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UNIVERSITY

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October 17, 2005

U.S. Nuclear Regulatory Commission
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, 2004 through June 30, 2005.

The 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 had yet another successful and productive year. I would like to emphasize that the achievements of this last year would not have been possible without the support and assistance we received from the invaluable programs administered by the USDOE. In particular, the Reactor Sharing program and the University Research Reactor Upgrades program are very cost-effective in providing invaluable support to the university reactor community and its users.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 10/17/05

Sincerely,

Steve R. Reese
Director

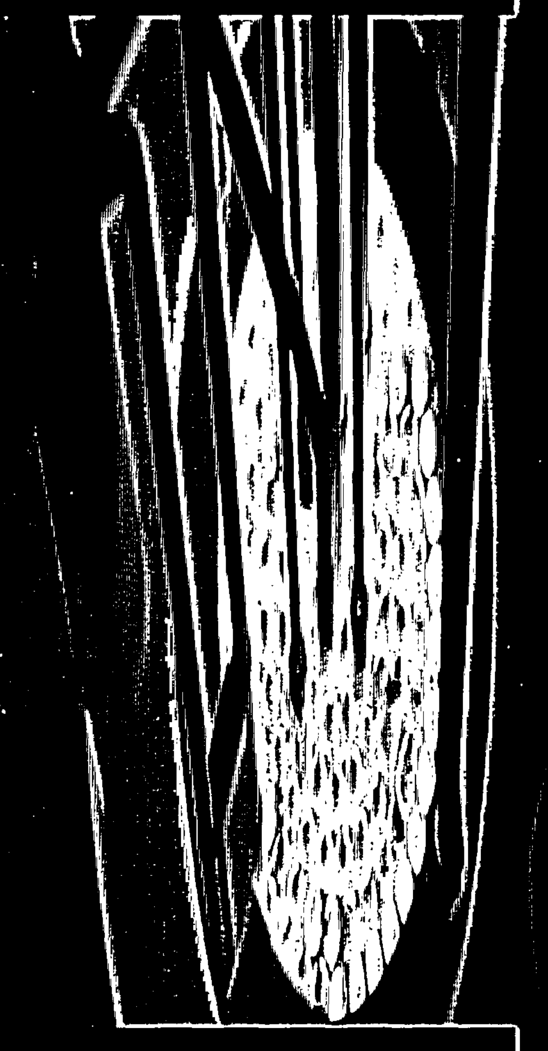
A020

enclosure

c: Alexander Adams, Edward Ray, Rich Holdren, Craig Bassett, Sabah Randhawa, Gary Wachs, Ken Niles, John Cassady, Shirley Campbell

Annual Report

July 2004 — June 2005



Oregon State University Radiation Center and TRIGA Reactor

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

July 1, 2004 - June 30, 2005

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 Department of Energy, OOE Rule No. 345-030-010.

