and High Power Level Power Fluctuation.

B-1 Activation Analysis of Stone Meteorites, Other Meteorites, and Terrestrial Rocks.

B-2 Measurements of Cd Ratios of Mn, In, and Au in Thermal Column.

B-4 Flux Mapping.

B-5 In-core Irradiation of Foils for Neutron Spectral Measurements.

B-6 Measurements of Neutron Spectra in External Irradiation Facilities.

B-7 Measurements of Gamma Doses in External Irradiation Facilities.

B-8 Isotope Production.

B-9 Neutron Radiography.

B-10 Neutron Diffraction.

B-13 This experiment number was changed to A-7.

B-14 Detection of Chemically Bound Neutrons.

B-15 This experiment number was changed to C-1.

B-16 Production and Preparation of ^{18}F.

B-17	Fission Fragment Gamma Ray Angular Correlations.
B-18	A Study of Delayed Status (n, γ) Produced Nuclei.
B-19	Instrument Timing via Light Triggering.
B-20	Sinusoidal Pile Oscillator.
B-21	Beam Port #3 Neutron Radiography Facility.
B-22	Water Flow Measurements Through TRIGA Core.
B-24	General Neutron Radiography.
B-25	Neutron Flux Monitors.
B-26	Fast Neutron Spectrum Generator.
B-27	Neutron Flux Determination Adjacent to the OSTR Core.
B-28	Gamma Scan of Sodium (TED) Capsule.
C-1	PuO_2 Transient Experiment.

C. Unplanned Shutdowns

There were thirteen unplanned reactor shutdowns during the current reporting period. A scram occurs when the control rods drop in as a result of an automatic trip or as a result of the operator pushing the manual trip button. Due to unusual conditions or operational anomalies of a less critical nature, the reactor may also be secured by manual rod insertion. Table IV.C.1 contains a summary of the unplanned scrams, including a brief description of the cause of each.

D. Changes to the OSTR Facility, to Reactor Procedures, and to Reactor Experiments Performed Pursuant to 10 CFR 50.59

The information contained in this section of the report provides a summary of the changes performed during the reporting period under the provisions of 10 CFR 50.59. For each item listed, there is a brief description of the action taken and a summary of the applicable safety evaluation.

1. 10 CFR 50.59 Changes to the Reactor Facility

There were 3 changes to the reactor facility during the reporting period.

For additional information regarding these changes, or copies of the changes, contact the OSTR Operations staff.

(1) *01-04, Reactor Bay Ventilation System Upgrade*

a. Description

The reactor building ventilation system was upgraded by the installation of a pressure and temperature control master unit manufactured by Johnson Controls, INC., and its associated analog/digital input and output ports.

This upgrade modified the bay pressure control scheme to modulate air supply damper position to maintain bay negative pressure. In addition, reactor bay temperature is controlled based on inlet supply air temperature, local bay temperature detection, and direct steam supply control air modulation. This modification follows earlier repairs to the supply duct heating coils.

System operating characteristic adjustments and additional minor equipment enhancements were conducted following the conversion to ensure proper and efficient system operation.

(b) Safety Evaluation

The consequences of control system failure were evaluated and compared to the current SAR calculations of doses based on various failure modes. All of the failure modes resulted in consequences less than or equal to that previously evaluated in the SAR.

The probability of failure should not be greater than what is already experienced with equipment, such as pneumatic valve diaphragms, already in the system.

The requirement for automatic shutdown upon high stack gas or particulate activity remains in effect.

(2) *01-09, Removal of Fuel Element in Grid Position F28*

(a) Description

Fuel element #8414 was removed from the core to ensure TS limits of Shutdown Margin were being maintained while in all core configurations. The reactivity worth of the removed fuel element was previously measured to be $0.22. The element removed from core position F28 was chosen for its location on the core periphery away from the neutron source and its distant proximity to active beam ports and nuclear instrumentation.

(b) Safety Evaluation

This fuel element removal from the core is expected to increase maximum power density by no more than 1 kW per element in the core positions with the highest power densities (B ring). Previous data indicates that operation with higher power densities has been found acceptable. Current power densities will not increase above that which has already been shown to be acceptable.

(3) *02-01, Beam Port #3 Blockhouse*

(a) Description

The shielded blockhouse on the end of Beam Port 3 was reconstructed to evaluate the feasibility of performing neutron radiography using industry standard film canisters similar to other university reactors. Large concrete blocks were used to fabricate a blockhouse encompassing a two-foot wide void and semi-enclosed cavity to form a backscatter shield. A movable side shield block allows access to the film canister holder for shutdown loading while ensuring adequate radiation shielding at full power. An installed microswitch, connected to the reactor external scram bus relay, provides scram actuation should the rolling block access shield be moved during reactor operation. A local area radiation monitor is positioned directly in front of the access door to provide the control room with remote radiation level indication.

(b) Safety Evaluation

The shielded blockhouse is constructed external to the reactor bioshield and will not affect the reactor's operation. Only the external reactor scram circuit is affected by the installation and operation of the beamport facility. The integrity of the blockhouse as a shield will be verified to reduce radiation levels to within tolerable limits. Dual protective features in the form of an externally actuated scram and installed ARM will minimize the possibility of creating a High Radiation Area near this facility.

The reduced reactor bay air volume will create higher than normal airborne radioactive material following a SSC malfunction, but the effect will not be significant.

2. 10 CFR 50.59 Changes to Reactor Procedures

There were two changes to reactor procedures which were reviewed, approved and performed under the provisions of 10 CFR 50.59 during the reporting period.

For additional information regarding these changes, or copies of the changes, contact the OSTR Operations staff.

(1) *02-02, Revisions to OSTROP 11,17,18*

(a) Description

This procedure change corrected inconsistencies in language between the OSTROP procedures and Technical Specifications, i.e. shall for must.

Changes corrected typographical errors.

(b) Safety Evaluation

The intent of each OSTROP will not be significantly altered. These changes make the language of each OSTROP more consistent with the TS or corrects typographical errors.

(2) *02-05, Revisions to OSTROP 6, 12, 18*

(a) Description

OSTROP 6-

Deleted references to the Assistant Health Physicist. Clarified wording of access authorization form titles.

OSTROP 12-

Added procedural step to coincide with the actual physical process of control rod testing preparation.

OSTROP 18-

Corrected typographical errors and reworded section to reflect obsolescence of multi-copy forms.

(b) Safety Evaluation

The intent of each OSTROP will not be significantly altered. These changes will correct typographical errors.

3. 10 CFR 50.59 Changes to Reactor Experiments

There were no changes to reactor experiments during this reporting period.

E. Surveillance and Maintenance

1. Non-Routine Maintenance

July 7, 2001	Replaced bypass capacitor in gaseous channel HV power supply.
August 8, 2001	Removed previously installed shim between shim rod upper and lower housing. Cleaned up binding wear areas inside lower assembly and on draw tube and enlarged foot switch actuating rod pass thru hole.
	Replaced two lead acid batteries in inverter rack.
September 1, 2001	SIT evaluated Stack and CAM particulate and gas channel log rate circuits for possible problem causes. Isolated several old an defective printed circuit board solder joints.
	Replaced Safe rod foot switch.
October 2001	Replaced ion chamber current monitoring Pico ammeter with new digital model.
November 2001	Scraped excess scale accumulation from Cooling Tower basin screens to increase basin drain flow.
December 2001	Safe rod up and down switches replaced.
January 2002	Replaced Control Room PA selector switch.
February 2002	Replace meteorological instrument bearings and position potentiometer.

	Reconstructed Beam Port 3 to evaluate neutron radiograph facility feasibility.
March 2002	Replaced rabbit system air manifold hoses.
May 2002	Replaced internals on D-106 fan room steam traps.
June 2002	Replaced fire alarm system thermal detectors in Reactor Bay.

2. Routine Surveillance and Maintenance

The OSTR has an extensive routine surveillance and maintenance (S&M) program. Examples of typical S&M checklists are presented in Figures IV.E.1 through IV.E.4. Items marked with an asterisk (*) are required by the OSTR Technical Specifications.

F. Reportable Occurrences

There were no reportable occurrences during this reporting period.

Table IV.A.1
OSTR Operating Statistics (Using the FLIP Fuel Core)

Operational Data for FLIP Core	August 1, 1976 Through June 30, 1977	July 1, 1977 Through June 30, 1978	July 1, 1978 Through June 30, 1979	July 1, 1979 Through June 30, 1980	July 1, 1980 Through June 30, 1981	July 1, 1981 Through June 30, 1982	July 1, 1982 Through June 30, 1983	July 1, 1983 Through June 30, 1984
Operating Hours (critical)	875	819	458	875	1255	1192	1095	1205
Megawatt Hours	451	496	255	571	1005	999	931	943
Megawatt Days	19.0	20.6	10.6	23.8	41.9	41.6	38.8	39.3
Grams ^{235}U Used	24.0	25.9	13.4	29.8	52.5	52.4	48.6	49.3
Hours at Full Power (1 MW)	401	481	218	552	998	973	890	929
Numbers of Fuel Elements Added or Removed (-)	85	0	2	0	0	1	0	0
Number of Irradiation Requests	44	375	329	372	348	408	396	469

Table IV.A.1 (Continued)

OSTR Operating Statistics (Using the FLIP Fuel Core)

Operational Data for FLIP Core	July 1, 1984 Through June 30, 1985	July 1, 1985 Through June 30, 1986	July 1, 1986 Through June 30, 1987	July 1, 1987 Through June 30, 1988	July 1, 1988 Through June 30, 1989	July 1, 1989 Through June 30, 1990	July 1, 1990 Through June 30, 1991	July 1, 1991 Through June 30, 1992	July 1, 1992 Through June 30, 1993
Operating Hours (critical)	1205	1208	1172	1352	1170	1136	1094	1158	1180
Megawatt Hours	946	1042	993	1001	1025	1013	928	1002	1026
Megawatt Days	39.4	43.4	41.4	41.7	42.7	42.2	38.6	41.8	42.7
Grams ^{235}U Used	49.5	54.4	51.9	52.3	53.6	53.0	48.5	52.4	53.6
Hours at Full Power (1 MW)	904	1024	980	987	1021	1009	909	992	1000
Numbers of Fuel Elements Added or Removed (-)	0	0	0	-2	0	-1,+1	-1	0	0

Table IV.A.1 (Continued)

OSTR Operating Statistics (Using the FLIP Fuel Core)

Operational Data for FLIP Core	July 1, 1993 Through June 30, 1994	July 1, 1994 Through June 30, 1995	July 1, 1995 Through June 30, 1996	July 1, 1996 Through June 30, 1997	July 1, 1997 Through June 30, 1998	July 1, 1998 Through June 30, 1999	July 1, 1999 Through June 30, 2000	July 1, 2000 Through June 30, 2001	July 1, 2001 Through June 30, 2002
Operating Hours (critical)	1248	1262	1226	1124	1029	1241	949	983	1029
Megawatt Hours	1122	1117	1105	985	927	1115	852	896	917
Megawatt Days	46.7	46.6	46.0	41.0	38.6	46.5	35.5	37.3	38.2
Grams ^{235}U Used	58.6	58.4	57.8	51.5	48.5	58.3	44.6	46.8	47.7
Hours at Full Power (1 MW)	1109	1110	1101	980	921	1109	843	890	912
Numbers of Fuel Elements Added or Removed (-)	0	0	-1[5]	-1, +[7]	0	-1[5]	0	0	-1[5]
Number of Irradiation Requests	303	324	268	282	249	231	234	210	239

(1) The reactor was shutdown on July 26, 1976 for one month in order to completely refuel the reactor with a new FLIP fuel core.
(2) No fuel elements were added, but one fueled follower control rod was replaced.
(3) Two fuel elements were removed due to cladding deformation.
(4) One fuel element removed due to cladding deformation and one new fuel element added.
(5) One fuel element removed for core excess adjustment.
(6) No fuel elements were added, but the instrumented fuel element was replaced.
(7) One fuel element removed due to cladding deformation and one used fuel element added.

Table IV.A.2

OSTR Operating Statistics with the Original (20% Enriched) Standard TRIGA Fuel Core

Operational Data for 20% Enriched Core	Mar 8, 67 Through Jun 30, 68	Jul 1, 68 Through Jun 30, 69	Jul 1, 69 Through Mar 31, 70	Apr 1, 70 Through Mar 31, 71	Apr 1, 71 Through Mar 31, 72	Apr 1, 72 Through Mar 31, 73	Apr 1, 73 Through Mar 31, 74	Apr 1, 74 Through Mar 31, 75	Apr 1, 75 Through Mar 31, 76	Apr 1, 76 Through Jul 26, 76	TOTAL: March 67 Through July 76
Operating Hours (critical)	904	610	567	855	598	954	705	563	794	353	6903
Megawatt Hours	117.2	102.5	138.1	223.8	195.1	497.8	335.9	321.5	408.0	213.0	2553.0
Megawatt Days	4.9	4.3	5.8	9.3	8.1	20.7	14.1	13.4	17.0	9.0	106.4
Grams ^{235}U Used	6.1	5.4	7.2	11.7	10.2	26.0	17.6	16.8	21.4	10.7	133.0
Hours at Full Power (250 kW)	429	369	58	---	---	---	---	---	---	---	856
Hours at Full Power (1 MW)	---	---	20	23	100	401	200	291	460	205	1700
Number of Fuel Elements Added to Core	70 (Initial)	2	13	1	1	1	2	2	2	0	94
Number of Irradiation Requests	429	433	391	528	347	550	452	396	357	217	4100
Number of Pulses	202	236	299	102	98	249	109	183	43	39	1560

(1) Reactor went critical on March 8, 1967 (70 element core; 250kW). Note: This period length is 1.33 years as initial criticality occurred in March of 1967.
(2) Reactor shutdown August 22, 1969 for one month for upgrading to 1MW (did not upgrade cooling system). Note: This period length is only 0.75 years as there was a change in the reporting period from July-June to April-March.
(3) Reactor shutdown June 1, 1971 for one month for cooling system upgrading.
(4) Reactor shutdown July 26, 1976 for one month for refueling reactor with a new full FLIP fuel core. Note: This period length is 0.33 years.

Table IV.A.3

Present OSTR Operating Statistics

Operational Data for FLIP Core	Annual Values (2000/2001)	Cumulative Values for FLIP Core
MWH of energy produced	917	23,661
MWD of energy produced	38.2	985.9
Grams ^{235}U used	47.7	1,237
Number of fuel elements added to (+) or removed from (-) the core	-1	79 + 3 FFCR[(1)]
Number of pulses	11	1,367
Hours reactor critical	1029	28,805
Hours at full power (1 MW)	912	23,243
Number of startup and shutdown checks	250	6567
Number of irradiation requests processed[(2)]	239	8,553
Number of samples irradiated	6660	109,985

(1) Fuel Follower Control Rod. These numbers represent the core loading at the end of this reporting period.

(2) Each irradiation request could authorize from 0 to 146 samples. The number of samples per irradiation request averaged 17.6 during the current reporting period.

Table IV.A.4

OSTR Use Time in Terms of Specific Use Categories

OSTR Use Category	Annual Values (hours)	Cumulative Values for FLIP Core (hours)
Teaching (departmental and others)[1]	42	13,148
OSU research[2]	178	8,867
Off-campus research[2]	1,711	17,369
Forensic services	3	234[3]
Reactor preclude time	1,013	20,655
Facility time[4]	5	7,098
TOTAL REACTOR USE TIME	2,952[5]	67,371

(1) See Tables III.A.2 and III.D.1 for teaching statistics.

(2) See Table III.A.3 for research statistics.

(3) Prior to the 1981-1982 reporting period, forensic services were grouped under another use category and the cumulative hours have been compiled beginning with the 1981-1982 report.

(4) The time OSTR spent operating to meet NRC facility license requirements.

(5) Total reactor use time includes all multiple use hours added separately.

Table IV.A.5

OSTR Multiple Use Time[1]

Number of Users	Annual Values (hours)	Cumulative Values for FLIP Core (hours)
Two	301	4,454
Three	176	1,463
Four	78	559
Five	18	133
Six	13	58.5
Seven	1	12
TOTAL MULTIPLE USE TIME	587[2]	6,679.5[3]

(1) Multiple use time is that time when two or more irradiation requests are being concurrently fulfilled by operation of the reactor.

(2) This represents 57% of the total hours the reactor was critical during this reporting period.

(3) This represents 23.2% of the total hours the reactor was critical since startup with FLIP fuel in August of 1976.

Table IV.B.1

Use of OSTR Reactor Experiments(1)

Reactor Experiment Number(2)	Research	Teaching	Forensic	NRC License Requirement	TOTAL
A-1	3	24	0	2	29
B-3	141	31	3	0	172
B-31	9	0	0	0	9
TOTAL	153	55	0	2	210

(1) This table displays the number of times reactor experiments were used for a particular purpose.

(2) The following tabulation gives the number of each reactor experiment used and its corresponding title:

A-1 Normal TRIGA Operation
B-3 Irradiation of Materials in the Standard OSTR Irradiation Facilities
B-31 TRIGA Flux Mapping

Table IV.C.1

Unplanned Reactor Shutdowns and Scrams

Type of Event	Number of Occurrences	Cause of Event
Safety Power Scram	1	Operator error. Automatic scram on high Safety Power Channel due to Lazy Susan samples shielding effect on monitored power channel during power increase.
Percent Power Scram	1	Operator error. Automatic scram on high Percent Power Channel due to Lazy Susan samples shielding effect on monitored power channel during power increase.
Period Scram	3	AC spike noise on period channel. Power at <0.1 watt. Noise occurs when moving rods. Twice occurred during licensee NRC exam. Scrams received while withdrawing shim rod to 15 watts. Determined to be caused by instrument noise at low power.
High Voltage 1 Scram	1	HV1 annunciated scram occurred at the same time left hand drawer was touched by Reactor Supervisor. Static discharge to LHD noted at the same time.
Manual Reactor Scram	1	Seismic activity felt in Control Room. Received later information confirming earthquake occurrence.
Manual Reactor Scram	1	Reactor shutdown prompted by loss of off-site power. Cause of loss later determined to mylar balloons hitting a substation.
Manual Reactor Shutdown	1	High stack gas alarm required shutdown. High level determined to be caused by change out of reactor top Lazy Susan filter, increasing system flow and causing "slug" effect through detector.
Manual Reactor Shutdown	1	Manual shutdown prompted by loss of #1 Cooling Tower Fan. Fuse in disconnect panel blew due to high resistance connection.

Figure IV.E.1

Monthly Surveillance and Maintenance (Sample Form)

OSTROP 13 SURVEILLANCE & MAINTENANCE FOR THE MONTH OF

SURVEILLANCE & MAINTENANCE TO BE PERFORMED	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED **	DATE COMPLETED	REMARKS & INITIALS
*1 FUNCTIONAL CHECK OF REACTOR WATER LEVEL ALARMS & GREEN LIGHT ALARM	MAXIMUM MOVEMENT ± 3 INCHES	UP:_____INCHES DN:_____INCHES ANN:_____ GREEN LIGHT:_____				
2 MEASUREMENT OF THE REACTOR PRIMARY WATER pH	MIN: 5 MAX: 8.5					
3 MEASUREMENT OF THE BULK SHIELD TANK WATER pH	MIN: 5 MAX: 8.5					
4 EMERGENCY POWER SYSTEM BATTERY CHECKS	LIQUID: ~1"DN					
INVERTER	S.G.: >1.250					
	FUNCTIONAL CHECK					
GENERATOR	S.G.: >1.250					
	VOLTS ≥ 12.6V DC					
5 EVACUATION HORN & P.A. EMERGENCY SYSTEM BATTERY CHECKS	LIQUID: FULL					
	S.G.: >1.250					
	VOLTS ≥ 12.6V DC					
	CORR: NONE					
6 INSPECTION OF THE BRUSHES ON THE PNEUMATIC TRANSFER SYSTEM BLOWER MOTOR	CHANGE WHEN ¼" LEFT					
7 REVIEW REACTOR SUPERVISOR'S LOG	CURRENT					
8 CHANGE LAZY SUSAN FILTER	FILTER CHANGED					
9 LUBRICATE THE TRIGA TUBE LOADING TOOL (REEL)	USE OIL GUN	NEED OIL?_____				
10 REACTOR TOP CAM OIL LEVEL CHECK	OSTROP 13.10	NEED OIL?_____				
11 PROPANE TANK LIQUID LEVEL CHECK (%FULL)	> 50%					
*12 BULK WATER TEMPERATURE ALARM CHECK	FUNCTIONAL					
13 PRIMARY PUMP BEARINGS OIL LEVEL CHECK	OSTROP 13.13	NEED OIL?_____				

* License Requirement

** Date not to be exceeded is only applicable to marked (*) items. It is equal to the time completed last month plus six weeks.

Rev. 3/98

Figure IV.E.2

Quarterly Surveillance and Maintenance (Sample Form)

OSTROP 14 SURVEILLANCE & MAINTENANCE FOR THE *QUARTER* OF ________/________/________ 19____

	SURVEILLANCE & MAINTENANCE TO BE PERFORMED	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED**	DATE COMPLETED	REMARKS & INITIALS
* 1	REACTOR OPERATION COMMITTEE (ROC) AUDIT OF REACTOR OPERATIONS FOR ____/____/____ QUARTER	QUARTERLY					
* 2	QUARTERLY ROC MEETING	QUARTERLY					
‡ 3	FUEL ELEMENT RADIATION LEVEL MEASUREMENTS IN WATER	≥23 R/hr @ 2' IN WATER					
4	INSPECTION OF THE SOLENOID VALVES IN THE PNEUMATIC TRANSFER SYSTEM	FUNCTIONAL					
5	PNEUMATIC TRANSFER SYSTEM INSERTION TIME CHECK	≤6 SECONDS					
6	ROTATING RACK CHECK FOR UNKNOWN SAMPLES	RACK SHOULD BE EMPTY					
7	FUNCTIONAL CHECK OF EMERGENCY LIGHTS (SEE CHECKSHEET)	FUNCTIONAL					
8	WATER MONITOR ALARM CHECK	FUNCTIONAL					
9	STACK MONITOR CHECKS (OIL DRIVE MOTORS, H.V. READINGS)	MOTORS OILED					
		PART: 1150 V ±50	VOLTS				
		GAS: 900 V ±50	VOLTS				
10	(NOT BEING USED)						
11	ARM SYSTEM ALARM CHECKS	FUNCTIONAL					

CHAN	1	2	3	4	5	6	7	8	9	10	11	12	13	14
AUD														
LIGHT														
PANEL														
ANN														

‡ Physical Security Plan Requirement
* License Requirement
** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date completed last quarter plus four months.

Figure IV.E.2 (Continued)

Quarterly Surveillance and Maintenance (Sample Form)

OSTROP 14 (CONTINUED) SURVEILLANCE & MAINTENANCE FOR THE *QUARTER* OF ________/________/________ 19____

	SURVEILLANCE & MAINTENANCE TO BE PERFORMED	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED	DATE COMPLETED	REMARKS & INITIALS
12	OPERATOR LOG	a) ≥4 hours: at console (RO) or as Rx. Sup. (SRO) b) Complete Operating Exercise	a) TIME	b) OPERATING EXERCISE			
	NAME						
13	CHECK FILTER TAPE SPEED ON STACK MONITOR	1"/HR ± 0.2					
14	INCORPORATE 50.59 & ROCAS INTO DOCUMENTATION	QUARTERLY					
15	(NOT BEING USED)						
16	FUNCTIONAL CHECK OF EVACUATION ALARMS	ALL FUNCTIONAL					
17	(NOT BEING USED)						
18	STACK MONITOR ALARM CIRCUIT CHECKS	ALARM ON CONTACT					
19	ALARM TESTING OF VITAL AREA DOUBLE DOORS	FUNCTIONAL					

‡ Physical Security Plan Requirement
* License Requirement
** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date completed last quarter plus four months.