Submitted by:
Steve R. Reese
Director, Radiation Center

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Corvallis, Oregon 97331-5903
Telephone: (541) 737-2341
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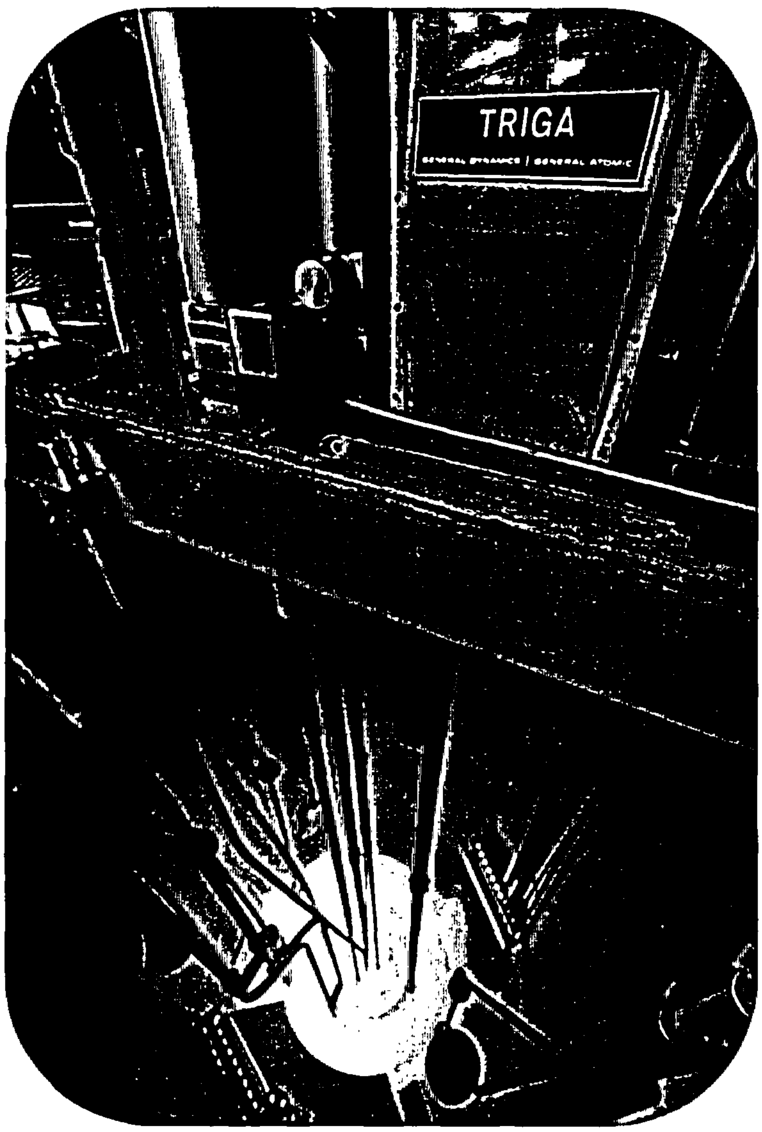


OVERVIEW

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 would like to extend its appreciation to all of those who contributed to the information and events contained in this report.

Oregon State University Research Office
"...without which we would not be." The unwavering support by John Cassidy, Rich Holdren and Jack Higginbotham is appreciated much more than they probably realize.

U. S. Department of Energy (USDOE)
The opportunities created through the Innovations in Nuclear Infrastructure and Education, University Reactor Use Share, and University Instrumentation Grant programs have become immensely important.

Oregon Department of Energy
Ken Niles and his group continue to be THE state resource for radiological hazard and emergency policy. We sincerely appreciate our involvement with their important mission.

Oregon State Police and OSU Public Safety
Security plays an important role in everything we do as of late. Lt. Phil Zerzan has been particularly helpful in developing and implementing new plans this past year. His understanding and ability to recognize the big picture is invaluable.

John Ringle, Art Johnson, and Bob Nelson
These three individuals played an enormous role in the development of the revised Safety Analysis Report submitted to the USNRC earlier this year. In addition to their past service to the Radiation Center, their influence should be felt for at least another 20 years.

We have had a few new faces join us in the last year, including Leah Minc, Dina Pope, and Heather Rangner. Although they have been here for only a short time, all of them have contributed to making the Radiation Center a better place to work. We truly welcome them!

Executive Summary

The data from this reporting year shows that the use of the Radiation Center and the Oregon State TRIGA reactor (OSTR) has continued to grow in many areas.

The Radiation Center supported 68 different courses this year, mostly in the Department of Nuclear Engineering and Radiation Health Physics. About 35% of these courses involved the OSTR. The number of OSTR hours used for academic courses and training was 55, while 1,435 hours were used for research projects. Seventy-seven percent of the OSTR research hours were in support of off-campus research projects, reflecting the use of the OSTR nationally and internationally. Radiation Center users published or submitted 84 articles this year, completed 7 theses/dissertations, and made

69 presentations on work that involved the OSTR or Radiation Center. The number of samples irradiated in the reactor during this reporting period was 3661. Funded OSTR use hours comprised 93% of the research use.

Personnel at the Radiation Center conducted 132 tours of the facility, accommodating 2,159 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.

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 188. Reactor related projects comprised 76% of all projects. The total research supported by the Radiation Center, as reported by our researchers, was $5,281,239. The actual total is likely considerably higher. This year the Radiation Center provided service to 50 different organizations/ institutions, 43% of which were from other states and 14% 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.

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 covers the period from July 1, 2004 through June 30, 2005. 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, 2005. 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 Department of Energy. Because of this, the report is divided into several distinct parts so that the reader may easily find the sections of interest.