Figure IV.E.3
Semi-Annual Surveillance and Maintenance (Sample Form)

OSTROP.15

SEMI-ANNUAL SURVEILLANCE AND MAINTENANCE FOR ______________

No.	SURVEILLANCE & MAINTENANCE TO BE PERFORMED		LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED**	DATE COMPLETED	REMARKS & INITIALS
*1	FUNCTIONAL CHECKS OF REACTOR INTERLOCKS	a) NEUTRON SOURCE COUNT RATE INTERLOCK	NO WITHDRAW	a1				
			≥5 cps	a2				
		b) TRANSIENT ROD AIR INTERLOCK	NO PULSE	b				
		c) PULSE PROHIBIT ABOVE 1 kW	≥1 kW	c				
		d) TWO ROD WITHDRAWAL PROHIBIT	1 only	d				
		e) PULSE MODE ROD MOVEMENT INTERLOCK	NO MOVEMENT	e				
		f) MAXIMUM PULSE REACTIVITY INSERTION LIMIT	≤ $2.50	f				
		g) PULSE INTERLOCK ON RANGE SWITCH	NO PULSE	g				
*2	SAFETY CIRCUIT TEST	PERIOD SCRAM	≥3 sec					
*3	CONTROL ROD WITHDRAWAL, INSERTION & SCRAM TIMES	TRANS / SAFE / SHIM / REG						
		a) SCRAM	≤2 sec	a				
		b) WITHDRAWAL	≤50 sec	b				
		c) INSERTION	≤50 sec	c				
*4	PULSE COMPARISON (PREVIOUS PULSE):	PULSE # ____ $ ____ ____ MW ____ °C	≤20% CHANGE	PULSE # ____ $ ____ ____ MW ____ °C				
*5	REACTOR BAY VENTILATION SYSTEM SHUTDOWN TEST		DAMPERS CLOSE IN ≤8 SECONDS	4TH FLOOR ____ 1ST FLOOR ____				
*6	CALIBRATION OF THE FUEL ELEMENT TEMPERATURE CHANNEL		±2°C					
*7	MATERIALS BALANCE REPORT/FUEL MANAGEMENT		REPORTS DONE/ ~ EVEN BURNUP		APRIL 15 OCTOBER 15	APRIL 30 OCTOBER 30		
*8	CLEANING & LUBRICATION OF TRANSIENT ROD CARRIER INTERNAL BARREL		3-IN-1 or GUN OIL	CLEANED ____ OILED ____				
*9	LUBRICATION OF BALL-NUT DRIVE ON TRANSIENT ROD CARRIER		3-IN-1 or GUN OIL	MOLY KOTE ____ OILED ____				
10	LUBRICATION OF THE ROTATING RACK BEARINGS		10 W OIL	OILED ____				
11	CONSOLE CHECK LIST (OSTROP 15.11)		OSTROP 15.11					
12	CONSTANT AIR MONITOR RECORDER MAINTENANCE							

* License Requirements.
** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date last time plus 7½ months.

Rev. 11/92

Figure IV.E.3 (Continued)

Semi-Annual Surveillance and Maintenance (Sample Form)

OSTROP 15 (continued)

SEMI-ANNUAL SURVEILLANCE AND MAINTENANCE FOR ____________

	SURVEILLANCE & MAINTENANCE TO BE PERFORMED		LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED**	DATE COMPLETED	REMARKS & INITIALS
13	Deleted							
14	STANDARD CONTROL ROD MOTOR CHECKS			OILED ____				
15	Deleted							
16	ION CHAMBER RESISTANCE MEASUREMENTS WITH MEGGAR INDUCED VOLTAGE	A. SAFETY CHANNEL	NONE (Info Only)					
		B. % POWER CHANNEL	NONE (Info Only)					
17	FISSION CHAMBER RESISTANCE CALCULATION $R = \frac{800V}{\Delta I}$	@ 100 V. I = ______AMPS @ 900 V. I = ______AMPS ΔI = ______AMPS R = ______Ω	NONE (Info Only)					
18	FUNCTIONAL CHECK OF HOLDUP TANK WATER LEVEL ALARMS		OSTROP 15.18	HIGH ____ FULL ____ GREEN LIGHT ____				

* License Requirements.

** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date last time plus 7½ months.

Rev. 11/94

Figure IV.E.4
Annual Surveillance and Maintenance (Sample Form)

OSTROP 16.0 | ANNUAL Surveillance and Maintenance for the Year ________ | Page 1

No.	Surveillance and Maintenance to be Performed		Limits	As Found	Target Date	Date Not to Be Exceeded**	Date Completed	Remarks & Initials
*1	Biennial Inspection of Control Rods:	a) FFCRs	OSTROP 12.0					
		b) TRANS						
*2	Annual Report (Due June 30 + 75 Days)		NOV 1		OCT 1	NOV 1		
*3	Control Rod Calibration:	a) SAFE	OSTROP 9.0					
		b) SHIM						
		c) REG						
		d) TRANS						
*4	Reactor Power Calibration		OSTROP 9.0					
*5	Calibration of Reactor Tank Water Temperature Meters		OSTROP 16.5					
*6	Continuous Air Monitor Calibration:	a) Particulate Monitor	RCHPP 18.0					
		b) Gas Monitor						
*7	Stack Monitor Calibration:	a) Particulate Monitor	RCHPP 18 & 28					
		b) Gas Monitor						
*8	Area Radiation Monitor Calibration		RCHPP 18.0					
*9	Water Monitor Calibration		RCHPP 18.0					
10	Reactor Tank and Core Component Inspection		No Powdery White Spots					
*11	SNM Physical Inventory		OSTROP 20.0					
*12	Emergency Response Plan Drill							
*13	Standard Control Rod Drive Inspection		OSTROP 16.13					
*14	OSU Police and Security Retraining							
*15	50.59 Report		NOV 15		OCT 15	NOV 15		
*16	Intrusion Alarm Response Drill (OSU Police and Security)		Response ≤5 MIN					

* License Requirements.
** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date completed last year plus 15 months. For biennial license requirements, it is equal to the date completed last time plus 2½ years.

Rev. 11/92

Figure IV.E.4 (Continued)
Annual Surveillance and Maintenance (Sample Form)

OSTROP 18.0 (continued) ANNUAL Surveillance and Maintenance for the Year ________ Page 2

	SURVEILLANCE AND MAINTENANCE TO BE PERFORMED	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED**	DATE COMPLETED	REMARKS & INITIALS
17	EMERGENCY POWER INVERTER TEST	OSTROP 22.0					
18	REPLACE P.A. & EVAC SYSTEM LEAD-ACID BATTERIES	EVERY 4 YEARS					

*19	REACTOR OPERATOR LICENSE CONDITIONS	ANNUAL				BIENNIAL		EVERY 6 YEARS				
		REQUALIFICATION				MEDICAL		NRC REQUAL EXAM		LICENSE		
		WRITTEN EXAMINATIONS		OPERATING TEST						APPLICATION		
	NAME	DUE DATE	DATE PASSED	DUE DATE	DATE PASSED	DUE DATE	DATE COMPLETED	DUE DATE	DATE PASSED	DUE DATE	DATE MAILED	EXPIRATION DATE

	SURVEILLANCE AND MAINTENANCE TO BE PERFORMED	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED**	DATE COMPLETED	REMARKS & INITIALS
20	FUEL ELEMENT INSPECTION FOR SELECTED ELEMENTS (B1, B2, B3, B5, B6, C3, C5, D5, D8)	PASS GO/NO GO TEST		Pulse # ______ Date ______	Pulse # ______ Date ______		
*21	DECOMMISSIONING COST UPDATE	N/A	N/A				
22	FUNCTIONAL TEST OF THE REACTOR WATER LOW LEVEL ALARM	MAXIMUM MOVEMENT ~3 INCHES	___INS ___ANN				

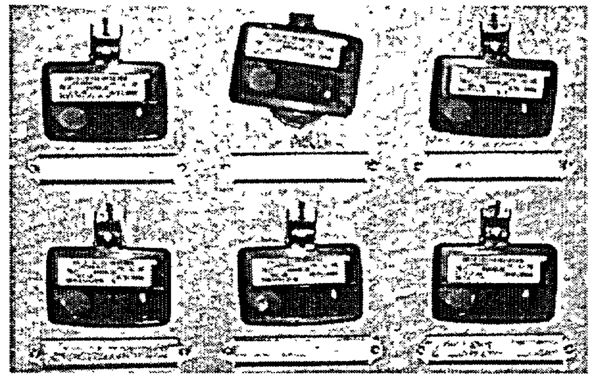
23	NAME	ANNUAL - CPR		EVERY 3 YEARS - FIRST AID	
		REMINDER DATE	EXPIRY DATE	REMINDER DATE	EXPIRY DATE

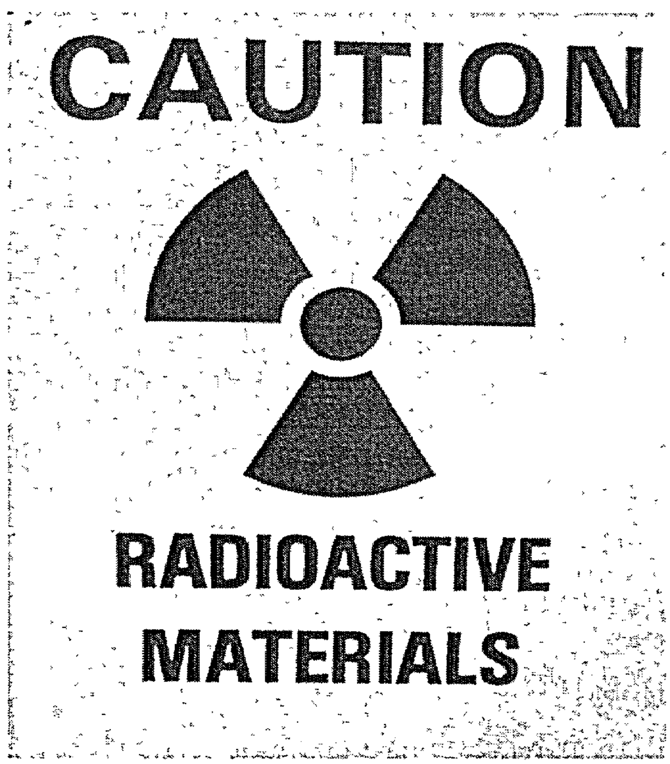
* License Requirements.
** Date not to be exceeded is only applicable to marked (*) items. It is equal to the date completed last year plus 15 months. For biennial license requirements, it is equal to the date completed last time plus 2½ years

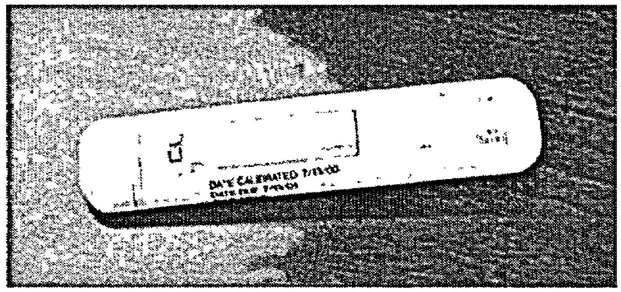
ev. 5/94

Part V

Protection







Part V

PROTECTION

A. Introduction

This section of the report deals with the radiation protection program at the OSU Radiation Center. The purpose of this program is to ensure the safe use of radiation and radioactive material in the Center's teaching, research, and service activities, and in a similar manner to ensure the fulfillment of all regulatory requirements of the state of Oregon, the U.S. Nuclear Regulatory Commission, and other regulatory agencies. The comprehensive nature of the program is shown in Table V.A.1, which lists the program's major radiation protection requirements and the performance frequency for each item.

The radiation protection program is implemented by a staff consisting of a Senior Health Physicist, two Health Physicists, and several part-time Health Physics Monitors (see Part II.F). Assistance is also provided by the reactor operations group, the neutron activation analysis group, the Scientific Instrument Technician, and the Radiation Center Director.

The data contained in the following sections have been prepared to comply with the current requirements of Nuclear Regulatory Commission (NRC) Facility License No. R-106 (Docket No. 50-243) and the Technical Specifications contained in that license. The material has also been prepared in compliance with Oregon Office of Energy Rule No. 345-30-010, which requires an annual report of environmental effects due to research reactor operations. A summary of required data for the OSTR is provided in Part I.E for quick reference.

Within the scope of Oregon State University's radiation protection program, it is standard operating policy to maintain all releases of radioactivity to the unrestricted environment and all exposures to radiation and radioactive materials at levels which are consistently "as low as reasonably achievable" (ALARA).

B. Environmental Releases

The annual reporting requirements in the OSTR Technical Specifications state that the licensee (OSU) shall include "a summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee, as measured at, or prior to, the point of such release or discharge." The liquid and gaseous effluents released, and the solid waste generated and transferred are discussed briefly below. Data regarding these effluents are also summarized in detail in the designated tables.

1. Liquid Effluents Released

a. Liquid Effluents Released

Oregon State University has implemented a policy to reduce the volume of radioactive liquid effluents to an absolute minimum. For example, water used during the ion exchanger resin change is now recycled as reactor makeup water. Waste water from Radiation Center laboratories and the OSTR is collected at a holdup tank prior to release to the sanitary sewer. Whenever possible, liquid effluent is analyzed for radioactivity content at the time it is released to the collection point. However, liquids are always analyzed for radioactivity before the holdup tank is discharged into the unrestricted area (the sanitary sewer system). For this reporting period, the Radiation Center and reactor made two liquid effluent releases to the sanitary sewer. All Radiation Center and reactor facility liquid effluent data pertaining to these releases are contained in Table V.B.1.a.

b. Liquid Waste Generated and Transferred

Liquid waste generated from glassware and laboratory experiments is transferred by the campus Radiation Safety Office to its waste processing facility. The annual summary of liquid waste generated and transferred is contained in Table V.B.1.b.

2. Airborne Effluents Released

Airborne effluents are discussed in terms of the gaseous component and the particulate component.

a. Gaseous Effluents

Gaseous effluents from the reactor facility are monitored by the reactor stack effluent monitor. Monitoring is continuous, i.e., prior to, during, and after reactor operations. It is normal for the reactor facility stack effluent monitor to begin operation as one of the first systems in the morning and to cease operation as one of the last systems at the end of the day. All gaseous effluent data for this reporting period are summarized in Table V.B.2.

b. Particulate Effluents

Particulate effluents from the reactor facility are also monitored by the reactor facility stack effluent monitor.

Evaluation of the detectable particulate radioactivity in the stack effluent confirmed its origin as naturally-occurring radon daughter products, within a range of approximately 3×10^{-11} μCi/ml to 1×10^{-9} μCi/ml. This particulate radioactivity is predominantly ^{214}Pb and ^{214}Bi, which is not associated with reactor operations.

There was no release of particulate effluents with a half life greater than eight days and therefore the reporting of the average concentration of radioactive particulates with half lives greater than eight days is not applicable.

3. Solid Waste Released

Data for the radioactive material in the solid waste generated and transferred during this reporting period are summarized in Table V.B.3 for both the reactor facility and the Radiation Center. Solid radioactive waste is routinely transferred to Radiation Safety. Until this waste is disposed of by Radiation Safety, it is held along with other campus radioactive waste on the University's state of Oregon radioactive materials license.

Solid radioactive waste is disposed of by Radiation Safety by transfer to the University's radioactive waste disposal vendor, Thomas Gray Associates, Inc., for burial at its installation located near Richland, Washington.

C. Personnel Doses

The OSTR annual reporting requirements specify that the licensee shall present a summary of the radiation exposure received by facility personnel and visitors. For the purposes of this report, the summary includes all Radiation Center personnel who may have received exposure to radiation. These personnel have been categorized into six groups: facility operating personnel, key facility research personnel, facilities services maintenance personnel, students in laboratory classes, police and security personnel, and visitors.

Facility operating personnel include the reactor operations and health physics staff. The dosimeters used to monitor these individuals include quarterly TLD badges, quarterly track-etch/albedo neutron dosimeters, monthly TLD (finger) extremity dosimeters, and pocket ion chambers.

Key facility research personnel consist of Radiation Center staff, faculty, and graduate students who perform research using the reactor, reactor-activated materials, or using other research facilities present at the Center. The individual dosimetry requirements for these personnel will vary with the type of research being conducted, but will generally include a quarterly TLD film badge and TLD (finger) extremity dosimeters. If the possibility of neutron exposure exists, researchers are also monitored with a track-etch/albedo neutron dosimeter.

Facilities Services maintenance personnel are normally issued a gamma sensitive electronic dosimeter as their basic monitoring device. A few Facilities Services personnel who routinely perform maintenance on mechanical or refrigeration equipment are issued a quarterly $X\beta(\gamma)$ TLD badge and other dosimeters as appropriate for the work being performed.

Students attending laboratory classes are issued quarterly $X\beta$(G) TLD badges, TLD (finger) extremity dosimeters, and track-etch/albedo or other neutron dosimeters, as appropriate.

Students or small groups of students who attend a one-time laboratory demonstration and do not handle radioactive materials are usually issued a gamma sensitive electronic dosimeter. These results are not included with the laboratory class students.

OSU police and security personnel are issued a quarterly $X\beta(\gamma)$ TLD badge to be used during their patrols of the Radiation Center and reactor facility.

Visitors, depending on the locations visited, may be issued a gamma sensitive electronic dosimeters. OSU Radiation Center policy does not normally allow people in the visitor category to become actively involved in the use or handling of radioactive materials.

An annual summary of the radiation doses received by each of the above six groups is shown in Table V.C.1. There were no personnel radiation exposures in excess of the limits in 10 CFR 20 or state of Oregon regulations during the reporting period.

D. Facility Survey Data

The OSTR Technical Specifications require an annual summary of the radiation levels and levels of contamination observed during routine surveys performed at the facility. The Center's comprehensive area radiation monitoring program encompasses the Radiation Center as well as the OSTR, and therefore monitoring results for both facilities are reported.

1. Area Radiation Dosimeters

Area monitoring dosimeters capable of integrating the radiation dose are located at strategic positions throughout the reactor facility and Radiation Center. All of these dosimeters contain at least a standard personnel-type beta-gamma film or TLD pack. In addition, for key locations in the reactor facility and for certain Radiation Center laboratories a CR-39 plastic track-etch neutron detector has also been included in the monitoring package.

The total dose equivalent recorded on the various reactor facility dosimeters is listed in Table V.D.1 and the total dose equivalent recorded on the Radiation Center area dosimeters is listed in Table V.D.2. Generally, the characters following the MRC (Monitor Radiation Center) designator show the room number or location.

2. Routine Radiation and Contamination Surveys

The Center's program for routine radiation and contamination surveys consists of daily, weekly, and monthly measurements throughout the TRIGA reactor facility and Radiation Center. The frequency of these surveys is based on the nature of the radiation work being carried out at a particular location or on other factors which indicate that surveillance over a specific area at a defined frequency is desirable.

The primary purpose of the routine radiation and contamination survey program is to assure regularly scheduled surveillance over selected work areas in the reactor facility and in the Radiation Center, in order to provide current and characteristic data on the status of radiological conditions. A second objective of the program is to assure frequent on-the-spot personal observations (along with recorded data), which will provide advance warning of needed corrections and thereby help to ensure the safe use and handling of radiation sources and radioactive materials. A third objective, which is really derived from successful execution of the first two objectives, is to gather and document information which will help to ensure that all phases of the operational and radiation protection programs are meeting the goal of keeping radiation doses to personnel and releases of radioactivity to the environment "as low as reasonably achievable" (ALARA).

The annual summary of radiation and contamination levels measured during routine facility surveys for the applicable reporting period is given in Table V.D.3.

E. Environmental Survey Data

The annual reporting requirements of the OSTR Technical Specifications include "an annual summary of environmental surveys performed outside the facility."

1. Gamma Radiation Monitoring

a. On-site Monitoring

Monitors used in the on-site gamma environmental radiation monitoring program at the Radiation Center consist of the reactor facility stack effluent monitor described in Section V.B.2 and nine environmental monitoring stations. These stations consist of a polyethylene bottle placed inside a PVC tube attached to the reactor building perimeter fence at a height of four feet.

Each fence environmental station is equipped with an OSU supplied and processed TLD area monitor (normally three Harshaw ^{7}LiF TLD-700 chips per ^{7}Li monitor in a plastic "LEGO" mount). These monitors are exchanged and processed quarterly. The total number of TLD samples for the reporting period was 108 (9 stations x 3 chips per station per quarter x 4 quarters per year). A summary of this TLD data is shown in Table V.E.1.

During this reporting period, each fence environmental station utilized an LIF TLD monitoring packet supplied and processed by ICN Worldwide Dosimetry Service (ICN), Costa Mesa, California. Each ICN packet contained three LIF TLDs and was exchanged quarterly for a total of 108 samples during the reporting period (9 stations x 3TLDs per station x four quarters). The total number of ICN TLD samples for the reporting period was 90. A summary of the ICN TLD data is also shown in Table V.E.1.

Monthly measurements of the direct gamma dose rate (μrem h^{-1}) were also made at each fence monitoring station. These measurements were made with a Bicron micro-rem per hour survey meter containing a 1" x 1" NaI detector.

A total of 108 μrem h^{-1} measurements were taken (9 stations per month x 12 months per year). The total calculated dose equivalent was determined by averaging the 12 separate μrem h^{-1} measurements and multiplying this average by 8760 hours per year. A summary of this data is shown in Table V.E.1.

From Table V.E.1 it is concluded that the doses recorded by the dosimeters on the TRIGA facility fence can be attributed to natural background radiation, which is about 110 mrem per year for Oregon (Refs. 1, 2).

or the OSU Radiation Center, and also helps indicate the general trend of the radioactivity concentration in each of the various substances sampled. See Figure V.E.1 for the locations of the sampling stations for grass (G), soil (S), water (W) and rainwater (RW) samples. Most locations are within a 1000 foot radius of the reactor facility and the Radiation Center. In general, samples are collected over a local area having a radius of about ten feet at the positions indicated in Figure V.E.1.

There are a total of 22 quarterly sampling locations: four soil locations, four water locations (when water is available), and fourteen vegetation locations. The total number of samples possible during the reporting period is 88 (16 soil samples, 16 water samples, and 56 vegetation samples).

The annual average concentration of total net beta radioactivity (minus tritium) for samples collected at each environmental soil, water, and vegetation sampling location (sampling station) is listed in Table V.E.3. Calculation of the total net beta disintegration rate incorporates subtraction of only the counting system background from the gross beta counting rate, followed by application of an appropriate counting system efficiency.

The annual average concentrations were calculated using sample results which exceeded the lower limit of detection (LLD), except that sample results which were less than or equal to the LLD were averaged in at the corresponding LLD concentration. Table V.E.4 gives the average LLD concentration and the range of LLD values for each sample category for the current reporting period.

As used in this report, the LLD has been defined as the amount or concentration of radioactive material (in terms of μCi per unit volume or unit mass) in a representative sample, which has a 95% probability of being detected.

Identification of specific radionuclides is not routinely carried out as part of this monitoring program, but would be conducted if unusual radioactivity levels above natural background were detected. However, from Table V.E.3 it can be seen that the levels of radioactivity detected were consistent with naturally occurring radioactivity and comparable to values reported in previous years.

F. Radioactive Material Shipments

A summary of the radioactive material shipments originating from the TRIGA reactor facility, NRC license R-106, is shown in Table V.F.1. A similar summary for shipments originating from the Radiation Center's state of Oregon radioactive materials license ORE 90005 is shown in Table V.F.2. A summary of radioactive material shipments exported under Nuclear Regulatory Commission general license 10 CFR 110.23 is shown in Table V.F.3.

b. Off-site Monitoring

The off-site gamma environmental radiation monitoring program consists of twenty monitoring stations surrounding the Radiation Center (see Figure V.E.2) and six stations located within a 5 mile radius of the Radiation Center.

Each off-site radiation monitoring station is equipped with an OSU-supplied and processed TLD monitor. Each monitor consists of three Harshaw ^{7}LiF TLD-700 chips in a plastic "LEGO" mount. The mount is placed in a polyethylene bottle inside a PVC tube which is attached to the station's post about four feet above the ground (MRCTE 21 and MRCTE 22 are mounted on the roof of the EPA Laboratory and National Forage Seed Laboratory, respectively). These monitors are exchanged and processed quarterly, and the total number of TLD samples during the current one-year reporting period was 240 (20 stations x 3 chips per station per quarter x 4 quarters per year). A summary of the OSU off-site TLD data is provided in Table V.E.2. The total number of ICN TLD samples for the reporting period was 144 (12 station x 3 TLDs per station x 4 quarters). The total number of ICN TLD samples for the reporting period was 128. A summary of ICN TLD data for the off-site monitoring stations is also given in Table V.E.2.

In a manner similar to that described for the on-site fence stations, monthly measurements of the direct gamma exposure rate in microrem per hour (μrem h^{-1}) are made at each of the twenty off-site radiation monitoring stations. As noted before, these measurements are made with a Bicron micro-rem per hour survey meter containing a 1" x 1" NaI detector. A total of 240 μrem h^{-1} measurements were made during the reporting period (21 stations per month x 12 months per year). The total dose equivalent for each station was determined by averaging the 12 separate μrem h^{-1} measurements and multiplying this average by 8760 hours per year. A summary of these data is given in Table V.E.2.

After a review of the data in Table V.E.2, it is concluded that, like the dosimeters on the TRIGA facility fence, all of the doses recorded by the off-site dosimeters can be attributed to natural background radiation, which is about 110 mrem per year for Oregon (Refs. 1, 2).

2. Soil, Water, and Vegetation Surveys

The soil, water, and vegetation monitoring program consists of the collection and analysis of a limited number of samples in each category on a quarterly basis. The program monitors highly unlikely radioactive material releases from either the TRIGA reactor facility

G. References

1. U. S. Environmental Protection Agency, "Estimates of Ionizing Radiation Doses in the United States, 1960-2000," ORP/CSD 72-1, Office of Radiation Programs, Rockville, Maryland (1972).

2. U. S. Environmental Protection Agency, "Radiological Quality of the Environment in the United States, 1977," EPA 520/1-77-009, Office of Radiation Programs; Washington, D.C. 20460 (1977).

Table V.A.1

Radiation Protection Program Requirements and Frequencies

FREQUENCY	RADIATION PROTECTION REQUIREMENT
Daily/Weekly/Monthly	Perform routine area radiation/contamination monitoring.
Monthly	Perform routine response checks of radiation monitoring instruments. Monitor radiation levels (μrem h^{-1}) at the environmental monitoring stations. Collect and analyze TRIGA primary, secondary, and make-up water. Exchange personnel dosimeters and inside area monitoring dosimeters, and review exposure reports. Inspect laboratories. Check emergency safety equipment. Perform neutron generator contamination survey. Calculate previous month's gaseous effluent discharge.
As Required	Process and record solid waste and liquid effluent discharges. Prepare and record radioactive material shipments. Survey and record incoming radioactive materials receipts. Perform and record special radiation surveys. Perform thyroid and urinalysis bioassays. Conduct orientations and training. Issue radiation work permits and provide health physics coverage for maintenance operations
Quarterly	Prepare, exchange and process environmental TLD packs Collect and process environmental soil, water, and vegetation samples. Conduct orientations for classes using radioactive materials. Collect and analyze sample from reactor stack effluent line. Exchange personnel dosimeters and inside area monitoring dosimeters, and review exposure reports.
Semi-Annual	Leak test and inventory sealed sources. Conduct floor survey of corridors and reactor bay. Inventory and inspect Radiation Center equipment located at Good Samaritan Hospital.
Annual	Calibrate portable radiation monitoring instruments and personnel pocket ion chambers. Calibrate reactor stack effluent monitor, continuous air monitors, remote area radiation monitors, water monitor, and air samplers. Measure face air velocity in laboratory hoods and exchange dust-stop filters and HEPA filters as necessary. Inventory and inspect Radiation Center emergency equipment. Conduct facility radiation survey of the ^{60}Co irradiators. Conduct personnel dosimeter training. Perform contamination smear survey of Radiation Center ventilation stacks Update decommissioning logbook.

Table V.B.1.a

Monthly Summary of Liquid Effluent Releases to the Sanitary Sewer[1,2]

(OSTR Contribution Shown in ( ) and Bold Print)

Date of Discharge (Month and Year)	Total Quantity of Radioactivity Released (Curies)	Detectable Radionuclides in the Waste	Specific Activity For Each Detectable Radionuclide in the Waste, Where the Release Concentration Was >1 x 10^{-7} μCi/cm^3 (μCi ml^{-1})	Total Quantity of Each Detectable Radionuclide Released in the Waste (Curies)	Average Concentration of Released Radioactive Material at the Point of Release (μCi ml^{-1})	Percent of Applicable Monthly Average Concentration for Released Radioactive Material (%)[3]	Total Volume of Liquid Effluent Released Including Diluent[4] (gal)
January 2002	0	—	0	0	0	0	2451
May 2002	0	---	0	0	0	0	1857
Annual Total for Radiation Center	0		0	0	0	0	4308
OSTR Contribution to Above	N/A	N/A	N/A	N/A	N/A	N/A	N/A

(1) OSU has implemented a policy to reduce to the absolute minimum radioactive wastes disposed to the sanitary sewer. There were no liquid effluent releases during months not listed.

(2) The OSU operational policy is to subtract only detector background from the water analysis data and not background radioactivity in the Corvallis city water.

(3) Based on values listed in 10 CFR 20, Appendix B to 20.1001 - 20.2401, Table 3, which are applicable to sewer disposal.

(4) The total volume of liquid effluent plus diluent does not take into consideration the additional mixing with the over 250,000 gallons per year of liquids and sewage normally discharged by the Radiation Center complex into the same sanitary sewer system.

(5) Less than the lower limit of detection at the 95% confidence level.

Table V.B.1.b

Annual Summary of Liquid Waste Generated and Transferred

Origin of Liquid Waste	Volume of Liquid Waste Packaged(1) (gallons)	Detectable Radionuclides in the Waste	Total Quantity of Radioactivity in the Waste (Curies)	Dates of Waste Pickup for Transfer to the Waste Processing Facility	Dates of Shipment from Oregon State University
TRIGA Reactor Facility	None	---	---	---	---
Radiation Center Laboratories	30	^{3}H, ^{65}Zn, ^{131}I, ^{32}P, ^{59}Fe, ^{86}Rb	5.52×10^{-3}	8/21/01, 4/24/02	6/21/02, 2/22/02
TOTAL	30	^{3}H, ^{65}Zn, ^{131}I, ^{32}P, ^{59}Fe, ^{86}Rb	5.52×10^{-3}	---	---

(1) TRIGA and Radiation Center liquid waste is picked up by the Radiation Safety Office for transfer to its waste processing facility for final packaging.

(2) The short-lived waste was held by the Radiation Safety Office for decay.

Table V.B.2

Monthly Summary of Gaseous Effluent Releases(1)

Date of Discharge (Month and Year)	Total Estimated Radioactivity Released (Curies)	Total Estimated Quantity of Argon-41 Released(2) (Curies)	Estimated Average Atmospheric Diluted Concentration of Argon-41 at Point of Release (Reactor Stack) (μCi/ml⁻¹)	Percent of the Applicable MPC for Diluted Concentration of Argon-41 at Point of Release (Reactor Stack) (%)
July 01	0.32	0.32	2.57E-08	0.64
August 01	0.24	0.24	1.90E-08	0.47
September 01	0.10	0.10	8.52E-09	0.21
October 01	0.24	0.24	1.92E-08	0.48
November 01	0.22	0.22	1.77E-08	0.44
December 01	0.11	0.11	8.46E-09	0.21
January 02	0.26	0.26	2.06E-08	0.52
February 02	0.16	0.16	1.37E-08	0.34
March 02	0.34	0.34	2.68E-08	0.67
April 02	0.23	0.23	1.87E-08	0.47
May 02	0.23	0.23	2.09E-08	0.52
June 02	0.27	0.27	2.19E-08	0.55
ANNUAL VALUE	2.71	2.71	1.84E-08	0.46

(1) Airborne effluents from the OSTR contained no detectable particulate radioactivity resulting from reactor operations, and there were no releases of *any* radioisotopes in airborne effluents in concentrations greater than 20% of the applicable effluent concentration. (20% is a value taken from the OSTR Technical Specifications)

(2) Routine gamma spectroscopy analysis of the gaseous radioactivity in the OSTR stack discharge indicated the only detectable radionuclide was argon-41.

Table V.B.3

Annual Summary of Solid Waste Generated and Transferred

Origin of Solid Waste	Volume of Solid Waste Packaged[1] (Cubic Feet)	Detectable Radionuclides in the Waste	Total Quantity of Radioactivity in Solid Waste (Curies)	Dates of Waste Pickup for Transfer to the OSU Waste Processing Facility	Dates of Shipment from Oregon State University[2]
TRIGA Reactor Facility	17.5[3]	^{46}Sc, ^{47}Sc, ^{58}Co, ^{60}Co, ^{54}Mn, ^{89}Rb, ^{85}Se	5.82×10^{-5}	8/21/01, 11/28/01, 4/24/02	2/22/02, 4/24/02, 7/17/02
Radiation Center Laboratories	27	^{3}H, ^{14}C, ^{46}Sc, ^{47}Sc, ^{22}Na, ^{60}Co, ^{65}Zn, ^{238}U, ^{59}Fe, ^{86}Rb, ^{90}Sr, ^{131}I, ^{187}Cs	5.2×10^{-2}	8/21/01, 11/28/01, 4/24/02	2/22/02, 4/24/02, 7/17/02
TOTAL	44.5	See Above	5.2×10^{-2}	---	---

(1) TRIGA and Radiation Center laboratory waste is picked up by Radiation Safety for transfer to its waste processing facility for final packaging.

(2) Solid radioactive waste is shipped to Thomas Gray Associates, Inc.

(3) Includes 4 ft^3 of dewatered resin beads.

Table V.C.1

Annual Summary of Personnel Radiation Doses Received

Personnel Group	Average Annual Dose[(1)]		Greatest Individual Dose[(1)]		Total Person-mrem For the Group[(1)]	
	Whole Body (mrem)	Extremities (mrem)	Whole Body (mrem)	Extremities (mrem)	Whole Body (mrem)	Extremities (mrem)
Facility Operating Personnel	8	17	63	549	246	968
Key Facility Research Personnel	0	<1	0	24	0	70
Facilities Services Maintenance Personnel	<1	N/A	10	N/A	10	N/A
Laboratory Class Students	<1	<1	23	107	86	367
Campus Police and Security Personnel	<1	N/A	12	N/A	23	N/A
Visitors	<1	N/A	8	N/A	81	N/A

(1) "N/A" indicates that there was no extremity monitoring conducted or required for the group.

Table V.D.1

Total Dose Equivalent Recorded on Area Dosimeters Located
Within the TRIGA Reactor Facility

Monitor I.D.	TRIGA Reactor Facility Location (See Figure V.D.1)	Total Recorded Dose Equivalent[(1)(2)]	
		$x\beta(\gamma)$ (mrem)	Neutron (mrem)
MRCTNE	D104: North Badge East Wall	101	ND
MRCTSE	D104: South Badge East Wall	60	ND
MRCTSW	D104: South Badge West Wall	259	ND
MRCTNW	D104: North Badge West Wall	50	ND
MRCTWN	D104: West Badge North Wall	60	ND
MRCTEN	D104: East Badge North Wall	266	ND
MRCTES	D104: East Badge South Wall	538	ND
MRCTWS	D104: West Badge South Wall	253	ND
MRCTTOP	D104: Reactor Top Badge	276	ND
MRCTHXS	D104A: South Badge HX Room	282	ND
MRCTHXW	D104A: West Badge HX Room	94	ND
MRCD-302	D302: Reactor Control Room	139	ND
MRCD-302A	D302A: Reactor Supervisor's Office	24	N/A
MRCBP1	D104: Beam Port Number 1	44	ND
MRCBP2	D104: Beam Port Number 2	89	ND
MRCBP3	D104: Beam Port Number 3	678	ND
MRCBP4	D104: Beam Port Number 4	348	ND

(1) The total recorded dose equivalent values do not include natural background contribution and, reflect the summation of the results of four quarterly beta-gamma dosimeters or four quarterly fast neutron dosimeters for each location. A total dose equivalent of "ND" indicates that each of the dosimeters during the reporting period was less than the vendor's gamma dose reporting threshold of 10 mrem or that each of the fast neutron dosimeters was less than the vendor's threshold of 10 mrem. "N/A" indicates that there was no neutron monitor at that location.

(2) These dose equivalent values do not represent radiation exposure through an exterior wall directly into an unrestricted area.

Table V.D.2

Total Dose Equivalent Recorded on Area Dosimeters
Located Within the Radiation Center

Monitor I.D.	Radiation Center Facility Location (See Figure V.D.1)		Total Recorded Dose Equivalent[1]	
			xβ(γ) (mrem)	Neutron (mrem)
MRCA100	A100:	Receptionist's Office	10	N/A
MRCBRF	A102H:	Front Personnel Dosimetry Storage Rack	ND	N/A
MRCA120	A120:	Stock Room	ND	N/A
MRCA120A	A120A:	NAA Temporary Storage	ND	N/A
MRCA126	A126:	Campus RSO's Isotope Receiving Lab	212	N/A
MRCCO-60	A128:	^{60}Co Irradiator Room	272	N/A
MRCA130	A130:	Shielded Exposure Room	ND	N/A
MRCA132	A132:	TLD Equipment Room	ND	N/A
MRCA134-2	A134:	Graduate Student Office	27[2]	N/A
MRCA138	A138:	Health Physics Laboratory	ND	N/A
MRCA146	A146:	Gamma Analyzer Room (Storage Cave)	ND	N/A
MRCB100	B100:	Gamma Analyzer Room (Storage Cave)	23	N/A
MRCB114	B114:	α Lab (^{226}Ra Storage Facility)	1,412	83
MRCB119-1	B119:	Source Storage Room	182	N/A
MRCB119-2	B119:	Source Storage Room	405	N/A
MRCB119A	B119A:	Sealed Source Storage Room	4222	1908
MRCB120	B120.	Instrument Calibration Facility	ND	N/A
MRCB122-2	B122:	Radioisotope Storage Hood	ND	N/A
MRCB122-3	B122:	Radioisotope Research Laboratory	ND	N/A
MRCB124-1	B124:	Radioisotope Research Lab (Hood)	ND	N/A
MRCB124-2	B124:	Radioisotope Research Laboratory	ND	N/A
MRCB124-6	B124:	Radioisotope Research Laboratory	ND	N/A
MRCB128	B128:	Instrument Repair Shop	ND	N/A
MRCC100	C100:	Radiation Center Director's Office	ND	N/A
MRCC106A	C106A:	Staff Lunch Room	ND	N/A
MRCC106B	C106:	Solvent Storage Room	ND	N/A
MRCC106-H	C106H:	East Loading Dock	ND	N/A

See footnotes following the table.

Table V.D.2 (continued)

Total Dose Equivalent Recorded on Area Dosimeters
Located Within the Radiation Center

Monitor I.D.	Radiation Center Facility Location (See Figure V.D.1)		Total Recorded Dose Equivalent(1)	
			$x\beta(\gamma)$ (mrem)	Neutron (mrem)
MRCC118	C118:	Radiochemistry Laboratory	18	N/A
MRCC120	C120:	Student Counting Laboratory	ND	N/A
MRCF100	F100:	APEX Facility	ND	N/A
MRCF102	F102:	APEX Control Room	ND	N/A
MRCB125N	B125:	Gamma Analyzer Room (Storage Cave)	ND	N/A
MRCB125S	B125:	Gamma Analyzer Room	ND	N/A
MRCC124	C124:	Student Computer Laboratory	ND	N/A
MRCC130-1	C130:	Radioisotope Laboratory (Hood)	ND	N/A
MRCD100	D100:	Reactor Support Laboratory	165	N/A
MRCD102	D102:	Pneumatic Transfer Terminal Lab	116	ND
MRCD102-H	D102H:	1st Floor Corridor at D102	38	ND
MRCD106-H	D106H:	1st Floor Corridor at D106	111	N/A
MRCD200	D200:	Reactor Administrators's Office	157	ND
MRCD202	D202:	Senior Health Physicist's Office	167	ND
MRCBRR	D200H:	Rear Personnel Dosimetry Storage Rack	ND	N/A
MRCD204	D204	Health Physicist Office	104	ND
MRCF104	F104:	ATHRL	ND	ND
MRCD300	D300:	3rd Floor Conference Room	94	ND

(1) The total recorded dose equivalent values do not include natural background contribution and, except as noted, reflect the summation of the results of 4quarterly beta-gamma dosimeters or four quarterly fast neutron dosimeters for each location. A total dose equivalent of "ND" indicates that each of the dosimeters during the reporting period was less than the vendor's gamma dose reporting threshold of 10 mrem or that each of the fast neutron dosimeters was less than the vendor's threshold of 10 mrem. "N/A" indicates that there was no neutron monitor at that location.

(2) The room was only monitored for one quarter of this report.

Table V.D.3

Annual Summary of Radiation Levels and Contamination Levels Observed Within the Reactor Facility and Radiation Center During Routine Radiation Surveys

Accessible Location (See Figure V.D.1)	Whole Body Radiation Levels (mrem h⁻¹)		Contamination Levels[1] (dpm/100 cm²)	
	Average	Maximum	Average	Maximum
TRIGA Reactor Facility:				
Reactor Top (D104)	1	80	<500	<1800
Reactor 2nd Deck Area (D104)	5	23	<500	<500
Reactor Bay SW (D104)	<1	3	<500	<800
Reactor Bay NW (D104)	<1	4	<500	<1800
Reactor Bay NE (D104)	<1	32	<500	1800
Reactor Bay SE (D104)	<1	5	<500	<600
Class Experiments (D104, D302)	<1	2	<500	<500
Demineralizer Tank--Outside Shielding (D104A)	<1	2	<500	<500
Particulate Filter--Outside Shielding (D104A)	<1	3	<500	<500
Radiation Center:				
NAA Counting Rooms (A146, B100, C134)	<1	<1	<500	<500
Health Physics Laboratory (A138)	<1	<1	<500	<500
^{60}Co Irradiator Room and calibration rooms (A128, A130, B120)	<1	3	<500	<500
Radiation Research Labs (B108, B114, B122, B124, C130, C132A)	<1	<1	<500	<500
Radioactive Source Storage (A120A, B119, B119A)	<1	2	<500	<500
Student Chemistry Laboratory (C118)	<1	<5	<500	<500
Student Counting Laboratory (C120)	<1	<1	<500	<500
Operations Counting Room (B136, C123)	<1	<1	<500	<500
Pneumatic Transfer Laboratory (D102)	<1	2	<500	<1600
TRIGA Tube Wash Room (D100)	<1	<1	<500	<500

(1) <500 dpm/100 cm² = Less than the lower limit of detection for the portable survey instrument used.

Table V.E.1

Total Dose Equivalent at the TRIGA Reactor Facility Fence

Fence Environmental Monitoring Station (See Figure V.E.1)	Total Recorded Dose Equivalent (Including Background) Based on ICN TLDs(1) (mrem)	Total Recorded Dose Equivalent (Including Background) Based on OSU TLDs(2)(3) (mrem)	Total Calculated Dose Equivalent (Including Background) Based on the Annual Average μrem h^{-1} Dose Rate(3) (mrem)
MRCFE-1	93 ± 10	65 ±6	74 ± 9
MRCFE-2	83 ± 3	61 ±6	70 ± 9
MRCFE-3	77 ± 3	62 ± 6	60 ± 11
MRCFE-4	85 ± 4	68 ± 10	66 ± 17
MRCFE-5	82 ± 3	61 ± 6	66 ± 8
MRCFE-6	84 ± 4	64 ± 7	70 ± 16
MRCFE-7	81 ± 3	62 ± 6	67 ± 11
MRCFE-8	81 ± 2	61 ± 6	63 ± 9
MRCFE-9	80 ± 3	60 ± 6	67 ± 9

(1) Average Corvallis area natural background using ICN TLDs totals 71 ± 5 mrem for the same period.

(2) OSU fence totals include a measured natural background contribution of 63 ± 6 mrem.

(3) ± values represent the standard deviation of the total value at the 95% confidence level.

Table V.E.2

Total Dose Equivalent at the Off-Site Gamma Radiation Monitoring Stations

Off-Site Radiation Monitoring Station[1] (See Figure V.E.2)	Total Recorded Dose Equivalent (Including Background) Based on ICN TLDs[2] (mrem)	Total Recorded Dose Equivalent (Including Background) Based on OSU TLDs[3][4] (mrem)	Total Calculated Dose Equivalent (Including Background) Based on the Annual Average µrem/h Exposure Rate[4] (mrem)
MRCTE-2L	---	56 ± 7	50 ± 11
MRCTE-3	88 ± 3	57 ± 6	64 ± 10
MRCTE-4	79 ± 2	95 ± 37	55 ± 8
MRCTE-5L	---	57 ± 6	70 ± 16
MRCTE-6	80 ± 4	53 ± 5	66 ± 15
MRCTE-7L	---	54 ± 6	77 ± 11
MRCTE-8	89 ± 3	59 ± 6	74 ± 10
MRCTE-9	76 ± 4	51 ± 5	64 ± 6
MRCTE-10	78 ± 3	89 ± 25	58 ± 7
MRCTE-12	84 ± 3	63 ± 9	69 ± 10
MRCTE-13L	---	56 ± 8	62 ± 13
MRCTE-14L	---	53 ± 6	53 ± 15
MRCTE-15	72 ± 4	53 ± 4	48 ± 8
MRCTE-16L	---	65 ± 6	64 ± 8
MRCTE-17	81 ± 3	66 ± 5	58 ± 8
MRCTE-18L	---	59 ± 6	60 ± 8
MRCTE-19	79 ± 2	64 ± 5	76 ± 11
MRCTE-20L	---	59 ± 4	66 ± 11
MRCTE-21	69 ± 3	55 ± 7	47 ± 10
MRCTE-22	74 ± 5	5 ± 7	53 ± 10

(1) Monitoring stations coded with an "L" contained one standard OSU TLD pack only. Stations not coded with an "L" contained, in addition to the OSU TLD pack, one ICN TLD monitoring pack.

(2) Average Corvallis area natural background using ICN TLDs totals 71 ± 5 mrem for the same period.

(3) OSU off-site totals include a measured natural background contribution of 63 ± 6 mrem.

(4) ± values represent the standard deviation of the total value at the 95% confidence level.

Table V.E.3

Annual Average Concentration of the Total Net Beta Radioactivity (Minus ^3H) for Environmental Soil, Water, and Vegetation Samples

Sample Location (See Figure V.E.2)	Sample Type	Annual Average Concentration of the Total Net Beta (Minus ^3H) Radioactivity[1]	Reporting Units
1-W	Water	1.02E-07 ± 9.70E-08[2]	µCi ml^{-1}
4-W	Water	1.02E-07 ± 4.16E-09[2]	µCi ml^{-1}
11-W	Water	4.01E-07 ± 1.33E-06[2]	µCi ml^{-1}
19-RW	Water	4.01E-07 ± 1.33E-06[2]	µCi ml^{-1}
3-S	Soil	3.85E-05 ± 6.65E-05	µCi g^{-1} of dry soil
5-S	Soil	2.33E-05 ± 4.54E-05	µCi g^{-1} of dry soil
20-S	Soil	2.65E-05 ± 4.15E-05	µCi g^{-1} of dry soil
21-S	Soil	4.20E-05 ± 2.54E-05	µCi g^{-1} of dry soil
2-G	Grass	3.73E-04 ± 1.05E-04	µCi g^{-1} of dry ash
6-G	Grass	2.43E-04± 2.62E-04	µCi g^{-1} of dry ash
7-G	Grass	3.91E-04 ± 9.65E-05	µCi g^{-1} of dry ash
8-G	Grass	3.41E-04 ± 1.26E-04	µCi g^{-1} of dry ash
9-G	Grass	3.07E-04 ± 1.64E-05	µCi g^{-1} of dry ash
10-G	Grass	1.26E-04 ±6.83E-05	µCi g^{-1} of dry ash
12-G	Grass	3.34E-04 ± 1.47E-04	µCi g^{-1} of dry ash
13-G	Grass	2.35E-04 ±2.23E-04	µCi g^{-1} of dry ash
14-G	Grass	1.95E-04 ± 2.84E-04	µCi g^{-1} of dry ash
15-G	Grass	1.63E-04 ± 1.49E-04	µCi g^{-1} of dry ash
16-G	Grass	1.71E-04 ± 1.44E-04	µCi g^{-1} of dry ash
17-G	Grass	2.58E-04 ± 7.56E-05	µCi g^{-1} of dry ash
18-G	Grass	1.98E-04 ± 1.60E-04	µCi g^{-1} of dry ash
22-G	Grass	2.91E-04 ± 3.22E-04	µCi g^{-1} of dry ash

(1) ± values represent the standard deviation of the average value at the 95% confidence level.