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 and Radiation Health Physics, the OSU Institute of Nuclear Science and Engineering, and for the OSU nuclear chemistry, radiation chemistry, geochemistry and radiochemistry 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 and AP1000 reactor designs. The AP600 and AP1000 are next-generation nuclear reactor designs which incorporate 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 450EF using electrical heaters instead of nuclear fuel. All major components of the AP600 and AP1000 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 (ATHRL), 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.

History

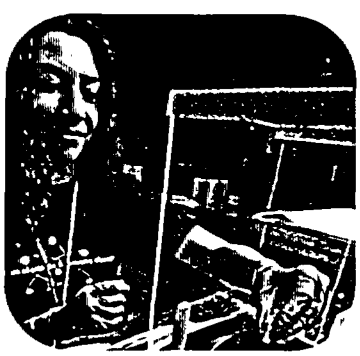
A brief chronology of the key dates and events in the history of the OSU Radiation Center and the TRIGA reactor is given below:

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.

AGN-201 reactor decommissioned and space released for unrestricted use.	July 1980
Shipment of the original 20% enriched OSTR fuel to Westinghouse Hanford Company.	June 1982
C. H. Wang retired as director. C. V. Smith became new director.	December 1984
Director C. V. Smith left to become Chancellor of the University of Wisconsin-Milwaukee. A. G. Johnson became new Director.	August 1986
AGN-201 components transferred to Idaho State University for use in their AGN-201 reactor program.	December 1988
OSTR licensed power increased to 1.1 MW.	December 1989
Installation of a 7000 Ci ^{60}Co Gammacell irradiator.	June 1990
25th anniversary of the OSTR initial criticality.	March 1992
Start of APEX plant construction.	November 1992
Retirement of Director A. G. Johnson. B. Dodd became new Director.	June 1994
APEX inauguration ceremony.	August 1994
Major external refurbishment: new roof, complete repaint, rebuilt parking lot, addition of landscaping and lighting.	August 1995
B. Dodd left on a leave of absence to the International Atomic Energy Agency. S. E. Binney became new Director.	September 1998
Installation of the Argon Production Facility in the OSTR.	January 1999
Completion of ATHRL facility brings the Radiation Center complex to a total of 47,198 square feet.	April 1999
S. E. Binney retired. J. F. Higginbotham became interim director.	July 2002
A. C. Klein became new director.	October 2002
Neutron Radiography Facility completed.	October 2004
A. C. Klein left on leave of absence to Idaho National Laboratory. S.R. Reese became new Director.	April 2005

Part II
People






PEOPLE

This section 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.

It should be noted that not all of the faculty and students who used the Radiation Center for their teaching and research are listed. 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.

Professional and Research Faculty

* Binney, Stephen E., Director Emeritus, Radiation Center
Professor Emeritus, Nuclear Engineering and Radiation Health Physics

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

Craig, A. Morrie, Professor
College of Veterinary Medicine

Daniels, Malcolm, Professor Emeritus
Chemistry

Duringer, Jennifer, Research Associate
College of Veterinary Medicine

Groome, John T., Faculty Research Assistant
ATHRL Facility Operations Manager
Nuclear Engineering and Radiation Health Physics

* Hamby, David, Professor
Nuclear Engineering and Radiation Health Physics

Hart, Lucas P., Faculty Research Associate
Chemistry

* Higginbotham, Jack F., Director, Oregon Space Grant
Professor, Nuclear Engineering and Radiation Health Physics

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

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

Keller, S. Tood, Interim Reactor Administrator/Reactor Operator
Radiation Center

** OSTR users for research and/or teaching*

Klein, Andrew C., Director, Radiation Center
Department Head, Nuclear Engineering and Radiation Health Physics
Professor, Nuclear Engineering and Radiation Health Physics

* Krane, Kenneth S., Professor Emeritus
Physics

Lafi, Abd Y., Assistant Professor Senior Research (Courtesy Appointment)
ATHRL Research Analyst
Nuclear Engineering and Radiation Health Physics

* Loveland, Walter D., Professor
Chemistry

* Menn, Scott A., Senior Health Physicist
Radiation Center

* Minc, Leah, Assistant Professor Senior Research
Radiation Center

"They can because they think they can"
Virgil

* Palmer, Todd S., Associate Professor
Nuclear Engineering and Radiation Health Physics