(2) Less than lower limit of detection value shown.

Table V.E.4

Average LLD Concentration and Range of LLD Values for
Soil, Water, and Vegetation Samples

Sample Type	Average LLD Value	Range of LLD Values	Reporting Units
Soil	1.19E-05	9.60E-06 *to* 1.47E-05	μCi g^{-1} of dry soil
Water	2.99E-07	6.08E-08 *to* 1.42E-06	μCi ml^{-1}
Vegetation	3.50E-05	1.33E-05 *to* 1.33E-04	μCi g^{-1} of dry ash

Table V.F.1

Annual Summary of Radioactive Material Shipments Originating From the TRIGA Reactor Facility's NRC License R-106

Shipped To	Total Activity (TBq)	Number of Shipments			
		Limited Quantity	Yellow II	Yellow III	Total
Berkeley Geochronology Center Berkeley, CA USA	6 86E-06	9	1	0	10
Brigham Young University Provo, UT USA	6.95E-07	1	0	0	1
California Institute of Technology Pasadena, CA USA	3.05E-05	2	0	0	2
Columbia University Palisades, NY USA	5.98E-06	5	0	0	5
General Dynamics Scottsdale, AZ USA	2.67E-06	6	0	0	6
Georgia Tech Atlanta, GA USA	1.13E-07	1	0	0	1
Idaho State University Pocatello, ID USA	4 02E-05	0	8	0	8
Oregon State University Corvallis, OR USA	1.94E-05	1	5	0	6
PCC Structurals, Inc. Portland, OR USA	5.64E-07	1	0	0	1
Plattsburgh State University Plattsburgh, NY USA	1.45E-06	3	0	0	3
Stanford University Stanford, CA USA	1.91E-05	3	1	0	4
Synetix Houston, TX USA	0.00E+00	1	0	0	1
Syracuse University Syracuse, NY USA	4.07E-06	2	1	0	3
Union College Schenectady, NY USA	2.56E-06	5	0	0	5
University of California at Berkeley Berkeley, CA USA	7.69E-06	2	0	0	2

Table V.F.1

Annual Summary of Radioactive Material Shipments Originating From the TRIGA Reactor Facility's NRC License R-106

Shipped To	Total Activity (TBq)	Number of Shipments			
		Limited Quantity	Yellow II	Yellow III	Total
University of California at Santa Barbara Santa Barbara, CA USA	2.56E-06	6	0	0	6
University of Nevada Las Vegas Las Vegas, NV USA	5.64E-07	1	0	0	1
University of Wisconsin-Madison Madison, WI USA	2.11E-05	2	2	0	4
University of Wyoming Laramie, WY USA	1.10E-06	2	0	0	2
Totals	1.67E-04	53	18	0	71

Table V.F.2

Annual Summary of Radioactive Material Shipments Originating From the Radiation Center's State of Oregon License ORE 90005

Shipped To	Total Activity (TBq)	Number of Shipments				
		LSA - 1	Limited Quantity	White I	Yellow II	Total
Argonne National Lab Argonne, IL USA	6.01E-08	1	1	0	0	2
Lawrence Berkeley National Laboratory Berkeley, CA USA	1.35E-09	2	1	0	0	3
Oregon State University Corvallis, OR USA	5.75E-04	0	3	1	0	4
PCC Structurals, Inc. Portland, OR USA	9.28E-08	0	1	0	0	1
Radiation Protection Services Portland, OR USA	8.43E-07	0	2	0	0	2

Table V.F.2

Annual Summary of Radioactive Material Shipments Originating From the Radiation Center's State of Oregon License ORE 90005

Shipped To	Total Activity (TBq)	Number of Shipments				
		LSA - 1	Limited Quantity	White I	Yellow II	Total
Reed College Portland, OR USA	5.73E-07	0	1	0	0	1
Totals	5.76E-04	3	9	1	0	13

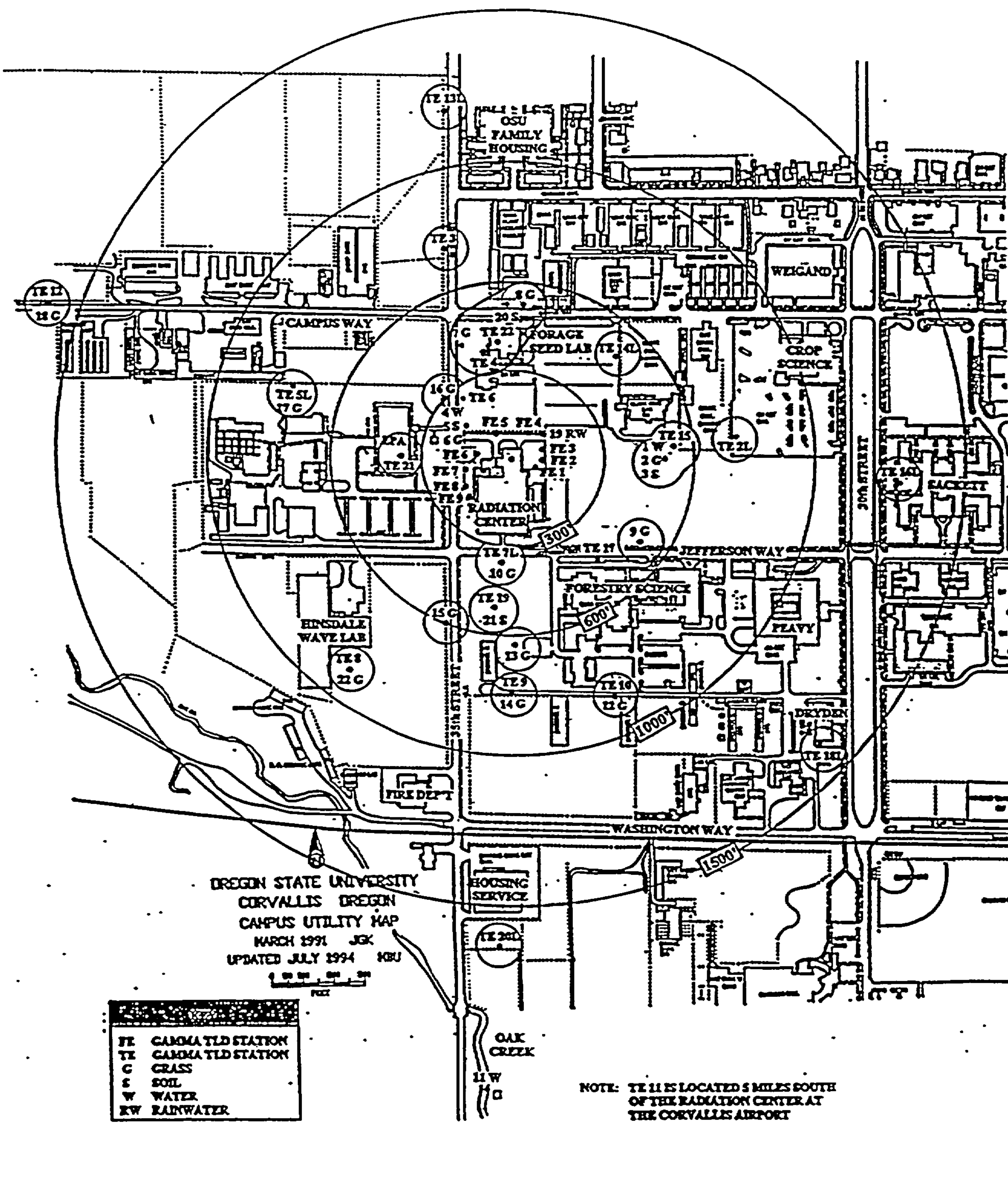
Table V.F.3

Annual Summary of Radioactive Material Shipments Exported
Under NRC General License 10 CFR 110.23

Shipped To	Total Activity (TBq)	Number of Shipments			
		Limited Quantity	Yellow II	Yellow III	Total
FAPIG Radiation Research Laboratory Ltd. Yokosuka Kanagawa, JAPAN	4.14E-07	1	0	0	1
Freiburg University Zurich, Switzerland	2.17E-07	1	0	0	1
Geological Institute Copenhagen K, Denmark	3.65E-07	1	0	0	1
Ruhr-Universitat Bochum Bochum, GERMANY	4.15E-07	1	0	0	1
Scottish Universities Research and Reactor Centre East Kilbride, SCOTLAND	1.75E-06	0	1	0	1
Universita' Degli Studı di Bologna Bologna, ITALY	5.50E-07	1	0	0	1
Universitat Potsdam Postdam, GERMANY	4.67E-07	4	0	0	4
Universitat Tubingen Tubingen, GERMANY	1.07E-06	2	0	0	2
Universite Paris-Sud Paris, FRANCE	2.43E-06	0	1	0	1
University of Manchester Manchester, UK	1.14E-06	1	0	0	1
University of Montpellier Montpellier, FRANCE	1.95E-06	2	0	0	2
University of Queensland Brisbane, Australia	5.78E-07	1	1	0	2
University of Queensland Brisbane, Queensland AUSTRALIA	1.36E-06	1	1	0	2
University of Tuebingen Tuebingen, GERMANY	1.16E-10	1	0	0	1
Vrije Universiteit Amsterdam, THE NETHERLANDS	1.56E-06	0	2	0	2
Totals	1.43E-05	17	6	0	23

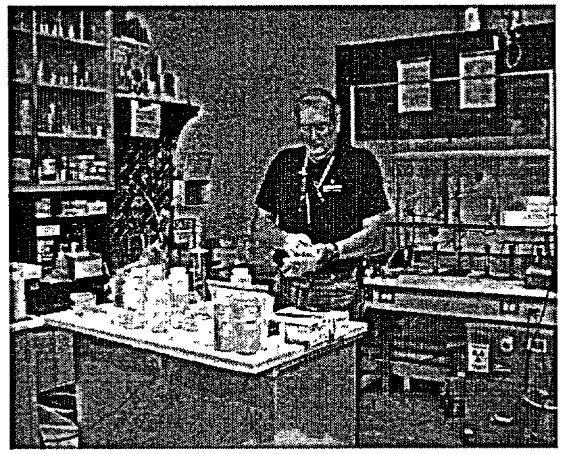
Figure V. D. 1

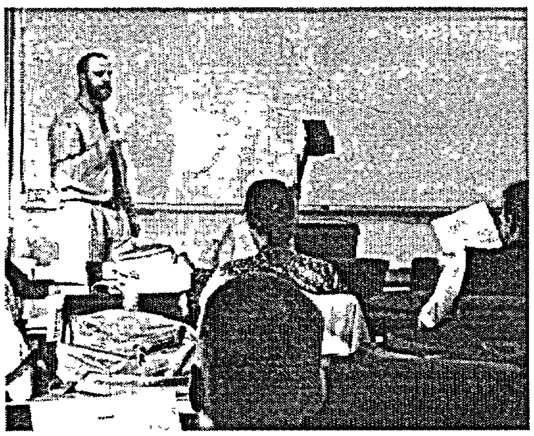
Monitoring Stations for the OSU TRIGA Reactor



Part VI

Work





Part VI

WORK

A. Summary

The Radiation Center offers a wide variety of resources for teaching, research, and service related to radiation and radioactive materials. Some of these are discussed in detail in other parts of this report. The purpose of this part is to summarize the teaching, research, and service efforts carried out during the current reporting period.

B. Teaching

An important responsibility of the Radiation Center and the reactor is to support OSU's academic programs. Implementation of this support occurs through direct involvement of the Center's staff and facilities in the teaching programs of various departments and through participation in University research programs. For example, during the current reporting period, the Radiation Center accommodated 119 academic classes involving a number of different academic departments from OSU and other Oregon universities. The OSU teaching programs (not including research) utilized 724 hours of reactor time. Tables III.A.1 and III.D.1 plus Section VI.C.5 provide more detailed information on the use of the Radiation Center and reactor for instruction and training.

C. Research and Service

Almost all Radiation Center research and service work is tracked by means of a project database. When a request for facility use is received, a project number is assigned and the project is added to the database. The database includes such information as the project number, data about the person and institution requesting the work, information about students involved, a description of the project, Radiation Center resources needed, the Radiation Center project manager, status of individual runs, billing information, and the funding source.

Table VI.C.1 provides a summary of institutions which used the Radiation Center during this reporting period. This table also includes additional information about the number of academic personnel involved, the number of students involved, and the number of uses logged for each organization. Details on graduate student research which used the Radiation Center are given in Table VI.C.2.

The major table in this section is Table VI.C.3. This table provides a listing of the research and service projects carried out during this reporting period and lists information relating to the personnel and institution involved, the type of project, and the funding agency. Projects which used the reactor are indicated by an asterisk. In addition to identifying specific projects carried out during the current reporting period, Part VI also highlights major Radiation Center capabilities in research and service. These unique Center functions are described in Sections VI.C.1 through VI.C.8.

1. Neutron Activation Analysis

Neutron activation analysis (NAA) stands at the forefront of techniques for the quantitative multi-element analysis of major, minor, trace, and rare elements. The principle involved in NAA consists of first irradiating a sample with neutrons in a nuclear reactor such as the OSTR to produce specific radionuclides. After the irradiation, the characteristic gamma rays emitted by the decaying radionuclides are quantitatively measured by suitable semiconductor radiation detectors, and the gamma rays detected at a particular energy are usually indicative of a specific radionuclide's presence. Computerized data reduction of the gamma ray spectra then yields the concentrations of the various elements in samples being studied. With sequential instrumental NAA it is possible to measure quantitatively about 35 elements in small samples (5 to 100 mg), and for activable elements the lower limit of detection is on the order of parts per million or parts per billion, depending on the element.

The Radiation Center's NAA laboratory has analyzed the major, minor, and trace element content of tens of thousands of samples covering essentially the complete spectrum of material types and involving virtually every scientific and technical field.

While some researchers perform their own sample counting on their own or on Radiation Center equipment, the Radiation Center provides a complete NAA service for researchers and others who may require it. This includes sample preparation, sequential irradiation and counting, and data reduction and analysis.

Data on NAA research and service performed during this reporting period are included in Table VI.C.3.

2. Forensic Studies

Neutron activation analysis can also be advantageously used in criminal investigations. The principle underlying such application usually involves matching trace element profiles in objects or substances by NAA. This in turn can help identify materials or products (e.g., identify the manufacturer of a given object), and in some cases can match bullets and other materials recovered from a victim to similar materials obtained from suspects. Materials which have been analyzed by the Radiation Center for forensic purposes include bullets, metals, paint, fuses, coats, glass, meat, and salts.

Forensic studies performed in this reporting period are included in the listings in Tables VI.C.1 and VI.C.3.

3. Irradiations

As described throughout this report, a major capability of the Radiation Center involves the irradiation of a large variety of substances with gamma rays and neutrons. Detailed data on these irradiations and their use during this reporting period are included in Part III as well as in Section C of this part.

4. Radiological Emergency Response Services

The Radiation Center has an emergency response team capable of responding to all types of radiological accidents. This team directly supports the City of Corvallis and Benton County emergency response organizations and medical facilities. The team can also provide assistance at the scene of any radiological incident anywhere in the state of Oregon on behalf of the Oregon Radiation Protection Services and the Oregon Office of Energy.

The Radiation Center maintains dedicated stocks of radiological emergency response equipment and instrumentation. These items are located at the Radiation Center and at the Good Samaritan Hospital.

During the current reporting period, the Radiation Center emergency response team conducted several training sessions and exercises, but was not required to respond to any actual incidents.

During the past year, Radiation Center personnel participated in drills and exercises, and provided advice relating to emergency response to a radiological incident at the Hanford Site in southwestern Washington, but no one was required to respond to a real Hanford emergency.

5. Training and Instruction

In addition to the academic laboratory classes and courses discussed in Parts III.A.2, III.D, and VI.B, and in addition to the routine training needed to meet the requirements of the OSTR Emergency Response Plan, Physical Security Plan, and operator requalification program, the Radiation Center is also used for special training programs. Radiation Center staff are well experienced in conducting these special programs and regularly offer training in areas such as research reactor operations, research reactor management, research reactor radiation protection, radiological emergency response, reactor behavior (for nuclear power plant operators), neutron activation analysis, nuclear chemistry, and nuclear safety analysis.

Special training programs generally fall into one of several categories: visiting faculty and research scientists; International Atomic Energy Agency fellows; special short-term courses; or individual reactor operator or health physics training programs. During this reporting period there were a large number of such people as shown in Part II.B.

As has been the practice since 1985, Radiation Center personnel annually present a HAZMAT Response Team Radiological Course. This year the course was held at the Oregon State University Radiation Center.

6. Radiation Protection Services

The primary purpose of the radiation protection program at the Radiation Center is to support the instruction and research conducted at the Center. However, due to the high quality of the program and the level of expertise and equipment available, the Radiation Center is also able to provide health physics services in support of Radiation Safety and to assist other state and federal agencies. The Radiation Center does not compete with private industry, but supplies health physics services which are not readily available elsewhere. In the case of support provided to state agencies, this definitely helps to optimize the utilization of state resources.

The Radiation Center is capable of providing health physics services in any of the areas which are discussed in Part V. These include personnel monitoring, radiation surveys, sealed source leak testing, packaging and shipment of radioactive materials, calibration and repair of radiation monitoring instruments (discussed in detail in Section VI.C.7), radioactive waste disposal, radioactive material hood flow surveys, and radiation safety analysis and audits.

The Radiation Center also provides services and technical support as a radiation laboratory to the Oregon State Health Division (OSHD) in the event of a radiological emergency within the state of Oregon. In this role, the Radiation Center will provide gamma ray spectrometric analysis of water, soil, milk, food products, vegetation, and air samples collected by OSHD radiological response field teams. As part of the ongoing preparation for this emergency support, the Radiation Center participates in inter-institution drills.

7. Radiological Instrument Repair and Calibration

While repair of nuclear instrumentation is a practical necessity, routine calibration of these instruments is a licensing and regulatory requirement which must be met. As a result, the Radiation Center operates a radiation instrument repair and calibration facility which can accommodate a wide variety of equipment.

The Center's scientific instrument repair facility performs maintenance and repair on all types of radiation detectors and other nuclear instrumentation. Since the Radiation Center's own programs regularly utilize a wide range of nuclear instruments, components for most common repairs are often on hand and repair time is therefore minimized.

In addition to the instrument repair capability, the Radiation Center has a facility for calibrating essentially all types of radiation monitoring instruments. This includes typical portable monitoring instrumentation for the detection and measurement of alpha, beta, gamma, and neutron radiation, as well as instruments designed for low-level environmental monitoring. Higher range instruments for use in radiation accident situations can also be calibrated in most cases. Instrument calibrations are performed using radiation sources certified by the National Institute of Standards and Technology (NIST) or traceable to NIST.

Table VI.C.4 is a summary of the instruments which were calibrated in support of the Radiation Center's instructional and research programs and the OSTR Emergency Plan, while Table VI.C.5 shows instruments calibrated for other OSU departments and non-OSU agencies. Table VI.C.6 shows instruments repaired for non-Radiation Center departments and agencies. It should be noted that the Radiation Center only calibrates and repairs instruments for local, state and federal agencies.

8. Consultation

Radiation Center staff are available to provide consultation services in any of the areas discussed in this Annual Report, but in particular on the subjects of research reactor operations and use, radiation protection, neutron activation analysis, radiation shielding, radiological emergency response, and radiotracer methods.

Records are not normally kept of such consultations, as they often take the form of telephone conversations with researchers encountering problems or planning the design of experiments. Many faculty members housed in the Radiation Center have ongoing professional consulting functions with various organizations, in addition to sitting on numerous committees in advisory capacities.

9. Public Relations

The continued interest of the general public in the OSTR is evident by the number of people who have toured the facility. In addition to many unscheduled visitors and interested individuals who stopped in without appointments because they were in the vicinity, a total of 128 scheduled tours including 1,499 people were given during this reporting period. See Table VI.F.1 for statistics on scheduled visitors.

Table VI.C.1

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
*Oregon State University(1) Corvallis, OR USA	79	38	11	210(2)
*Crescent Valley High School Corvallis, OR USA	2	1	0	1
*Linn Benton Community College Albany, OR USA	1	0	0	3
*Marist High School Eugene, OR USA	1	0	0	1
*McKay High School Salem, OR USA	1	0	0	1
Osmotek Albany, OR USA	1	1	0	1
*PCC Structurals, Inc. Portland, OR USA	1	0	0	5
*Eddyville High School Eddyville, OR USA	1	1	0	1
*Fall City High School Fall City, OR USA	1	1	0	1
*Grants Pass High School Grants Pass, OR USA	1	1	0	1
*Jefferson High School Jefferson, OR USA	1	1	0	1
*Philomath High School Philomath, OR USA	1	1	0	1
Providence St. Vincent Hospital Portland, OR USA	1	0	0	11
*Reed College Portland, OR USA	1	1	0	1
*Sheridan School District Sheridan, OR USA	1	1	0	1
*Thurston High School Springfield, OR USA	1	1	0	1
*Wheeler County Sheriff's Office Fossil, OR USA	1	0	0	2

* Project which involves the OSTR.

Table VI.C.1 (continued)

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
Army Corps of Engineers Portland, OR USA	1	0	0	2
AVI Biopharma Corvallis, OR USA	1	0	0	1
ESCO Corporation Portland, OR USA	1	0	0	6
Evanite Fiber Corp Corvallis, OR USA	1	0	0	1
Federal Aviation Administration Portland, OR USA	1	0	0	5
Good Samaritan Hospital Corvallis, OR USA	1	0	0	7
Hot Cell Services Kent, WA USA	1	0	0	4
Josephine County Public Works Oregon, USA	1	0	0	1
Kirner Consulting Tacoma, WA USA	1	0	0	1
Occupational Health Laboratory Portland, OR USA	1	0	0	1
Oregon Office of Energy Salem, OR USA	1	0	0	31
Oregon Department of Transportation Salem, OR USA	1	0	0	1
Oregon Health Sciences University Portland, OR USA	1	0	0	22
Oregon Public Utilities Commission Salem, OR USA	1	0	0	5
Oregon State Health Division Salem, OR USA	1	0	0	58
Rogue Community College Grants Pass, OR USA	1	0	0	1
USDA Agricultural Research Station Oregon, USA	1	0	0	1

* Project which involves the OSTR

Table VI.C.1 (continued)

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
USDA Agricultural Research Station Oregon, USA	1	0	0	1
U.S. Environmental Protection Agency Newport, OR USA	2	0	0	5
Valley Landfills, Inc. Corvallis, OR USA	1	0	0	2
Veterinary Diagnostic Imaging Cytopathology Clackamas, OR USA	1	0	0	1
*Double Hat Enterprises Idaho Falls, ID USA	1	0	0	1
*Idaho State University Pocatello, ID USA	1	1	1	4
*Liberty Christian High School Richland, WA USA	1	0	0	1
*Berkeley Geochronology Center Berkeley, CA USA	1	0	4	19
*California Institute of Technology Pasadena, CA USA	1	1	0	3
M.K. Gems and Minerals La Habra, CA USA	1	0	0	1
*Stanford University Stanford, CA USA	2	2	0	4
*University of California at Berkeley Berkeley, CA USA	3	3	1	2
*University of California at Davis Davis, CA USA	1	0	0	1
*University of California at Santa Barbara Santa Barbara, CA USA	2	2	5	8
*University of Nevada Las Vegas Las Vegas, NV USA	1	1	0	1
*Brigham Young University Provo, UT USA	1	1	1	1
*University of Wyoming Laramie, WY USA	1	1	2	2

* Project which involves the OSTR.

Table VI.C.1 (continued)

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
*General Dynamics Scottsdale, AZ USA	1	0	0	7
*University of California at Los Angeles Los Angeles, California	1	1	1	1
*Brigham Young University Provo, Utah	2	2	2	4
*University of Wyoming Laramie, Wyoming	1	1	2	3
*General Dynamics Scottsdale, AZ USA	1	0	0	7
*Geovic Ltd. Grand Junction, CO USA	1	0	0	3
*University of Houston Houston, TX USA	1	1	2	1
*University of Wisconsin Madison, WI USA	2	2	5	7
*International Titanium Powder Lockport, IL USA	1	0	0	1
*University of Michigan Ann Arbor, MI USA	1	1	0	1
*Wayne State University Detroit, MI USA	1	1	0	1
*Georgia Institute of Technology Atlanta, GA USA	1	1	0	2
Mississippi State University Mississippi State, MS USA	1	0	0	1
*Columbia University Palisades, NY USA	3	3	3	5
*George Washington University Washington, DC USA	1	1	2	2
*North Carolina State University Raleigh, NC USA	2	2	3	3
*Plattsburgh State University Plattsburgh, NY USA	2	2	3	3

* Project which involves the OSTR

Table VI.C.1 (continued)

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
*Syracuse University Syracuse, NY USA	1	1	3	4
*Union College Schenectady, NY USA	2	2	0	4
*University of Georgia Aiken, SC USA	1	1	1	1
*University of Florida Gainesville, FL USA	2	2	0	2
*FAPIG Radiation Research Laboratory Ltd. Yokosuka Kanagawa, JAPAN	1	0	0	1
*Scottish Universities Research and Reactor Centre East Kilbride, SCOTLAND	1	1	15	2
*University of Manchester Manchester, UK	1	1	1	1
*Universite Paris-Sud Paris, FRANCE	1	1	0	1
*University of Montpelier Montpelier, FRANCE	1	0	0	3
*Vrije Universiteit Amsterdam, THE NETHERLANDS	1	1	4	2
*Albert-Ludwigs-Universitaet Freiburg, GERMANY	1	0	0	3
*Geological Institute Copenhagen, DENMARK	1	0	0	1
*Guzzi Dental Services Milano, ITALY	1	0	0	1
*Ruhr-Universitat Bochum Bochum, GERMANY	1	1	0	2
*Universita'Degli Studi di Bologna Bologna, ITALY	1	2	0	1
*Universitat Potsdam Potsdam, GERMANY	1	0	0	5
*Universitat Tubingen Tubingen, GERMANY	1	1	0	1

* Project which involves the OSTR.

Table VI.C.1 (continued)

Institutions and Agencies Which Utilized the Radiation Center

Institution	Number of Projects	Number of Faculty Involved	Number of Students Involved	Number of Uses of Center Facilities
*University of Tuebingen Tuebingen, GERMANY	1	1	3	1
*University of Queensland Brisbane, Queensland AUSTRALIA	1	1	0	2
Total	172	55	93	519

10. Use by Oregon State University does not include any teaching activities or classes accommodated by the Radiation Center.

11. This number does not include ongoing projects being performed by residents of the Radiation Center such as the APEX project, others in the Department of Nuclear Engineering or Department of Chemistry, or projects conducted by Dr. W. D. Loveland, which involve daily use of Radiation Center facilities.

* Project which involves the OSTR.

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
Berkeley Geochronology Center					
Culler, Timothy	PhD	Earth and Planetary Science	Alvarez	920	Lunar Impact History from Analysis of Impact Melt Spherules
Knight, Kimberly	MA	Earth and Planetary Science	Renne	920	Geochemical and Isotopic Insights into Continental Flood Basalts
Kyoungwon, Min	MA	Earth and Planetary Science	Renne	920	Reduction of Systematic Errors in 40Ar/39Ar Geochronology
Zhou, Zhensheng	MA	Earth and Planetary Science	Renne	920	Rates and Tempo of Permian-Triassic Boundary Events.
Brigham Young University					
Hae Hae, Kevin	MS	Geology	Kowallis	335	Subsidence and Uplift History of the Uinta Basin from Apatite Fission Track Analysis
Columbia University					
Machlus, Malka	PhD	Earth Sciences	Olsen	1267	Milankovitch cyclicity in the Eocene Green River Formation, including dating tuff beds within the formation by Ar-Ar dating.
Young, Amy	PhD	UCLA Geology	Turrin	1423	Petrology and geochemical evolution of the Damavand trachyandesite volcano in northern Iran.
Zhong, Jian	MS	Geosciences	Hanson	1553	The Grain Size and Provenance of Long Island Loess
Idaho State University					
Scarberry, Kaleb	MS	Geology	Hughes	1588	

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
North Carolina State University					
McCarter, Renee	MS	Departmnt of Marine, Earth, and Atmospheric Sci	Fodor	1559	Crystallization and compositional evolution of basaltic reservious, Mauna Loa volcano, Hawaii: petrology of gabbroic xenoliths.
Oregon State University					
Hart, Kevin	MS	Radiation Health Physics	Higley	1589	Determination of Scanning Detection Efficiency
Huang, Zhongliang	PhD	Chemistry	Loveland	1598	
Mankowski, Mark	PhD	Forest Products	Morrell	815	Biology of Carpenter Ants in the Pacific Northwest and its Relationship with Fungal Decay in Buildings
Sinton, Christopher	PhD	Oceanography	Duncan	444	Age and Composition of Two Large Igneous Provinces: The North Atlantic Volcanic Rifted Margin and the Caribbean Plateau
Stone, Jennifer	PhD	Chemistry		1580	
Villamar, Glenda	MS	Nuclear Engineering & Radiation Health Physics	Higley	1593	Determination of radiosensitivity of ovarian cells in hamsters.
Scottish Universities Research and Reactor Centre					
Barry, T.	PhD	Leicester University	Pringle	1073	Mongolian Basalts/Tectonics
Blecher, J.	PhD	Oxford University	Pringle	1073	Aden Volcanic Differentiation
Carn, S.	PhD	Cambridge University	Pringle	1073	Indonesian Volcanics

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
Chambers, L.	PhD	Edinburgh University	Pringle	1073	North Atlantic Tertiary Province
Dixon, H.	PhD	Bristol University	Pringle	1073	Subglacial Volcanics
Harford, C.	PhD	Bristol University	Pringle	1073	Montserrat Volcanic Hazards
Heath, E.	PhD	Lancaster University	Pringle	1073	St. Vincent Volcano Hazards
May, G.	PhD	Aberdeen University	Pringle	1073	Chilean Basins
McElderry, S.	PhD	Liverpool University	Pringle	1073	Chilean Tertiary Faulting
Najman, Y.	PhD	Edinburgh University	Pringle	1073	Himalayan Foredeep
Purvis, M.	PhD	Edinburgh University	Pringle	1073	Turkish Basin Tectonics
Shelton, R.	PhD	Queens University	Pringle	1073	North Channel Basin Evolution
Sowerbutts, A.	PhD	Edinburgh University	Pringle	1073	Sardinia Evolution
Steele, G.	PhD	Aberdeen University	Pringle	1073	Cerro Rico Silver
White, R.	PhD	Leicester University	Pringle	1073	Caribean Crustal Growth

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
Syracuse University					
Kline, Simon	MS	Earth Sciences	Fitzgerald	1555	Uplift of the Transantarctic Mountains in the Reedy Glacier area
Monteleone, Brian	PhD	Earth Sciences	Fitzgerald	1555	Papua New Guinea Woodlark Basin Project
Schwabe, Erika	PhD	Earth Sciences	Fitzgerald	1555	Exhumation in the western Pyrenees
University of California at Berkeley					
Patin, Joshua	PhD	College of Chemistry	Hoffman	1468	Study of Production Mechanisms in Heavy Ion Actinide and Lead Target Reactions
University of California at Santa Barbara					
Calvert, Andy	PhD	Geological Sciences	Gans	1020	Tectonic Studies in Eastern-Most Russia
Nauert, Jon	MS	Geological Sciences	Gans	1020	Volcanism in the Eldorado Mountains, Southern Nevada
University of Geneva					
Rapaille, Cedric	PhD	Mineralogy	Marzoli	1413	Le Filon de Messejana (Espagne et Portugal): Pétrologie et Géochronologie
University of Georgia					
Tostowaryk, Tracy	MS	Radiological Health Sciences	Whicker	1475	The elimination and assimilation of cesium by freshwater invertebrates
University of Manchester					
Flude, Stephanie	PhD	Earth Sciences	Burgess	1592	Rhyolite volcanism in Iceland: timing and timescales of eruption

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
University of Tuebingen					
Angelmaier, Petra	PhD	Institut fur Geologie und Palaotologie	Dunkl	1519	Exhumation path of different tectonic blocks along the central part of the Transalp-Traverse (Eastern Alps).
Most, Thomas	PhD	Institut fur Geologie und Palaontologie	Dunkl	1519	Mesozoic and Tertiary Tectonometamorphic Evolution of Pelagonian Massif
Schwab, Martina	PhD	Institut fur Geologie und Palaontologie	Dunkl	1519	Thermochronology and Structural Evolution of Pamir Mts.
University of Wisconsin					
Barquero-Molina, Miriam	PhD	Geology and Geophysics	Singer	1612	
Harper, Melissa	MS	Geology and Geophysics	Singer	1612	
Jicha, Brian	MS	Geology and Geophysics	Singer	1612	
Jicha, Brian	MS	Geology and Geosciences	Singer	1465	
Relle, Monica	MS	Geology and Geophysics	Singer	1465	
University of Wyoming					
Beland, Peter	MS	Geology and Geophysics	Murphy	321	
McMillan, Beth	PhD	Geology and Geophysics	Murphy	321	

Table VI.C.2

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Department	Faculty Advisor	Project	Thesis Topic
Vrije Universiteit					
Beintema, Kike	PhD	Department of Structural Geology	White/Wijbrans	1074	The Kinematics and Evolution Major Structural Units of the Archean Pilbara Craton, Western Australia
Carrapa, Barbara	MA	Isotope Geochemistry	Wijbrans/Bertotti	1074	The tectonic record of detrital minerals on sun-orogenics clastic sediments
Kuiper, Klaudia	PhD	Isotope Geochemistry	Hilgen/Wijbrans	1074	Intercalibration of astronomical and radioisotopic timescales

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
321	Murphy	University of Wyoming	Fission Track Dating	Thermal column irradiations of apatite and zircon samples for fission track production to determine rock age.	University of Wyoming
335	Kowallis	Brigham Young University	Fission Track Dating	Dating of natural rocks and minerals via fission track methodology.	National Science Foundation
444	Duncan	Oregon State University	Ar-40/Ar-39 Dating of Oceanographic Samples	Production of Ar-39 from K-39 to measure radiometric ages on basaltic rocks from ocean basins.	OSU Oceanography Department
481	Le	Oregon Health Sciences University	Instrument Calibration	Calibration of radiation survey instruments.	Oregon Health Sciences University
488	Farmer	Oregon State University	Instrument Calibration	Calibration of portable radiation survey instruments for radiation users on OSU campus.	OSU Radiation Center
519	Martin	US Environmental Protection Agency	Instrument Calibration	Calibration of portable radiation survey meters using the standard RC protocol.	USEPA-Corvallis
521	Vance	University of Washington	Fission Track Studies	Thermal column irradiation of zircon and other samples to induce fission tracks in catcher foils for dating.	University of Washington
547	Boese	US Environmental Protection Agency	Survey Instrument Calibration	Calibration of GM and other portable survey meters as per standard OSU protocol.	USEPA, Cincinnati, OH
664	Reese	Oregon State University	Good Samaritan Hospital Instrument Calibration	Calibration of radiation survey instruments.	OSU Radiation Center
665	Reese	Oregon State University	Corvallis Fire Department Instrument Calibration	Calibration of radiation survey instruments.	OSU Radiation Center

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
815	Morrell	Oregon State University	Sterilization of Wood Samples	Sterilization of wood samples to 2.5 Mrads in Co-60 irradiator for fungal evaluations.	OSU Forest Products
920	Becker	Berkeley Geochronology Center	Ar-39/Ar-40 Age Dating	Production of Ar-39 from K-39 to determine ages in various anthropologic and geologic materials.	Berkeley Geochronology Center
930	McWilliams	Stanford University	Ar-40/Ar-39 Dating of Geological Samples	Irradiation of mineral grain samples for specified times to allow Ar-40/Ar-39 dating.	Stanford University Geological & Environmental Sci
932	Dumitru	Stanford University	Fission Track Dating	Thermal column irradiation of geological samples for fission track age-dating.	Stanford University Geology Department
1018	Gashwiler	Occupational Health Lab	Calibration of Nuclear Instruments	Calibrate radiation survey meters.	Occupational Health Laboratory
1020	Gans	University of California at Santa Barbara	Tectonic Studies in Eastern-Most Russia	Irradiation for Ar-40/Ar-39 dating using the CLICIT or dummy fuel element.	National Science Foundation
1072	Rasmussen	Army Corps of Engineers	Instrument Calibration	Calibration of radiation detection instruments.	U.S Army Engineer District, Portland.
1073	Pringle	Scottish Universities Research and Reactor Centre	Argon 40/39 Dating of Rock Minerals	Age dating of various materials using the Ar-40/Ar-39 ratio method.	Scottish Universities Research and Reactor Centre
1074	Wijbrans	Vrije Universiteit	40Ar-39 Ar Dating of Rocks and Minerals	40Ar-39Ar dating of rocks and minerals.	Vrije Universiteit, Amsterdam

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1075	Lederer	University of California at Berkeley	Activation Analysis Experiment for NE Class	Irradiation of small, stainless steel discs for use in a nuclear engineering radiation measurements laboratory.	University of California at Berkeley
1118	Larson	Oregon State University	Primary Phytoplankton Production Studies at Crater Lake	Evaluation of the primary production of phytoplankton in Crater Lake and lakes in Mount Rainier, Olympic, and North Cascades National Parks.	US Geological Survey
1127	Numata	FAPIG Radiation Research Laboratory Ltd.	Kyoto Fission Track Age Dating	Irradiation of samples in the thermal column for fission track age dating.	FAPIG Radiation Research Laboratory
1188	Salinas	Rogue Community College	Photoplankton Growth in Southern Oregon Lakes	C-14 liquid scintillation counting of radiotracers produced in a photoplankton study of southern Oregon lakes: Miller Lake, Lake of the Woods, Diamond Lake, and Waldo Lake.	Rogue Community College
1191	Vasconcelos	University of Queensland	Ar-39/Ar-40 Age Dating	Production of Ar-39 from K-39 to determine ages in various anthropologic and geologic materials.	Earth Sciences, University of Queensland
1267	Hemming	Columbia University	Geochronology by Ar/Ar Methods	Snake River plain sanidine phenocrysts to evaluate volcanic stratigraphy; sandine and biotite phenocrysts from a late Miocene ash, Mallorca to more accurately constrain stratigraphic horizon; hornblends and feldspar from the Amazon to assess climatic changes and differences in Amazon drainage basin provenance.	Columbia University

INAA = Instrumental Neutron Activation Analysis   REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1290	Kahn	M. K. Gems and Minerals	Mineral Irradiations	Irradiations of various minerals to evaluate colorization effects.	M. K. Gems & Minerals
1302	Niles	Oregon Office of Energy	Calibration of Emergency Response Instruments	Routine calibration of radiological monitoring instruments associated with the Oregon Office of Energy's programs supporting HazMat and other emergency response teams.	Oregon Office of Energy
1352	Niles	Oregon Office of Energy	General Consultation	Radiological and radioactive material transport consulting services	Oregon Office of Energy
1354	Wright	Radiation Protection Services	Radiological Instrument Calibration	Routine calibration of radiological monitoring instruments.	Oregon Health Division
1359	Niles	Oregon Office of Energy	State Laboratory Support	Maintenance of state radiological monitoring support capability, including QA, counting standards and calibrations of gamma spectrometer systems for measuring low lradioactivities in environmental and foodstuff samples.	Oregon Office of Energy
1366	Quidelleur	Universite Paris-Sud	Ar-Ar Geochronology	Determination of geological samples via Ar-Ar radiometric dating.	Universite Paris-Sud
1376	Proebsting	Oregon State University	Genetics of Peas	Produce deletion mutants of peas on the SN and NP genes	OSU Horticulture
1390	Bottomley	Oregon State University	Soil Study	Soil Study	OSU Crop and Soil Science

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1397	Teach	Providence St. Vincent Hospital	Sterilization of various biological materials	Sterilization of various biological materials for St. Vincents Hospital, Portland	Oregon Medical Laser Institute
1399	Olander	University of California at Berkeley	Volatilization of uranium material	Irradiation of vapor from depleted uranium loaded on resin and heated to high temperatures in reducing atmosphere. U-235 in vapor deposits fissions; U-238 absorbs neutrons. Gamma ray spectrometry determines amount of uranium volatilized.	University of California at Berkeley
1404	Riera-Lizarau	Oregon State University	Evaluation of wheat DNA	Gamma irradiation of wheat seeds	OSU Crop and Soil Science
1406	Pate	Tracerco	Production of Argon-41	Production of Argon-41 for various field uses	Tracerco
1413	Webb	University of Geneva	Argon Geochronology	Ar-39/Ar-40 dating of pure mineral and whole rock separates.	University of Geneva
1415	McGinness	ESCO Corporation	Calibration of Instruments	Instrument calibration	ESCO Corporation
1417	Loveland	Oregon State University	Production of Radionuclides for LBNL	Various radionuclides will be produced for research to be conducted at LBNL.	OSU Chemistry / Loveland DOE
1423	Turrin	Columbia University	40Ar/39Ar Analysis	Petrology and geochemical evolution of the Damavand trachyandesite volcano in Northern Iran.	Columbia University
1424	Yasinko	Tru-Tec	Argon 41 Production	Irradiation of argon gas to produce argon 41.	Tru-Tec

INAA = Instrumental Neutron Activation Analysis   REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1430	Bottomley	Oregon State University	Atrazine Remediation in a Wetland Environment	Characterization of fate of atrazine in wetland mesocoms and a constructed wetland; investigation of presence of atrazine degrading microorganisms in rhizosphere soil.	OSU Microbiology Department
1431	Stein	AVI Bio Pharma	Instrument Calibrations	Instrument calibration	AVI Bio Pharma
1464	Slavens	USDOE Albany Research Center	Instrument Calibration	Instrument calibration	USDOE Albany Research Center
1465	Singer	University of Wisconsin	Ar-40/Ar-39 Dating of Young Geologic Materials	CLICIT irradiation of geological materials such as volcanic rocks from sea floor, etc. for Ar-40/Ar-39 dating.	University of Wisconsin
1467	Kirner	Kirner Consulting, Inc	Instrument Calibration	Instrument calibration	Kirner Consulting
1468	Nitsche	University of California at Berkeley	Chemistry 146 Experiment	Sample irradiation	University of California at Berkeley
1470	Bolken	SIGA Technologies, Inc.	Instrument Calibration	Instrument calibration	Siga Pharmaceuticals
1473	Alarcon	Becton Dickenson Technologies	Gamma Irradiations	Gamma Irradiation to 5k, 3k, & 2k.	Becton Dickenson Technologies
1475	Hinton	University of Georgia	Cesium Cycling in a Freshwater Ecosystem	Cesium transfer rates among ecosystem components are being determined in a freshwater ecosystem. Stable cesium was added to the entire pond and the dynamics are being followed using INAA to assay the cesium.	Savannah River Ecology Laboratory

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1479	Paul	Oregon State University	Biological Toxin Sensor	Multidisciplinary development of a biological toxin sensor using arethrophore cells for the Defense Advanced Research Projects Agency.	OSU Industrial & Manufacturing Engineering
1486	Hockmuth	General Dynamics	Irradiation of Electronic Components	Study radiation effects on electronic components for the Nuclear and Space Radiation Effects Group	Motorola
1488	Gartner	Oregon State University	Determinants of sapwood quantity and composition	Sterilization of wood cores from tree stems to 3 Megarads.	OSU Forest Products
1489	Roden-Tice	Plattsburgh State University	Thermochronologic evidence linking Adirondack and New England regions Connecticut Valley Regions	The integration of apatite fission-track ages and track length based model thermal histories, zircon fission-track ages, and U-Th/He analyses to better define the pattern of regional post-Early Cretaceous differential unroofing in northeastern New York's Adirondack region and adjacent western New England.	Plattsburgh State University
1492	Stiger	Federal Aviation Administration	Instrument Calibration	Instrument calibration	Federal Aviation Administration
1494	Hall	Oregon State University	Flux Measurements in OSTR Irradiation Facilities	Measurement of the thermal, epithermal, and fast fluxes in the various OSTR irradiation facilities	OSU Radiation Center

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1497	Dick	Oregon State University	Tracing C-13 Signatures from Pine Litter Raised under Elevated CO2 into Soil C Storage Pools	Using pine litter as a tracer for C into soil pools, looking for C sequestered from a set amount of pine litter. Will put the litter into EPA terracosm chambers. Need to sterilize pine needles.	OSU Crop and Soil Science
1502	Teaching and Tours	Portland Community College	Portland Community College Tours/Experiments	Reactor tour and half life experiment.	USDOE Reactor Sharing
1503	Teaching and Tours	Oregon State University	Non-class related tours	Non-class related tours.	OSU Radiation Center
1504	Teaching and Tours	Oregon State University	OSU Nuclear Engineering class tours	OSU Nuclear Engineering class tours.	USDOE Reactor Sharing
1505	Teaching and Tours	Oregon State University	OSU Chemistry class tours	OSU Chemistry class tours.	USDOE Reactor Sharing
1506	Teaching and Tours	Oregon State University	OSU Geosciences class tours	OSU Geosciences class tours.	USDOE Reactor Sharing
1507	Teaching and Tours	Oregon State University	OSU Physics class tours	OSU Physics class tours.	USDOE Reactor Sharing
1508	Teaching and Tours	Oregon State University	Adventures in Learning class tours	Adventures in Learning class tours.	USDOE Reactor Sharing
1509	Teaching and Tours	Oregon State University	HAZMAT course tours	First responder training tours.	Oregon Office of Energy
1510	Teaching and Tours	Oregon State University	SMILE	Science and Mathematics Investigative Learning Experience tours.	USDOE Reactor Sharing
1511	Teaching and Tours	Oregon State University	Reactor Staff Use	Reactor operation required for conduct of operations testing, operator training, calibration runs, encapsulation tests and other.	OSU Radiation Center

INAA = Instrumental Neutron Activation Analysis   REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1512	Teaching and Tours	Linn Benton Community College	Linn Benton Community College Tours/Experiments	Reactor tour and half life experiment.	USDOE Reactor Sharing
1513	Ayres	Oregon State University	Absorption of Pharmaceuticals in the Colon	Pharmaceuticals tagged with Sm-153 are used to determine their absorption in the colon.	OSU Pharmacy
1514	Sobel	Universitat Potsdam	Apatite Fission Track Analysis	Age determination of apatites by fission track analysis.	Universitat Potsdam
1516	McConica	Oregon State University	Analysis of Fouled Harvester Engine Pistons	Residue from severely fouled harvester engine pistons was analyzed by INAA to determine silicon and metals content.	Chemical Engineering
1517	Parikh	Mississippi State University	Evaluation of Treated 'OSB' Boards Against Brown Rot Fungi and White Rot Fungi	After sterilization of 'OSB' Blocks, the blocks will be placed in fungi to determine the biocide toxic threshold level.	Mississippi State University
1519	Dunkl	University of Tuebingen	Fission Track Analysis of Apatites	Fission track dating method on apatites: use of fission tracks from decay of U-238 and U-235 to determine the cooling age of apatites.	University of Tuebingen
1520	Teaching and Tours	Western Oregon University	Reactor tours	Reactor tour and half life experiment.	USDOE Reactor Sharing
1522	Control Room	Oregon State University	General Reactor Operation	Reactor operation when no other project is involved.	OSU Radiation Center
1523	Zattin	Universita' Degli Studi di Bologna	Fission track analysis of apatites	Fission track analysis of apatites.	Universita' Degli Studi di Bologna
1524	Thomson	Ruhr-Universitat Bochum	Fission track analysis of apatites and zircon	Fission track analysis of apatites and zircon.	Ruhr-Universitat Bochum

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1525	Teaching and Tours	Life Gate High School	Production of Al for T1/2 lab	Tour of OSTR.	USDOE Reactor Sharing
1526	Crawford	Hot Cell Services	Instrument calibration	Calibration of radiation detectors.	Hot Cell Services
1527	Teaching and Tours	Oregon State University	Odyssey orientation class	Introduction to OSU, including tour of OSU Radiation Center.	USDOE Reactor Sharing
1528	Teaching and Tours	Oregon State University	Upward Bound	Upward Bound recruitment program for prospective science and engineering majors.	USDOE Reactor Sharing
1529	Teaching and Tours	Oregon State University	OSU Connect	Orientation program for new students.	USDOE Reactor Sharing
1530	Teaching and Tours	Newport Elementary Schools	Reactor tour	Tour of OSTR.	USDOE Reactor Sharing
1531	Teaching and Tours	Central Oregon Community College	Reactor tour	Tour of OSTR.	USDOE Reactor Sharing
1532	Binney	Oregon State University	Development of a Neutron Activation Analysis Program for the McClellan Nuclear Radiation Center	Assistance will be provided to help the MNRC set up a neutron activation analysis program. NAA courses will be taught, software will be developed, and suggestions will be made to implementation of the program.	University of California Davis
1533	Teaching and Tours	Oregon State University	Groups or Organizations from Educational Institutions	Tours of OSTR for individual groups or organizations associated with educational institutions other than academic courses.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis

REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1534	Teaching and Tours	Oregon State University	Student Recruitment Tours	Reactor tours for the purpose of student recruitment into OSU academic programs.	USDOE Reactor Sharing
1535	Teaching and Tours	Corvallis School District	Center for Alternative Learning tours	Reactor tours.	USDOE Reactor Sharing
1536	Nuclear Engineering Faculty	Oregon State University	Gamma Irradiations for NE/RHP 114/115/116	Irradiation of samples for Introduction to Nuclear Engineering and Radiation Health Physics courses NE/RHP 114/115/116.	OSU Radiation Center
1537	Teaching and Tours	Oregon State University	Naval Science tours	Tour of OSTR by Naval Science classes.	USDOE Reactor Sharing
1538	Teaching and Tours	Oregon State University	OSTR tours	Tour of the OSTR.	USDOE Reactor Sharing
1539	Most	Universitat Tubingen	Fission track studies	Age dating by the fission track method.	Universitat Tubingen
1540	Teaching and Tours	McKay High School	Reactor Tours	Tour of the OSTR.	USDOE Reactor Sharing
1541	Teaching and Tours	Crescent Valley High School	Reactor Tours	Tour of OSTR.	USDOE Reactor Sharing
1542	Teaching and Tours	Oregon State University	OSTR tours for Engineering Sciences classes	Tours of the OSTR.	USDOE Reactor Sharing
1543	Bailey	Veterinary Diagnostic Imaging & Cytopathology	Instrument Calibration	Calibration of radiation detection instrumentation.	Veterinary Diagnostic Imaging & Cytopathology
1544	Teaching and Tours	West Albany High School	Reactor tours and experiments	Tour of the OSTR and half life experiment.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1545	Teaching and Tours	Oregon State University	OSTR Tours	Tours of the OSTR.	USDOE Reactor Sharing
1546	Istok	Oregon State University	Elimination of microorganism activity in groundwater	Gamma irradiation to eliminate microorganism activity in groundwater samples.	OSU Civil, Constr., and Environmental Engineering
1547	Poklemba	U.S. Department of Agriculture	Mutations in lolium tenulentum flowering	Mutations in lolium tenulentum ("Ceres") to affect flowering.	Agricultural Research Service
1548	Teaching and Tours	Willamette Valley Community School	Reactor tours and experiments	Tour of the OSTR.	USDOE Reactor Sharing
1549	Giovannoni	Oregon State University	Irradiation of Vivaspin concentrators	Gamma irradiation of Vivaspin concentrators to destroy any contaminating DNA.	OSU Microbiology Department
1551	Rizo	Tru-Tec	Production of high-activity solid radionuclides	Production of Na-24 and other solid high activity radionuclides.	Tru-Tec
1552	Higley	Oregon State University	Radioecology Experiment for RHP 488/588	Measurement of radionuclide transport in an aquatic environment.	USDOE Reactor Sharing
1553	Hemming	Columbia University	Provenance of Long Island Loess	Dating of single grain Muscovite and biotite in Long Island loess by Ar/Ar method and correlating mica ages with possible hinterland.	USDOE Reactor Sharing
1554	Fleischer	Union College	Fission Track Irradiations		USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis

REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1555	Fitzgerald	Syracuse University	Fission track thermochronology	Irradiation to induce U-235 fission for fission track thermal history dating, especially for hydrocarbon exploration. The main thrust is towards tectonics, in particular the uplift and formation of mountain ranges.	Syracuse University
1556	Karchesy	Oregon State University	Determination of chlorine in wood products	The objective of this study is to determine the concentration of chlorine in plywood products.	USDOE Reactor Sharing
1557	Garver	Union College	Fission Track Age Dating	Use of fission tracks from U-235 to determine the location and concentration of U-238 in zircon crystals to determine the fission track age of unknown samples.	USDOE Reactor Sharing
1558	Binney	Oregon State University	Measurement of cross sections for medical radionuclides	Irradiations to measure neutron cross sections for medically important radionuclides.	USDOE
1559	Fodor	North Carolina State University	Petrochemistry of gabbros and basalts from the Mauna Loa volcano, Hawaii	Analysis of gabbro and basalt samples from Mauna Loa volcano in Hawaii.	USDOE Reactor Sharing
1560	Enochs	Oregon State University	Assessment of Age Dating Potential of Petrified Wood	Chemical analyses of petrified wood samples from Ashwood Oregon. The objective of this project is to determine potassium and uranium in order to evaluate possible radiometric methods for absolute dating.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis   REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1561	Hertel	Georgia Institute of Technology	Comparison of response of tissue equivalent ion chambers	Comparison of the response of a tissue equivalent ion chamber with a boron-loaded tissue equivalent ion chamber.	USDOE Reactor Sharing
1562	Mueller	University of Florida	Evolution of continental crust in the northern Wyoming province	Trace element analyses along with internally generated isotopic and major element analyses to understanding the evolution of continental crust in the northern Wyoming province.	USDOE Reactor Sharing
1563	Jones	Xerox Corporation	Xerox stainless steel analysis	INAA of stainless steel used in Xerox Corporation print head manufacturing.	Xerox Corporation, Wilsonville
1564	Krane	Oregon State University	Measurement of Tb-160 neutron capture cross section	Measurement of Tb-160 neutron capture cross section by irradiation of Tb-159 to produce Tb-161.	USDOE Reactor Sharing
1565	Tollo	George Washington University	Petrology and geochemistry of Mesoproterozoic basement, Blue Ridge Province, VA	NAA for petrologic study of granitoids and gneisses from the basement core of the Blue Ridge anticlinorium in northern VA.	USDOE Reactor Sharing
1566	Dolan	Oregon State University	Irradiation of soil cores to degrade chlorinated solvents	Irradiation of asceptically acquired soil cores from an in situ treatment process site to degrade chlorinated solvents.	OSU Civil, Constr., and Environmental Engineering
1567	Johnson	University of Houston	Compositions of apatites from magnetite-rich segregation deposits in the Cornucopia stock, NE Oregon	Study of chemical composition of apatites from magnetite deposits in Cornucopia stock to determine processes responsible for their genesis.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis

REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1568	Spell	University of Nevada Las Vegas	Ar/Ar dating of rocks and minerals	Irradiation of rocks and minerals for Ar/Ar dating to determine eruption ages, emplacement histories, and provenances studies.	University of Nevada Las Vegas
1569	Barrett	PCC Structurals, Inc.	Investigation of voids in titanium	INAA to determine the composition of voids in titanium ingots	PCC Structurals, Inc.
1570	Jacobsen	International Titanium Powder	Analysis of titanium samples	Analysis of titanium samples for chlorine and sodium	International Titanium Powder
1571	Hansen	Geological Institute	Fission track analysis	Study of East Greenland contionental margin to determine thermotectonic evolution as an aid in understanding rifting and opening of a continental volcanic margin with formation of a new ocean.	Geological Institute
1572	Wheatcroft	Oregon State University	Uranium Ore Counting on a HPGe	Counting uranium ore samples to determine the activity of different isotopes.	OSU COAS
1573	Baxter	California Institute of Technology	Ar partitioning experiments	Measurement of the partitioning of noble gases between crystals and grain boundaries.	California Institute of Technology
1574	Lampi	Osmotek	Sterilization of Nutrients	Sterilization of hydration bags containing nutrients.	Osmotek
1575	Staton	GlaxoSmithKline	Production of Sm-153	Production of Sm-153 for use as a radiopharmaceutical.	GlaxoSmithKline
1577	Li	Wayne State University	The study of antibacterial activity in penile implant animal model	To evaluate the anti-infective efficacy of antibiotic-coated bioflex strips as a surrogate for the penile prosthesis.	Wayne State University

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1578	Monie	University of Montpellier	Fission Track Analysis of U-235	Use of fission tracks from U-235 to determine the uranium content in minerals.	University of Montpellier
1579	Leisy	Oregon State University	Evaluation of Bacillus spores as an immunogen in rainbow trout	Fish will be immunized with Bacillus subtilis spores and challenged with virulent infectious hematopoietic necrosis virus (IHNV) to test for immunization against IHNV. All experiments will be conducted at the OSU Salmon Disease Laboratory.	OSU Microbiology Department
1580	Keszler	Oregon State University	Analysis of tourmaline	INAA of a tourmaline crystal.	USDOE Reactor Sharing
1581	Thompson	Philomath High School	Short Activation Analysis of Peat	Short activation analysis of peat samples from Wilsonville.	USDOE Reactor Sharing
1582	Madson	Double Hat Enterprises	Gemstone irradiation	Irradiation of gemstones to produce color change.	Stacey Madson
1583	Teaching and Tours	Neahkahnie High School	Reactor tours	Tour of OSTR.	USDOE Reactor Sharing
1584	Teaching and Tours	Reed College	Tours for Reactor Staff	Tours for Reed College reactor staff and trainees.	USDOE Reactor Sharing
1585	Krane	Oregon State University	Measurement of Yttrium Cross Sections	Measurement of the Y-91 cross section by neutron activation.	USDOE Reactor Sharing
1586	Krane	Oregon State University	Measurement of Sulfur Cross Sections	Measurement of S-37 cross section by neutron activation.	USDOE Reactor Sharing
1587	Poniar	Oregon State University	Trace metals analysis of amber	Determination of trace metals in amber for identification of origin point	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1588	Hughes	Idaho State University	NAA Series 02-03	Thesis research under GEOL 650 for MS degree. Kaleb Scarberry.	USDOE Reactor Sharing
1589	Higley	Oregon State University	Scan Efficiency Calibration Factor Determination Using a Rb-86 Point Source	Production of a Rb-86 calibration source that is used in the determination of scanning detection efficiency for area sources.	USDOE Reactor Sharing
1590	Slavens	USDOE Albany Research Center	Determination of Uranium & Thorium Content in Tech Norm	Determination of natural uranium, thorium, and radium in slurry waste from former zirconium metals processing. Purpose is to determine waste characterization.	USDOE Albany Research Center
1591	Guzzi	Guzzi Dental Services	Analysis of Dental Alloy	The trace element concentration of dental amalgam powder is determined by INAA.	Gianpaolo Guzzi
1592	Burgess	University of Manchester	Ar-Ar dating of Icelandic rhyolites	Nuclear irradiation of rock chips in cadmium-lined irradiation facility for Ar-Ar dating studies of Icelandic rhyolites.	University of Manchester
1593	Higley	Oregon State University	Irradiation of Hamster Cells	Irradiation of hamster ovarian cells that have the S1P molecule incorporated into them to test for increased radioprotection of the cells.	OSU Radiation Center
1594	Teaching and Tours	Jefferson High School	OSTR tours	Tour of the OSTR and half life experiment.	USDOE Reactor Sharing
1595	Rahn	Albert-Ludwigs-Universitaet	Fission Track Dating of the Mid-European Rhine Graben Shoulder	Dating of the shoulder uplift along the Mid-European Rhine graben shoulders by the fission track technique.	German Science Foundation

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1596	Roeske	University of California at Davis	Geochemistry of clinopyroxene and whole rock samples, Brooks Range, Alaska	Determination of the trace element composition of clinopyroxene and whole rock samples of a high grade metamorphic terrane near the Brooks Range, Alaska.	USDOE Reactor Sharing
1597	Reese	Oregon State University	Neutron Radiography	Neutron radiography of airplane components and related material.	Precision Castparts Corp.
1598	Loveland	Oregon State University	QSAR of organically bound metals	Measurement of octanol/water partition coefficients for a series of chemically related organically bound metals.	OSU Chemistry Department
1599	Minc	University of Michigan	NAA of Iridium Solution	Determination of iridium content in solution through NAA. Samples also contain Na, Br, and Cu.	University of Michigan
1600	Walker	Wheeler County Sheriff's Office	Lead Bullet Analysis	1994 Homicide OSP Case No. 94-182466, 7 mm bullets, Bend OSP Officer Rob Ringsage. Original project # 1089. Two new bullets to be compared to 108901a, b, c (from spine of victim) OSP 94P-566.	Wheeler County, Oregon
1601	Crutchley	Josephine County	Instrument Calibrations	Calibration of instruments.	Josephine County Public Works
1602	Kirsch	Crescent Valley High School	Advanced placement physics class support	This project supports the advanced placement physics class at Cresent Valley High School. It will utilize the reactor for an investigation of arsenic concentrations in soils and bedrock of the Sweet Home area.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress
at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1603	Teaching and Tours	Thurston High School	Reactor tours	Tour of OSTR.	USDOE Reactor Sharing
1604	Buckovic	Geovic Ltd.	Support of Cobalt-Nickel Laterite Analyses	Analysis of Co/Ni in soil samples from Africa.	Geovic, Ltd.
1605	Roden-Tice	Plattsburgh State University	Timing of Movement on the Norumbega Fault System in Southern Maine	Determination if an offset in apatite fission track ages exists along the Norumbega fault in southern Maine.	USDOE Reactor Sharing
1606	McGuire	Oregon State University	Sterilization of Nisin Coated Medical Devices	Exploration of effect of several commericially available sterilization methods on activity of adsorbed nisin, an antimicrobial peptide. Sterilization by ethylene oxide, high temperature, high pressure, and irradition are being investigated.	OSU Radiation Center
1607	Struzik	Polish Academy of Sciences	Timing of uplift and exhumation of Polish Western Carpathians	Determination of timing of uplift and exhumation of Polish Western Carpathians (Tatra Mts. and Podhale Flysch) using AFT methods to verify paleotemperature, which are determined by illite-smectite methods. Reconstruction of thermal history.	Polish Academy of Sciences
1608	Sivaramakrishnan	Oregon State University	Radiation Effects on Gallium Arsenide	Determination of neutron irradiation effects on semiconductors, particularly gallium arsenide.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis　　REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1609	Loveland	Oregon State University	Time-Resolved Laser Spectroscopy	Photophysic determination of olgomeric components of DNA; use of luminescence spectroscopy to investigate the speciation of uranyl ions in aqueous systems.	OSU Chemistry Department
1610	Gans	University of California at Santa Barbara	Ar-Ar geochronology	Age dating of volcanic and plutonic rocks from Sonora, Mexico to determine the timing and magnitude of crustal extension prior to and during the opening of the Gulf of California.	USDOE Reactor Sharing
1611	Teaching and Tours	Grants Pass High School	OSTR tours	Tour of OSTR.	USDOE Reactor Sharing
1612	Singer	University of Wisconsin	Determination of age of Eocene and Quaternary volcanic rocks	Determination of age of Eocene and Quaternary volcanic rocks by production of Ar-39 from K-39.	USDOE Reactor Sharing
1613	Teaching and Tours	Silver Falls School District	OSTR tour	Tour of Radiation Center and OSTR.	USDOE Reactor Sharing
1614	Mosier	Marist High School	OSTR tours	Tour of the OSTR.	USDOE Reactor Sharing
1615	Teaching and Tours	Liberty Christian High School	OSTR tours	Half life experiment and tour.	USDOE Reactor Sharing
1616	Doyle	Evanite Fiber Corporation	Instrument Calibration	Calibration of radiological instruments	Evanite Fiber Corporation
1618	Teaching and Tours	Fall City High School	Tour of OSTR	Tour of OSTR and half life experiment.	USDOE Reactor Sharing
1619	Teaching and Tours	Sheridan School District	Tour of OSTR	Tour of OSTR and half life experiment.	USDOE Reactor Sharing

INAA = Instrumental Neutron Activation Analysis　　REE = Rare Earth Elements

Table VI.C.3

Listing of Major Research and Service Projects Performed or In Progress at the Radiation Center and their Funding Agencies

Project	Users	Organization Name	Project Title	Description	Funding
1620	Teaching and Tours	Eddyville High School	Tour of OSTR	Tour of OSTR and APEX.	USDOE Reactor Sharing
1621	Foster	University of Florida	Irradiation for Ar/Ar Analysis	Ar/Ar analysis of geological samples.	University of Florida
1622	Reese	Oregon State University	Flux Measurements of OSTR	Measurement of neutron flux in various irradiation facilities.	OSU Radiation Center

INAA = Instrumental Neutron Activation Analysis

REE = Rare Earth Elements

Table VI.C.4

Summary of the Types of Radiological Instrumentation Calibrated to Support the OSU TRIGA Reactor and the Radiation Center

Type of Instrument	Number of Calibrations
Alpha Detectors	3
GM Detectors	39
Ion Chambers	10
Micro-R Meters	3
Personal Dosimeters	48
TOTAL	103

Table VI.C.5

Summary of Radiological Instrumentation Calibrated
to Support Other OSU Departments and Other Agencies

Department/Agency	Number of Calibrations
OSU Departments	
Animal Science	4
Biochemistry/Biophysics	7
Botany and Plant Pathology	6
Center for Gene Research	1
Civil, Construction and Environmental Engineering	2
Crop Science	2
Electrical and Chemical Engineering	1
E M T.	6
Exercise and Sport Science	1
Fisheries and Wildlife	1
Food Science	2
Forest Science	3
Horticulture	2
Linus Pauling Institute	2
Microbiology	6
Oceanic and Atmospheric Sciences	1
Pharmacy	4
Physics	5
Radiation Safety	16
R/V Wecoma	1
Veterinary Medicine	8
Zoology	2
OSU Departments Total	83
Non-OSU Agencies	
Army Corps of Engineers	2
AVI Biopharma	1
ESCO Corporation	6
Evanite Fiber Corp	1
Federal Aviation Administration	5
Good Samaritan Hospital	7
Hot Cell Services	4
Josephine County Public Works	1
Kirner Consulting	1
Occupational Health Laboratory	1
Oregon Office of Energy	31
Oregon Department of Transportation	1
Oregon Health Sciences University	22
Oregon Public Utilities Commission	5
Oregon State Health Division	58
Rogue Community College	1
USDA Agricultural Research Service	1
U S Environmental Protection Agency	5
Valley Landfills, Inc	2
Veterinary Diagnostic Imaging Cytopathology	1
Non-OSU Agencies Total	153

Table VI.F.1

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
7/6/2001	1	Laura Wendling
7/6/2001	5	Peterson Family
7/12/2001	19	Adventures in Learning
7/17/2001	16	Adventures in Learning
7/17/2001	12	LBCC Science, Technology and Society
7/17/2001	8	Advisory Committee on Reactor Safeguards
7/18/2001	3	Daniel's Family
7/20/2001	10	OSU GEO 300 Environmental Conservation
7/25/2001	3	Melanie Marshall and Hank and Janice Schvette
7/26/2001	1	Geovic Ltd., Dr. Mark Rose
7/27/2001	10	Mike Cloughesy Friends and Family
8/22/2001	4	Research Showcase with Jim Johnson
8/22/2001	12	REU Physics
8/27/2001	3	Don Peterson's Family
8/29/2001	3	Glaxo-Smith Klein Visitors
9/17/2001	1	Alex Plionis
9/18/2001	9	New Graduate Students
9/20/2001	10	OSU Connect Students
10/4/2001	1	Joe Karchesy
10/5/2001	2	Gail Matheson; photographer
10/8/2001	10	NE 451/551 class
10/8/2001	10	OSU Nuclear Engineering 114
10/10/2001	10	OSU Nuclear Engineering 114

Table VI.F.1

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
10/15/2001	2	Dan Keuter, Dan Denver: NE Advisory Board
10/15/2001	1	Mike Matthews from Varian Technology
10/18/2001	22	COCC Engineering 111
10/25/2001	14	LBCC GS 105
10/25/2001	9	LBCC GS 105
10/26/2001	60	Alumni Tour of ATHRL
11/2/2001	2	George Hedges and Ken Spitzer from WSU
11/7/2001	6	LBCC GS 105
11/15/2001	1	Rachel Engelbrecht from Central Valley High School
11/29/2001	6	Philomath High School students with parents
12/7/2001	4	Jim Barrett-Precision Castparts
1/10/2002	13	OSU CH 462
1/11/2002	30	Reed College Students
1/22/2002	1	Skip Rung
2/12/2002	15	Nuclear Engineering and Radiation Health Physics 482/582
2/14/2002	20	American Water Works Association
2/15/2002	15	Nuclear Engineering and Radiation Health Physics 482/582
2/15/2002	3	Napier Family
2/26/2002	9	High School students
2/27/2002	23	General Science 152
2/27/2002	47	Engineering Students from ENGR 331
2/27/2002	28	High School students
3/5/2002	23	OSU CH 222

Table VI.F.1

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
3/5/2002	20	OSU CH 222
3/5/2002	20	OSU CH 222
3/5/2002	20	OSU CH 222
3/6/2002	25	OSU CH 222
3/6/2002	19	OSU CH 222
3/7/2002	21	OSU CH 222
3/7/2002	22	OSU CH 222
3/7/2002	21	OSU CH 222
3/7/2002	14	OSU CH 222
3/8/2002	4	John Wood, Paul Schmelzenbach, and W. David Kulp, with Ken Krane
3/11/2002	1	David Snelling
3/12/2002	21	OSU CH 222
3/12/2002	18	OSU CH 222
3/12/2002	26	OSU CH 222
3/12/2002	18	OSU CH 222
3/13/2002	24	OSU CH 222
3/13/2002	19	OSU CH 222
3/13/2002	1	Magan Do
3/14/2002	23	OSU CH 222
3/14/2002	25	OSU CH 222
3/14/2002	24	OSU CH 222
3/14/2002	23	OSU CH 222

Table VI.F.1

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
3/15/2002	23	Nelly Juarez and SMILE students
3/15/2002	23	Nelly Juarez and SMILE students
3/15/2002	2	Joel and Ryan Kreitzberg
3/18/2002	20	Crescent Valley Engineering Club
3/22/2002	2	Teri Palmer and Phil Gunner
3/22/2002	3	Keller Family
4/3/2002	2	Dr. Morrie Craig -vet med- and one guest
4/4/2002	20	Crescent Valley Physics Class
4/5/2002	23	Nelly Juarez and SMILE students
4/5/2002	10	Nelly Juarez and SMILE students
4/5/2002	23	Nelly Juarez and SMILE students
4/5/2002	10	Nelly Juarez and SMILE students
4/9/2002	13	Admissions Office Personnel
4/9/2002	12	Admissions Office Personnel
4/11/2002	24	Thurston High School Students
4/17/2002	16	Nuclear Engineering and Radiation Health Physics 116
5/1/2002	7	Neahkahnie High School
5/4/2002	20	Mom's Weekend
5/8/2002	3	Crescent Valley High School
5/8/2002	3	Crescent Valley High School
5/9/2002	5	Crescent Valley High School
5/9/2002	1	Crescent Valley High School
5/9/2002	1	Crescent Valley High School

Table VI.F.1

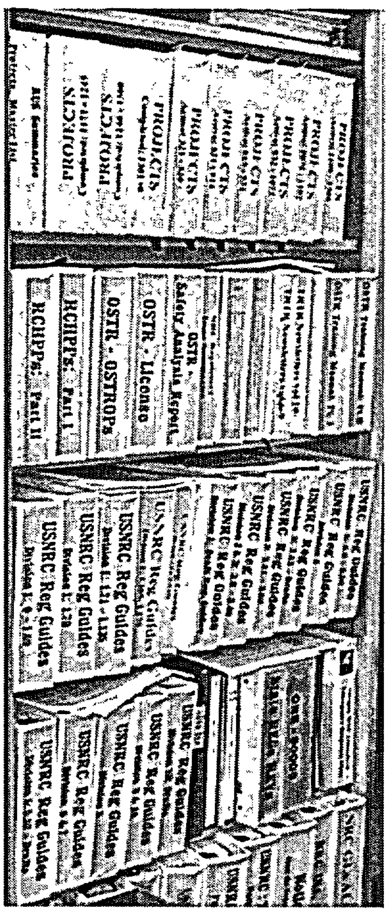
Summary of Visitors to the Radiation Center

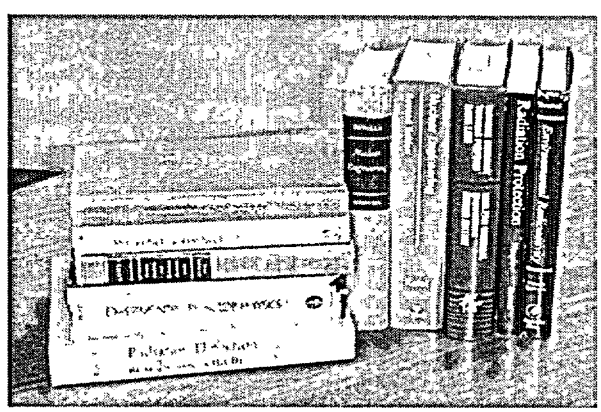
Date	No. of Visitors	Name of Group
5/10/2002	3	Crescent Valley High School
5/10/2002	2	Crescent Valley High School
5/10/2002	1	Crescent Valley High School
5/14/2002	24	Marist High School
5/14/2002	24	Marist High School
5/14/2002	7	John Garver and Graduate Students from Union College
5/15/2002	24	Mark Twain Middle School
5/15/2002	5	Scott Hughes and group
5/17/2002	15	LBCC Science, Technology and Society
5/21/2002	15	Liberty Christian High School
5/23/2002	15	Grants Pass High School
5/30/2002	11	Fall City High School
5/31/2002	16	Sheridan High School
6/4/2002	9	Eddyville High School
6/4/2002	13	West Albany High School
6/6/2002	1	Mike Quinn from Computer Science
6/14/2002	4	Andrea Stout, her parents and boyfriend
6/20/2002	3	Corvallis Fire Department
6/27/2002	25	4H group
6/27/2002	16	4H group

Total Tours: 111 **Total Visitors: 1425**

Part VII

Words





Part VII

WORDS

A. Documents Published or Accepted for Publication

Anderson, R.C., E. Hansen, and J.J. Morrell. 2002. Use of anti-stain chemical treatments by the Western U.S. softwood lumber industry, 1999. Forest Products Journal 52(4):69-71.

*Asfaw, B., H. Gilbert, Y. Beyene, W.K. Hart, P.R. Renne, G. WoldeGabriel, E. Yrba, and T.D. White. 2002. Pleistocene Hominids form Bouri Ethiopia integrate *Homo erectus*: Nature 416:317-320.

*Balestrieri, M.L., M. Bernet, M.T. Brandon, V. Picotti, P. Reiners, and M. Zattin. Pliocene and Pleistocene exhumation and uplift of two key areas of the Northern Apennines. Quaternary International, in press.

*Batt, G.E., M.T. Brandon, K.A. Farley, and M. Roden-Tice. 2001. Tectonic synthesis of Olympic Mountains segment of the Cascadia Wedge, using 2-D thermal and kinematic modeling of thermochronologic ages. Journal of Geophysical Research. V. 106, Part 11, p. 26, 731-26,746.

*Baxter, E.F., D.J. DePaolo, and P.R. Renne. 2002. Spatially correlated anomalous $^{40}Ar/^{39}Ar$ "age" variations in biotites about a lithologic contact near Simplon Pass, Switzerland: A mechanistic explanation for "excess Ar": Geochimica et Cosmochimica Acta 66(6):1067-1083.

*Behrensmeyer, A.K., A.L. Deino, A. Hill, J.D. Kingston, and J.J. Sanders. 2002. Geology and geochronology of the middle Miocene Kipsaramon site complex, Muruyur Beds, Tugen Hills, Kenya: Journal of Human Evolution 42:11-38.

*Beland et al., 2001. Fission track evidence of cooling and exumation of the Wind River Basin, Wyoming. Geological Society of America Meeting, Boston, Massachusetts.

*Bernet, M., M. Zattin, J.I. Garver, M. Brandon, and J.A. Vance. 2001. Steady-state erosion of the European Alps. Geology, 29, 35-38.

*Indicates OSTR use.

Bistacchi A., G.V. Dal Piaz, M. Massironi, M. Zattin, and M.L. Balestrieri. 2001. The Aosta-Ranzola extensional fault system and Oligocene-Present evolution of the Austroalpine-Penninic wedge in the northwestern Alps. International Journal of Earth Sciences, 90, 654-667.

*Blatter, D.L., I.S.E. Carmichael, A.L. Deino, and P.R. Renne. 2001. Neogene volcanism at the front fo the central Mexican volcanic belt: Basaltic andesite to dacite, with contemporaneous shoshonite and high-TiO_2 lava: Geological Society of America Bulletin 113:1324-1342.

*Busby, C.J., G. Yip, L. Blikra, and P.R. Renne. 2002. Coastal landsliding and catastrophic sedimentation triggered by K/T bolide impact: A Pacific margin example?: Geology 30:687-690.

Cahill, J., D. Parry, J.J. Morrell and C.S. Love. 2001. Feasibility of locating a pole remanufacturing facility in the mid-Willamette Valley of Western Oregon. In: Proceedings, Western Energy Institute Utility Pole Conference, October 25-26, 2001, Reno, Nevada. Pages 22-45.

Cavazza W., M. Zattin., B. Ventura. and G.G. Zuffa. Apatite fission-track analysis and Neogene low-temperature thermochronology of northern Corsica (France). Terra Nova, 13, 51-57.

*Davis, L.L., S.S. Hughes, and C. Fleisher. 2001. Characterization of an alkali aluminaborosilicate glass considered for storage of radioactive waste: Environmental Geology, v. 40, n. 7, p. 829-846.

*De Min, A., E.M. Piccirillo, A. Marzoli, G. Bellieni, P.R. Renne, M. Ernesto, and L.S. Marques. The Central Atlantic Magmatic Province in Brazil: Petrogenesis, $^{40}Ar/^{39}Ar$ Ages, Paleomagnetism and Geodynamic Implications: American Geophysical Union Monograph, in press.

*Deino, A.L. and A. Hill. 2002. $^{40}Ar/^{39}Ar$ the Chemeron Formation strata encompassing the site of hominid KNM-BC 1, Tugen Hills, Kenya: Journal of Human Evolution. 42:141-151.

*Deino, A.L., J. Gattacceca, R. Rizzo, and A. Montanari. 2002. $^{40}Ar/^{39}Ar$ dating and paleomagnetism of the Miocene volcanic succession of Monte Furru (western Sardinia): Implications for rotation history the Corsica-Sardinia microplate: Geophysical Research Letters 28:17:3373-76.

*Indicates OSTR use.

*Deino, A.L. and S. McBrearty. 2002. $^{40}Ar/^{39}Ar$ dating of the Kapthurin Formation, Baringo, Kenya: Journal of Human Evolution 42:185-235.

*Deino, A.L., L. Tauxe, M. Monaghan, and A. Hill. 2002. $^{40}Ar/^{39}Ar$ geochronology and paleomagnetic stratigraphy of the Lukeino and lower Chemeron Formations at Tabarin and Kapcheberek, Tugen Hills, Kenya: Journal of Human Evolution 42:117-140.

Fayon, A.K., D.L. Whitney, C. Teyssier, J.I. Garver, and Y. Dilek. 2001. Differential exhumation of an Alpine microcontinent, Central Anatolia, Turkey: Evaluation of rates and mechanisms using FT analysis. Submitted to Earth and Planetary Science Letters, 192, p. 191-205.

Fleischer, R.L. 2002. Solution and defect hardening. In: Intermetallic Compounds- Principles and Practice, v. 3. J.H. Westbrook and R.L. Fleischer, eds., J. Wiley and Sons, Chichester, UK. Chapter 18, p. 351-360.

Fleischer, R.L. 2002. Ion tracks. In: Intermetallic Compounds- Principles and Practice, v. 3. J.H. Westbrook and R.L. Fleischer, eds., J.Wiley and Sons, Chichester, UK, Chapter 14, p. 263-273.

*Fleischer, R.L., S. Fujita and M. Hoshi. 2001. Hiroshima neutron fluence at a glass button from near ground zero. Health Physics 81,720-723.

Fleischer, R.L. 2001. Solid state nuclear track detectors: applications. In: Encyclopedia of Materials Science and Technology. K.H.J. Buschow, R.W. Cahn, M.C. Flemings, B. Ilschner, E.J. Kramer, and S. Mahajan, eds., Pergamon Press. P. 8737-8745.

Fleischer, R.L., S.A. Hadley, N.R. Meyer, J. MacDonald, and A. Cavallo. 2001. Personal radon dosimetry from eyeglass lenses. Radiation Protection Dosimetry 79, 251-258.

Fleischer, R.L. and R.H. Doremus. 2001. Uncertainties in retrospective radon exposure of glass: possible effects of water. Health Physics 81,110-113.

*Fleischer, R.L. 2002. Serendipitous radiation monitors. American Scientist. 90(#4), July-August, 324-331.

*Fodor, R.V., A.N. Sial, G. Gandhoh. 2002. Petrology of spinel peridolite xenoliths from northeastern Brazil: lithosphere with a high geothermal gradient imported by Fernando de Noconha plume. Jour. South American Earth Sciences 15:199-214.

*Indicates OSTR use.

*Fodor, R.V. 2001. The role of tonolite and diouls in Mauna Kea volcano, Hawaiin magmatism: petrology of summit- region leucoratic xenoliths. Jour. Petrology 42:1685-1704.

Frietag, C.M. and J.J. Morrell. 2002. Effect of glycol on movement of borate from fused borate rods. Forest Products Journal 52(6):68-74.

*Freitag, C.M. and J.J. Morrell. 2001. Durability of a changing western red cedar resource. Wood and Fiber Science 33:69-75.

*Garver, J.I. 2002. Discussion: "Metamictization of natural zircon: accumulation versus thermal annealing of radioactivity-induced damage." Contributions to Minerology and Petrology. (In press June 2002).

*Garver, J.I. Etching age standards for fission track analysis: a survey of the methodologies used in active laboratories; Radiation Measurements. Submitted July 2001. Re-submitted March 2002. Accepted June 2002.

*Garver, J.I., and P.J.J. Kamp. 2002. Integration of zircon color and zircon fission track zonation patterns in Orogenic belts: Application of the Southern Alps, New Zealand. Special issue of Tectonophysics on: "Low Temperature Thermochronology: From Tectonics to Landscape Evolution". V. 349, n. 1-4, p. 203-219.

*Geist, D., E. Sims, S.S. Hughes, and M. McCurry. 2002. Open-system evolution of a single cycle of Snake River magmatism, in Link, P.K., and L.L. Mink, eds., Geology, Hydrogeology and environmental Remediation, Idaho National Engineering and Environmental Laboratory, Eastern Snake River Plain: Geological Society of America Special Paper 353, p. 193-204.

*Hansen, K., C.K. Brooks, and S. Bernstein. 2002. Tracking the exhumation history of the East Greenland continental margin north of 72 N. In Barbero, L. and Columbo, F. (eds.) International Workshop on "Fission-track Analysis: Theory and Applications: El Puerto de Santa Maria (Cadiz) 4-7 June 2002, Geotemas 4, 91-92.

*Hansen, H., A.K. Pedersen, R.A. Duncan, D.K. Bird, C.K. Brooks, J.J. Fawcett, J. Gittins, M. Gorton, and P. O'day. 2001. Volcanic stratigraphy of the Southern Prinzen of Wales Bjerge region, East Greenland. Geol. Soc. London, Spec. Publication. In Press.

*Helgason, J. and R.A. Duncan. 2001. Glacial-interglacial history of the Skattafell region, southeast Iceland, 0-5 Ma. Geology, 29:179-182.

*Indicates OSTR use.

Hourigan, J.K., A.V. Soloviev, G.V. Ledneva, J.I. Garver, M.T. Brandon, and P.W. Reiners. 2002 (in press). Dating of syenite intrusion of the eastern slope of Sredinny Range (Kamchatka): implication for exhumation rate of the accretionary complexes. Geochemistry International.

*Hughes, S.S., P.H. Wetmore, and J.L. Casper. 2002. Evolution of Quaternary tholeiitic basalt eruptive centers on the eastern Snake River Plain, Idaho, in Bonnichsen, B., White, C., and McCurry M., eds., Tectonic and magmatic evolution of the Snake River Plain volcanic province: Idaho Geological Survey Bulletin 30, in press.

*Hughes, S.S. and M. McCurry. 2002. Geochemical evidence for time-space evolution of Snake River Plain rhyolites, in Bonnichsen, B., White, C., and McCurry M., eds., Tectonic and magmatic evolution of the Snake River Plain volcanic province: Idaho Geological Survey Bulletin 30, in press.

*Hughes, S.S., M. McCurry, and D.J. Geist. 2002. Geochemical correlations and implications for the magmatic evolution of basalt flow groups at the Idaho National Engineering and Environmental Laboratory, in Link, P.K., and L.L. Mink, eds., Geology, Hydrogeology and Environmental Remediation, Idaho National Engineering and Environmental Laboratory, Eastern Snake River Plain: Geological Society of America Special Paper 353, p. 151-173.

*Ingle, S.P., P.A. Mueller, A.L. Heatherington, and M. Kozuch. Isotopic evidence for the magmatic and tectonic histories of the Carolina terrane: implications for stratigraphy and terrane affiliation. Submitted to Journal of Geology, reviewed and in revision.

J.H. Westbrook and R.L. Fleischer, eds. 2002. Intermetallic Compunds-Principles and Practice. J. Wiley and Sons, Chichester, UK.

*Jun, B., S. Subramanian, A. Peszalksi. 2001. Neutron irradiation effects in high electron mobility transition. IEEE Trans. Nucl. Sci. v. 48, n. 6, p. 2250-2261.

Kirner, N. 2002. Annual ALARA Report for ESCO. Submitted to State of Oregon.

Lebow, S., S. LeVan, J.J. Morrell, and N.D. Christofferson. 2002. Assessment of the treatability of small-diameter grand fir posts. Research Note FPL-RN-0285. U.S.D.A. Forest Service, Forest Products Laboratory, Madison, Wisconsin. 4 pages.

*Indicates OSTR use.

*Lyons, J.O., R.S. Coe, X. Zhao, P.R. Renne, A.Y. Kazansky, A.E. Izokh, L.V. Kungurtsev, and D.V. Mitrokhin. 2002. Paleomagnetism of the early Triassic Semeitau igneous series, eastern Kazakhstan: Journal of Geophysical Research 107:10.1029/2001JB000521.

*Mahoney, J.J. R.A. Duncan, G.R. McCormick and E. Gnos and W. Khan. 2002. Cretaceous volcanic rocks of the Southern Tethya Suture Zone, Pakistan: Implications for the reunion hotspot. Earth Planet. Sci. Letts. In Press.

*Marra, F., C. Freda, P. Scarlato, J. Taddeucci, D.B. Karner, P.R. Renne, M. Gaeta, D.M. Palladino, R. Trigila and G. Cavarretta. $^{40}Ar/^{39}Ar$ Geochronology and Compositional Features of Young Volcanic Rocks from the Alban Hills Volcanic District (Rome, Italy): Evidence of Rejuvenation Volcanism: Bulletin of Volcanology, in press.

*Maughan, L.L., E.H. Christiansen, M.G. Best, C.S. Grommè, A.L. Deino, and D.G. Tingey. 2002. The Oligocene Lund Tuff, Great Basin, USA: a very large volume monotonous intermediate: Journal of Volcanology and Geothermal Research 113:129-157.

*Mertz, D.F. A. Weinrich, W.D. Sharp, and P.R. Renne. 2001. Alkaline intrusions in a near-trench setting, Franciscan Complex, California: Constraints from geochemistry, petrology, and $^{40}Ar/^{39}Ar$ geochronology: American Journal of Science 301(10): 877-911.

Morrell, J.J. 2001. Biodeterioration of wood-based composites and its prevention. Proceedings International Particleboard Symposium, Washington State University, Pullman, Washington. Pages 17-24.

Morrell, J.J. 2002. Protecting untreated wood from wetting. Proceedings American Wood Preservers Association (in press).

Morrell, J.J. 2001. Remedial treatments for wood poles. In: Proceedings, Western Energy Institute Utility Pole Conference, October 25-26, 2001. Reno, Nevada. Pages 97-107.

Morrell, J.J. 2002. Wood-based building components: what have we learned? International Biodeterioration and Biodegradation 49:253-258.

Morrell, J.J. and C.S. Love. 2002. Long term release of chloropicrin in Douglas-fir and western redcedar poles from a controlled release ampule. In: Proceedings 7th International Conference on Utility Line Structure, March 25-27, 2002, Fort Collins, CO. EDM International, Ft. Collins, Colorado.

*Indicates OSTR use.

*Morell, J.J., C.S. Love, R.J. Leichti, and R.J. Scott. 2001. Predicting decay rates in structures: the effects of wood moisture content on decay rate. In: Proceedings Second Annual Conference on Durability and Disaster Mitigation in Wood-Frame Housing. November 6-8, 2000. Madison, WI. Forest Products Society, Madison, WI. Pages 43-49.

*Morrell, J.J., C.S. Love, and C.M. Freitag. 2002. Preventing discoloration of unseasoned hem-fir and Douglas-fir lumber with selected fungicide formulations. Forest Products Journal 52(2):53-61.

Morrell, J.J. and P.I. Morris. 2002. Methods for improving preservative penetration into wood: a review. International Research group on Wood Preservation Document No. IRG/WP/02-40227. Stockholm, Sweden 17 pages.

Morrell, J.J. and R.G. Rhatigan. 2002. Ability of an acoustic inspection device to detect internal voids in untreated pole sections. International Research group on Wood Preservation Document No. IRG/WP/02-20246. Stockholm, Sweden 8 pages.

*Morse, L. H. and M. McCurry. 2001. In press. Genesis of alteration of Quaternary basalts within a portion of the eastern Snake River Plain aquifer, in Link, P.K., and L.L. Mink, eds., Geology, Hydrogeology and Environmental Remediation, Idaho National Engineering and Environmental Laboratory, Eastern Snake River Plain: Geological Society of America Special Paper 353, p. 213-224.

*Mueller, P.A., A.L. Heatherington, D.M. Kelly, J.L. Wooden, and D.W. Mogk. 2002. Paleoproterozoic crust within the Great Falls tectonic: Implications for the assembly of southern Laurentia, Geology.

*Peate, D.W., J.A. Baker, J. Blichert-Toft, D.R., M. Storey, A.J.R. Kent, C.K. Brooks, H. Hansen, A.K. Pedersen and R.A. Duncan. 2002. The Prinzen of Wales Bjerge Formation lavas, East Greenland: the transition from tholeiitic to alkali magmatism during Palaeogene continental break-up. J. Petrol. In press.

Reiners, P.W., T.A. Ehlers, J.I. Garver, S.G. Mitchell, D.R. Montgomery, J.A. Vance, and S. Nicolescu. In Press (2002). Rapid late Miocene uplift of the Washington Cascades: Low-temperature thermochronometric evidence. Geology.

*Renne, P.R., W.D. Sharp, I.P. Montañez, T.A. Becker and R.A. Zierenberg. 2001. $^{40}Ar/^{39}Ar$ dating of Late Permian evaporites, southeastern New Mexico, USA: Earth and Planetary Science Letters 193(3/4):539-547.

*Indicates OSTR use.

Rhatigan, R.G., C.M. Freitag, and J.J. Morrell. 2002. Performance of ammonicacal copper arsenate treated Douglas-fir poles. Proceedings American Wood Preservers Association. (In Press).

Rhatigan, R.G., C.S. Love, and J.J. Morrell. 2002. Seasonal variations in moisture content of inservice poles in the Willamette Valley. In: Proceedings 7th International Conference on Utility Line Structures, march 25-27, 2002, Fort Collin, Colorado. EDM International, Ft. Collins, Colorado. Pages 69-77.

Robbins, C. and J. Morrell. 2002. Mold, housing and wood. Western Wood Products Association, Portland, Oregon. 11 pages.

*Roden-Tice, M.K. In press. Best kept secrets of the Adirondacks and Champlain Valley. New England Intercollegiate Geological Conference and New York State Geological Association Field Trip Guidebook, Lake George, New York; September 27-29, 2002.

*Roden-Tice, M.K., and R.P. Wintsch. 2002. Early Cretaceous normal faulting in Southern New England: Evidence from apatite and zircon fission-track ages. The Journal of Geology, v. 110, p. 159-178.

*Shakalov, A., S. Subramanian, and A. Klein. 2001. Correlation between nonionizing energy loss and no offset voltage shift in Ir P-IrAaAs HBIs. IEEE Trans. Nucl. Sci. v. 48, n. 6, p. 2262-2269.

Shapiro, M.N., A.V. Soloviev, J.I. Garver, and M.T. Brandon. 2001. Sources of zircons from Cretaceaous and lower Paleogene terrigenous sequences from the southern Koryak upland and western Kamchatka. Lithology and Mineral Resources, v. 36, n. 4, p. 322-336.

Shapiro, M.N., A.V. Soloviev, E.A. Shcherbinina, Kravchenko-Berezhnoi, and J.I. Garver. 2001. New data on the time of collision of Island Arc with the continent on Kamchatka. Russian Geology and Geophysics. v. 42, n. 5. Pp. 841-851.

Schowalter, T.D. and J.J. Morrell. 2002. Nutritional quality of Douglas-fir wood: effect of vertical and horizontal position on nutrient levels. Wood and Fiber Science 34:158-164.

*Silva, A., C. Freitag, J.J. Morrell. 2001. Effect of fungal attack on creep behavior and strength of wood plastic composites. In: Proceedings, Sixth International Conference on Woodfiber-Plastic Composites, Forest Products Society Proceedings 7251, Madison, WI. Pages 73-77.

*Indicates OSTR use.

*Simonsen, J., C. Freitag, and J.J. Morrell. 2001. Effect of wood-plastic ratio on the performance of borate biocides against brown rot fungi. In: Proceedings, Sixth International Conference on Woodfiber-Plastic Composites, Forest Products Society Proceedings 7251, Madison, Wisconsin. Pages 69-72.

Soloviev A.V., M.N. Shapiro, J.I. Garver. 2002 (in press) Lesnaya thrust, Northern Kamchatka. Geotectonics, n. 6.

Soloviev, A.V., M.N. Shapiro, J.I. Garver, E.A. Scherbinina, I.R. Kravchenko-Berezhnoy. 2002. New age data from the Lesnaya Group: a key to understanding the timing of arc-continent collision, Kamchatka, Russia. Island Arc, 11 (1), p. 79-90.

Soloviev, A.V., A.V. Lander, T.N. Palechek, G.V. Ledneva, V.E. Verzhbitsky, D.V. Kurilov, J.I. Garver. 2001. Structure and age of Omgon Ridge complexes, Western Kamchatka. Modern questions of tectonics. Moscow, Scientific World p. 35-40 (in Russian).

Soloviev, A.V., M.N. Shapiro, and J.I. Garver. 2001. Velocity of collisional thrusting (Lesnaya thrust, Northern Kamchatka). Bull. Mosk. Obschestva Ispyt. Prir., Otd. Geol. v. 76, n. 5, pp. 29-32 (in Russian).

*Struzik, A.A., M. Zattin, R. Anaxhieuriz. 2002. Timing of uplift and denudation of the Polish Western Carpathians. In: International Workshop on "Fission Track Analysis Theory and Applications," Al Puerto de Santa Maria (Cadiz). Geotemas, 14:15-754.

*Stuzik, A.A., M. Zattin, and R. Anaxhieuriz. 2002. Apatite fission track analyses from the Polish Western Carpathians. In: Proceedings of the fourth meeting of the Czech Tectonic Studies Group, Zelarno, Gedines. 14:87-89

*Sweezy, J.E., A. Lennox, and N.E. Hertel. 2002. Paired tissue equivalent ionization chambers for boron enhanced fast neutron therapy. 10th International Congress on Neutron Capture Therapy, NCT Essen 2002, September 8-11, Essen, Germany.

*Sweezy, J.E., N.E. Hertel, and A. Lennox. 2002. A conceptual design of a filter and collimation system for boron enhanced fast neutron therapy. Proceedings of the 12th Biennial ANS Radiation Protection and Shielding Division Topical Meeting. April 14-18, Santa Fe, New Mexico.

*Indicates OSTR use.

*Teixeira, W., J.P.P. Pinese, M. Iacumin, V.A.V. Girardi, E.M. Piccirillo, H., Echeveste, A. Ribot, R. Fernandez, P.R. Renne and L.M. Heaman. Geochronology of calc-alkaline and tholeiitic dyke swarms of Tandilia, Rio De La Plata Craton, Argentina, and their role in the Paleoproterozoic tectonics of southern South America and African counterpart: Precambrian Research, in press.

*Thomson, S.N. 2002. Late Cenozoic geomorphic and tectonic evolution of the Patagonian Andes between latitudes 42° S and 46° S: An appraisal based on fission-track results from the transpressional intro-arc Liquine-Ofqui fault zone. Geological Society of America, Bulletin. Accepted for publication.

*Thomson, S.N. F. Herrè, and B. Stöckhet. 2001. The Mesozoic-Cenozoic denudation history of the southern Chiliean Andes and its correlation to different subduction processes. Tectonics v. 20, n. 5, p. 693-711.

*Tollo, R.P., J.N. Aleinikoff, M.J. Bartholomew, and D.W. Rankin. Late Neoproterozoic A-type granitoids, Blue Ridge Province, Southeast New York to North Carolina: Extension-related intraplate magmatism of the Rodinian supercontinent. Submitted to special volume of Precambrian Research on anorogenic granites.

*Tollo, R.P., E.A. Borduas, A.A. Antignano IV, and C.C. Claflin. In press. Bedrock geologic map of the Fletcher 7.5 minute Quadrangle, Greene, Madison, Page, and Rockingham Counties, Virginia: Virginia Division of Mineral Resources; scale 1:24,000.

*Tollo, R.P., E.A. Borduas, and P.C. Hackley. In press. Geology of basement rocks in the Thornton Gap, Old Rag Mountain, and Fletcher quadrangles, Blue Ridge province, Virginia, Virginia Division of Mineral Resources Report.

*Ukstins, I.A., P.R. Renne, E. Wolfenden, J. Baker, M. Menzies, and D. Aleyew. 2002. Matching conjugate volcanic margins: $^{40}Ar/^{39}Ar$ chronostratigraphy of pre- and syn-rift bimodal flood volcanism in Ethiopia and Yemen: Earth and Planetary Science Letters 198(3/4):289-306.

*Umhoefer, P.J., R.J. Dorsey, S. Willsey, L. Mayer, and P.R. Renne. 2001. Stratigraphy and geochronology of the Comondú Group near Loreto, Baja California sur, Mexico: Sedimentary Geology 144(1-2):125-147.

*Wolf, R.F., H. Xiic, J. Petty, J.S. Teach, and S.A. Pashl. 2002. Argon Ion Besm hemostasis with albumin with liver resection. Amer. Journ. Surg. 183(5):584-587.

*Indicates OSTR use.

*Wright, K.E., M. McCurry, and S.S. Hughes. 2002. Petrology and geochemistry of the Neogene Tuff of McMullen Creek, central Snake River Plain, in Bonnichsen, B., White, C., and McCurry M., eds., Tectonic and magmatic evolution of the Snake River Plain volcanic province: Idaho Geological Survey Bulletin 30, in press.

*Zattin, M., V. Picotti., and G.G. Zuffa. Fission-track reconstruction of the front of the northern Apennine thrust wedge and overlying Ligurian unit. American Journal of Sciences, in press.

*Indicates OSTR use.

B. Documents Submitted for Publication

Bernet, M., Brandon, M.T., and Garver, J.I. 2002b, Downstream changes in detrital zircon FT cooling ages in large modern rivers, submitted to Journal of Sedimentary Research.

Bernet, M., Brandon, M.T., Garver, J.I., Balestrieri, M.-L., Ventura, B., and Zattin, M., 2002c, Exhuming the Alps through time: clues from detrital zircon fission-track ages: Geological Society of America Bulletin,. In review.

Bernet, M., Brandon, M.T., Garver, J.I., and Molitor. Accepted, Testing detrital fission-track analysis on modern river sediment of the European Alps; Basin Research, Submitted June 2001.

Bondarenko, G.E., Soloviev, A.V., Tuchkova M.I., Garver J.I., Podgorny, I.I. 2002. The primary detrital zircon fission-data from Mesozoic flyschof South-Anui sututre (Western Chukotka, NE Asia); Doklady of the Earth Science.

Bullen, M.E., Burbank, D.W., Garver, J.I., and Farley, K.A. In review. Episodic rock uplift of the Kyrgyz Range, Northern Ten Shan. Submitted to Journal of Geology, 6/2002.

*Coffin, M.F., M.S. Pringle, R.A. Duncan, T.P. Gladezenko, M. Storey, R.D. Muller and L.A. Gahagan. 2002. Kerguelen hotspot magma output since 130 Ma. Journal of Petrology.

*Couliè E., X. Quidelleur, J.C. Lefèvre and P.Y. Gillot. 2002. A multi-collection system for the $^{40}Ar/^{39}Ar$ technique. Submitted to Chemical Geology.

*Couliè E., X. Quidelleur, P.Y. Gillot, V. Courtillot, J.C. Lefèvre, and S. Chiesa. 2001. Combined $^{40}Ar/^{39}Ar$ and K/Ar dating of Ethiopian and Yemenite Traps volcanism. Submitted to Earth Planet. Sci. Lett.

*Duncan, R.A. 2000. A time frame for construction of the Kerguelen Plateau and Broken Ridge. Jounal of Petrology.

*Garver, J.I. Submitted. Etching age standards for fission track analysis: a survey of the methodologies used in active laboratories; Radiation Measurements.

*Heatherington, A.L. and P.A. Mueller. Submitted. Mesozoic igneous activity in the Suwannee Terrane, Southeastern USA. American Geophysical Union Memoir, The Central Atlantic Magmatic Province.

*Heatherington, A.L. and P.A. Mueller. Mesozoic igneous activity in the Suwannee Terrane, Southeastern USA, submitted to American Geophysical Union Memoir, The Central Atlantic Magmatic Province.

*Indicates OSTR use.

*Hughes, S.S., S.E. Lewis, M.J. Bartholomew, A.K. Sinha, and N. Herz. 2003. Geology and geochemistry of Fe-Ti-rich granitic and charnockitic rocks in the central Lovngston massif of the Grenvillian Blue Ridge terrane, U.S.A.: submitted to R.P. Tollo, L. Corriveau, J.B. McLelland, M.J. Bartholomew, editors, Proterozoic Tectonic Evolution of the Grenville Orogen in Eastern North America.

*Jun, B. and S. Subramanian. Carrier removal and mobility degradation in heterojunction field effect transistor structures. Submitted to IEEE Trans. Nucl. Sci. December 2002.

*Knight, K.B., P.R. Renne, A. Halkett, and N. White. $^{40}Ar/^{39}Ar$ dating of the Rajahmundry Traps, Eastern India, and their relationship to the Deccan Traps: Earth and Planetary Science Letters, in review.

*Mueller, P.A., J.L. Wooden, A.L. Heatherington, and H.R. Burger. Evidence for Paleoproterozoic Metamorphism in the Tobacco Root Mountains, Montana, submitted to Geology.

*Ravenhurst, C.E., M.K. Roden-Tice, and D.S. Miller. Submitted. Thermal annealing of fission tracks in apatite: experimental results. Canadian Journal of Earth Sciences.

*Ring, M., S.N. Thomson, and M. Bröcker. 2002. Fission-track data supply evidence for fast-slipping extensional detachment in the magmatic arc of the Late Miocene Hellenic subduction zone, Cyclades, Greece. Geology. Submitted for publication, May 2002.

*Thomson, S.N. and F. Herrè. 2002. Integrating detrital zircon fission-track and U-Pb shrimp age to estimate the age of deposition, metamorphism and later reheating of metamorphic complexes at the ancestral Gondwana margin of southern Chile 142° S-52° S. Revista Geológica de Chile. Submitted for publication April 2002.

*Tollo, R.P., J.N. Aleinikoff, E.A. Borduas, and P.C. Hackley. Petrologic and geochronologic evolution of the Grenville orogen, northern Blue Ridge, Virginia. Submitted to Geological Society of North America Memoir entitled " Proterozoic Tectonic Evolution of the Grenville Orogen in North America", edited by Tollo, R., Corriveau, L., McLelland, J., and Bartholomew, M.; publication expected by April 2004.

*Weinstein, J. D. R.V. Fodor, G.R. Bauer. Koolau shield basalt as xenoliths entrained during rejuvenated-stage eruptions: perspectives on magma mixing. Submitted to Bull. Volcanology.

*Indicates OSTR use.

*Zattin, M. C. Stefani, and S. Martin. Detrital fission-track analysis and petrographyas keys of Alpine exhumation: the example of the Veneto Foreland (Southern Alps, Italy): Journal of Sedimentary Research, submitted for publication.

*Indicates OSTR use.

C. Documents in Preparation

*Baxter, A. F. Grain Boundary Partitioning of Ar and He. In preparation.

*Bernet, M., M.T. Brandon, J.I. Garver, B. Ventura, M. L. Balestrieri and M. Zattin. 2001. Exhuming the Alps through time: clues from detrital zircon fission-track ages, GSA Bulletin.

Brandon, M.T., M. Bernet, J.I. Garver, P.W. Reiners, and P.G. Fitzgerald. 2002. Natural calibration of zircon fission-track closure temperature at Gold Butte, Nevada.

*Burton et al., in preparation. Thermal history and exhumation of the Okanogan area, Washington State.

*Farrell, J., J.S. MacDonald, M.A. Zalesky, R.L. Fleischer and R. Doremus. Leaching of Imbedded Alpha-Recoil Atoms in Glasses. In preparation.

Garver, J.I., D.T. Rodbell, and M. Montario. 2002. Climate change drives rapid tectonic exhumation in Cordillera Blanca, Northern Peru. Target submittal: Geology, September 2002.

*Heatherington, A.L. and P.A. Mueller. Crustal sources of the Stone Mountain granite and Elberton batholith, and the origin of the Inner Piedmont terrane. In preparation for submission to Southeastern Geology.

*Heatherington, A.L. and P.A. Mueller. Alleghanian plutonism in the Suwannee terrane. In preparation.

Hourigan, J.K., M.T. Brandon, J.I. Garver, A.V. Soloviev and P.W. Reiners. 2002. A comparison of the detrital zircon grain-age distributions from the Ukelayat Group and Shiktinskaya Complex: Implications for the origin of the Sredinniy Range, Kamchatka.

*Hughes, S.S., D.J. Geist, and M. McCurry. In preparation. Petrogenesis of olivine tholeiites on the eastern Snake River Plain. To be submitted to Journal of Petrology, 2003.

*John, B., J.M. Murphy, and D.L. Foster. In review. Extremely rapid cooling rates in Late Tertiary diabase from the Indian Ocean spreading ridge offshore of South Africa. Apatite and zircon fission track and $^{40}Ar/^{39}Ar$ dating results of ODP core samples.

Kirner, N. Annual ALARA Report for ESCO-2002. In preparation.

*MacDonald, J.S. and R.L. Fleischer. Uranium and Thorium in Cores from Two New York State Lakes. In preparation.

*Indicates OSTR use.

*MacDonald, J.S. and R. L. Fleischer. Neutron Fluence Near Ground Zero at Hiroshima from Nuclear Tracks in Porcelain. In preparation.

Soloviev, A.V., J.I. Garver, M.T. Brandon, and M.N. Shapiro. 2001. Eocene arc-continent collision in northern Kamchatka, Russian Far East. Target submittal: Geology, December 2002.

*Strecker, U., J.M. Murphy and J. Steidtmann. In preparation. Early Tertiary uplift history of the Black Hills, South Dakota, using fission track thermochronology.

*Wetmore, P.H., S.S. Hughes, D.W. Rodgers and S.R. Anderson. In preparation. Competing processes of subsidence and volcanic construction during late Pleistocene evolution of the southern Big Lost Trough, Axial Volcanic Zone, and Arco-Big Southern Butte volcanic rift zone.

*Zattin, M. and G.G. Zuffa. Unravelling source rocks of wedge-top and foredeep Late Eocene-Miocne arenites of northern Apennines and southern Alps.

*Indicates OSTR use.

D. Theses and Student Project Reports

*Bartlett, R. 2002. Measurement of n,n' cross sections of Sn and Pt. Department of Physics, Oregon State University, Corvallis, Oregon.

*Beland, P.E. 2002. Apatite fission track and (U-Th)/He thermochronology and vitrinite reflectance of the Casper Arch, Maverick Springs Dome, and the Wind River Basin: Implications for Late Cenozoic deformation and cooling in the Wyoming foreland. MS thesis. Geology Department, University of Wyoming, Laramie, Wyoming, 97p.

*Borduas, E. 2002. Petrologic significance of Grenville-age leucocratic granitoids, Blue Ridge Province, Virginia. BS thesis. George Washington University, Washington, D.C.

*Chen, S. 2001. Hydrogeochemical studies of the Portneuf River, Southeastern Idaho: M.S. Thesis, Idaho State University, Pocatello, Idaho. 134p.

*Coulié, E. 2001. Chronologie ^{40}Ar/^{39}Ar et K/Ar de la déchirure continentale en Afar depuis 30 Ma, Doctoral Dissertation, Université Paris sud, Orsay, 380p.

Johnston, S.J. 2002. Zircon fission-track cooling ages of the Sredinniy Range metamorphic complexes, Kamchatka: Implications for post Orogenic exhumation. Department of Geology, Union College, Schenectady, NY. 77p.

*Jun. B. July 2002. Radiation effects in III-IV heterostructure devices. Doctoral Dissertation. Oregon State University. Corvallis, Oregon.

*MacDonald, J.S., 2002. Fission and alpha track etching techniques for measuring uranium and thorium concentrations in core samples from Ballston and Quichy Lakes, and sedimentation rates from near-surface decay of radon progeny. BS thesis. Union College, Schenectady, New York.

Mankowski, M.N. 2002. Biology of carpenter ants *Camponotus vicinus* (Mayr) and *Camponotus modoc* (Wheeler) in western Oregon. Doctoral Dissertation, Oregon State University, Corvallis, Oregon.

*McCarther, R.L. 2002. Compositional evolution and crystallization of a prehistoric Mokuaweoweo lava lake, Mauna Loa volcano, Hawaii: petrology fo gabbroic xenoliths. MS thesis. North Carolina State University, Raleigh, North Carolina. 95p.

*Min, K. Improved Calibration and Applications of the ^{40}Ar/^{39}Ar Dating Method. Doctoral Dissertation. University of California at Berkeley, Berkeley, California. Filed.

*Indicates OSTR use.

*Rosenstein, D. 2002. Ceramic production as a reflection of technological and social complexity in the Late Iron Age of South Africa: an ethnographic and petrographic study. BA thesis. George Washington University, Washington, D.C.

*Struzik, A.A. Comparison of thermal evolution recorded by the Uite-smeolite and AFT in the Polish Western Carpathians" MS thesis. Institute of Geological Sciences, Polish Academy of Sciences, Seacha 1-81-002, Krakow, Poland.

*Sweezy, J.E., Development of a boron neutron capture enhanced fast neutron therapy beam. PhD Thesis. Nuclear Engineering, Georgia Institute of Technology, March 2002.

Wilson, J. 2002. The effect of sterilization method on the activity of surface-bound nisin. Honors thesis. Bioengineering Department, Oregon State University, Corvallis, Oregon.

*Indicates OSTR use.

E. **Presentations**

Abbate, E., M.L. Balestrieri, G. Bigazzi, M. Brandon, V. Picotti, P. Reiners, M. Zattin, and G.G. Zuffa. 2001. Space and time variability of exhumation in Northern Apennines. Workshop "Uplift and erosion: driving processes and resulting landforms:, Certosa di Pontignano (Italy), September 20-21.

*Balestrieri, M.L. and M. Zattin. 2002. Exhumation of the Northern Apennine chain: do we need something more than apatite fission-track data? International Workshop on "Fission-track Analysis: theory and applications", El Puerto de Santa Maria (Spain), June 4-7.

*Baxter, Asimow, Farley. 2001. Experimental Study of Grain Boundary Partitioning of Ar. AGU 2001 Fall Meeting, San Francisco, California.

*Beland, et al., 2001. Fission track evidence of cooling and exhumation of the Wind River Basin, Wyoming. Geological Society of America Annual Meeting, Boston, Massachusetts.

*Brandon, M. E. Abbate, M.L. Balestrieri, M. Bernet, G. Bigazzi, V. Picotti, P. Reiners, M. Zattin and G.G. Zuffa. 2001. Quantifying exhumation history across the Northern Apennines. AGU 2001 Fall Meeting, San Francisco, 10-14 December 2001.

*Chiarenzelli, J., M. Roden-Tice. 2002. History and tectonic evolution of the Sask Craton, Trans-Hudson Orogen. Saskatoon 2002 Proceedings. Geological Association of Canada. May 24, 2002.

* Deford, D. 2001. Vascular angstomosis using a pulse diode laser. SPIE, San Jose, California.

*Fellin, M.G., V. Picotti and M. Zattin. 2002. Late Quaternary compression revealed by surface faults at the western margin of Corsica basin. EGS 2002 Annual Meeting, Nice, April 21-26.

*Garver, J.I., A.V. Soloviev, M.T. Brandon, M.N. Shapiro, and J.K. Hourigan. 2001. Tectonic and magmatic history of Kamchatka and NE Asia revealed through detrital zircon thermochronology of Cretaceous to Miocene deep-water strata, Kamchatka (Russia). 7th Zoneshain International Conference on plate tectonics, Moscow, Russia, p. 503.

*Garver, J.I., B.C.D. Riley and G. Wang. 2002. Partial resetting of fission tracks in detrital zircon, European Fission-track conference, Cadiz, Spain, Geotemas, v.4, p.73-75.

---

*Indicates OSTR use.

*Hansen, K. C.K. Brooks and S. Bernstein. 2002. Tracking the exhumation history of the East Greenland continental margin north of 72 N. In Barbero, L. and Colombo, F. eds., International Workshop on "Fission-track Analysis: Theory and Applications" El Puerto de Santa Maria (Cadiz) 4-7 June 2002, Geotemas 4, 91-92.

Hourigan. J.K., M.T. Brandon, J.I. Garver, and A.V. Soloviev. 2001. A comparison of the detrital zircon grain-age distributions from the Ukelayat Group and the Kamchatsky Complex: implications for the origin of the Sredinniy Range, Kamchatka. 7th Zoneshain International Conference on plate tectonics, Moscow, Russia, p.504.

*Hughes, S.S., and M. McCurry. 2002. Geochemical diversity of Quaternary olivine tholeiites on the eastern Snake River Plain: Geological Society of America Abstracts with Programs vol. 34, no. 5.

*Hughes, S.S., and M. McCurry. 2002. Geochemistry of Precambrian charnockitic rocks of the central Lovingston massif, Grenvillian Blue Ridge Terrane, Virginia: Geological Society of America Abstracts with Programs vol. 33, No. 6, p. A-28.

*Hughes, S.S., S.E.H. Sakimoto, and T.K.P. Gregg. 2002. Plains volcanism in the eastern Snake River Plain: Quantitative measurements of petrologic contributions to topography with comparisons to Mars: Geological Society of America Abstracts with Programs vol. 34, No. 6.

Ledneva, G.V., J.I., Garver, J.R. Lederer, M.N. Shapiro, M.T. Brandon and K. Hollocher. 2001. Geochemistry and FT ages of felsic cobbles in Oligocene flysch and mélange (Karaginski Island, Kamchatka, Russian Far East): implications for reconstruction of post-collisional paleogeology. 7th Zoneshain International Conference on plate tectonics, Moscow, Russia, p. 509-510.

*MacDonald, J.S., and R.L. Fleischer. 2002. Neutron fluence near ground zero at Hiroshima from nuclear tracks in porcelain. Northeastern Section Meeting, Geological Society of America, Springfield, Massachusetts, March 25-27.

*McCurry, M. and K. Schmidt. 2001. Petrology and oxygen isotope geochemistry of the Pucón Ignimbrite -Southern Andean Volcanic Zone, Chile: Implications for genesis of mafic ignimbrites, III South American Symposium on Isotope Geology, Extended Abstracts Volume (CD), p. 317-320, Sociedad Geológica de Chile, Santiago, Chile.

*Indicates OSTR use.

*Roden-Tice, M.K., S.J. Tice, R.P. Wintsch and K.A. Farley. 2001. Evidence for widespread early Cretaceous unroofing in the southeastern Adirondacks, Champlain Valley and Vermont based on apatite fission-track ages. Geological Society of America Abstracts with Programs, v. 33, p. A-82, Annual Meeting of the Geological Society of America, November 1-10, 2001, Boston, Massachusetts.

*Scarberry, K., S. Hughes, and M. McCurry. 2002. Geochemistry, stratigraphy, and petrogenetic implications of the F basalt flow group, eastern Snake River Plain, Idaho: Geological Society of America Abstracts with Programs Vol. 34, No. 5.

Shoemaker, S., M. Ducca, P.W. Reiners, J.I. Garver and M.F. Campa. 2002. Cenozoic plate tectonic history of southwestern Mexico; constraints from low temperature thermochronology, European Fission-track conference, Cadiz, Spain, Geotemas, v. 4, p. 137-138.

Soloviev, A.V. and J.I. Garver. 2002. Fision-track study of the Omgon accretionary complex, Western Kamchatka (Russian Far East): possible northern continuation of the Shimanto belt (Japan); European Fission-track conference, Cadiz, Spain, Geotemas, v.4, p. 143-146.

Soloviev, A.V., J.I. Garver, M.T. Brandon. 2001. Dating terrigenious sediments by zircon fission-track (ZFT) thermochronology. 7th Zoneshain International Conference on plate tectonics, Moscow, Russia, p. 515.

Soloviev A.V., M.N. Shapiro, and J.I. Garver. 2001. Estimation of the forming speed of the collision thrust by isotopic dating (Lesnaya thrust, Northern Kamchatka) Tectonics: general and regional questions. Moscow. February 1-4, 2001. V.2. p. 211-214. (In Russian).

*Stahle, K.A., M.C. Young, and M.K. Roden-Tice. 2002. Mesozoic unroofing history of Eastern New York and Western New England based on apatite fission-track ages. Geological Society of America Abstracts with Programs, v. 34, p. A-69.

*Struzik, A.A., M. Zattin and R. Anczkiewicz. 2002. Timing of uplift and exhumation of the Polish Western Carpathians. International Workshop on "Fission-track Analysis: theory and applications", El Puerto de Santa Maria (Spain), June 4-7.

*Subramanian, S. Radiation effects in III-V heterostructure devices. Seminar. University of California at Berkeley. October 2001.

*Indicates OSTR use.

*Sweezy, J.E., N.E. Hertel and A. Lennox. 2002. A conceptual design of a filter and collimation system for boron enhanced fast neutron therapy. Proceedings of the 12th biennial ANS Radiation Protection and Shielding Division Topical Meeting. April 14-18, Santa Fe, New Mexico.

*Sweezy, J.E., A. Lennox, and N.E. Hertel. 2002. Paired tissue equivalent ionization chambers for boron enhanced fast neutron therapy. 10th International Congress on Neutron Capture Therapy, NCT Essen 2002, September 8-11, Essen, Germany.

Thomson, S.N. 2002. Cenozoic geomorphic and tectonic development of the Patagonian Andes (42° S to 52° S). Talk presented at International Workshop on Fission-track Analysis: Theory and Applications, Cadiz, Spain, June 2002.

Thomson, S.N. F. Hené, B. Stôckhert, and M.R. Brix. 2001. Late Cenozoic uplift and erosion history of the Patagonian Andes between 42° S and 52° S. International Workshop on Uplift and Erosion: Driving Processes and Resulting Landforms, September, 2001, Siena, Italy.

Thomson, S.N. 2001. The geomorphic and tectonic response of the upper plate to different subduction processes assessed using fission-track thermochronology: an example from the southern Chilean Andes. German Geological Society Annual Meeting, Kiel Germany, October, 2001.

*Tollo, R.P. and J.N. Aleinikoff. 2001. Petrologic and temporal characteristics of Grenville-age orogenesis, Blue Ridge province, Virginia: Geological Society of America, November 2001, Boston, Massachusetts.

*Zattin, M., G. Fellin, V. Picotti, and J. Vance. 2002. Fission-track record of exhumation of Northern Corsica (France). 98th Annual Meeting GSA Cordilleran Section, Corvallis (OR-USA), May 13-15.

*Indicates OSTR use.