* Paulenova, Alena, Assistant Professor Senior Research
Radiation Center

Popovich, Milosh, Vice President Emeritus
Oregon State University

* Reese, Steven R., Reactor Administrator/Director
Radiation Center

Reyes, Jr., José N., ATHRL Principal Investigator
Department Head, Nuclear Engineering and Radiation Health Physics

Ringle, John C., Professor Emeritus
Nuclear Engineering and Radiation Health Physics

Robinson, Alan H., Department Head Emeritus
Nuclear Engineering and Radiation Health Physics

* Schmitt, Roman A., Professor Emeritus
Chemistry

* Schütfort, Erwin G., Faculty Research Assistant
Radiation Center

** OSTR users for research and/or teaching*

* Wachs, Gary, Reactor Supervisor
Radiation Center

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

Walker, Karen, Research Assistant
College of Veterinary Medicine

Woods, Brian, Assistant Professor
Nuclear Engineering and Radiation Health Physics

Wu, Qiao, Associate Professor
Nuclear Engineer and Radiation Health Physics

Young, Roy A., Professor Emeritus
Botany and Plant Pathology

** OSTR users for research and/or teaching*

Name	Degree, Prograqm	Advisor
Abel, Kent	PhD, Nuclear Engineering	J. N. Reyes
Ashbaker, Eric	MS, Radiation Health Physics	S. R. Reese
Bak, Alysse	MS, Radiation Health Physics	K. A. Higley
Bentley, Blair	MA, Radiation Health Physics	K. A. Higley
Brumley, Willis	MS ,Radiation Health Physics	K. A. Higley
Bruso, Jason	MS, Nuclear Engineering	A. Paulenova
Bytwerk, David	MS, Radiation Health Physics	K. A. Higley
Courville, Alicia	-	D. M. Hamby
Darrett, Jeannine	MS, Radiation Health Physics	K. A. Higley
Frey, Wesley	MS, Radiation Health Physics	J. F. Higginbotham
Gambone, Cindy	MS, Nuclear Engineering	T. S. Palmer & S. R. Reese
Gambone, Kimberly	MS, Radiation Health Physics	D. M. Hamby
Hooda, Benny	MS, Radiation Health Physics	K. A. Higley
Huang, Zhongliang	PhD, Nuclear Chemistry	W. D. Loveland
Keller, S. Todd	MS, Nuclear Engineering	T.S. Palmer
Kim, Dong W.	PHD, Nuclear Engineering	Q. Wu
Lee, Dongyoung	MENg, Nuclear Engineering	Q. Wu
Lobach, Sergiy	PhD, Nuclear Engineering	A. Paulenova
Lopez, Alejandro	MS, Radiation Health Physics	D. M. Hamby
Maloy, Kyle	MS, Radiation Health Physics	D. M. Hamby & T. S. Palmer
Misner, Alex	MS, Nuclear Engineering	K. A. Higley & D. M. Hamby
Naik, Radhika	PhD, Nuclear Chemistry	W. D. Loveland
Napier, Bruce	PhD, Radiation Health Physics	D. M. Hamby
Nes, Razvan	PhD, Nuclear Engineering	T. S. Palmer
Newman, Errol	MS, Radiation Health Physics	D. M. Hamby
Palotay, Josh	MS, Radiation Health Physics	K. A. Higley
Rafie, Frank	PhD, Radiation Health Physics	K. A. Higley
Rajan, Ajith	MS, Radiation Health Physics	D. M. Hamby
Robinson, Adam	MS, Nuclear Engineering	B. Woods
Rodriguez, John	MS, Radiation Health Physics	K. A. Higley
Sabharwall, Piyush	MS, Nuclear Engineering	Q. Wu
Schilling, Raymond	MS, Radiation Health Physics	K. A. Higley
Schubring, DuWayne	MS, Nuclear Engineering	J. N. Reyes
Slauson, Marjorie	MS, Radiation Health Physics	K. A. Higley
Smith, Angela	MS, Radiation Health Physics	K. A. Higley
Sprunger, Peter	PhD, Physics	W. D. Loveland
Staples, Christopher	MS, Physics	K. Krane
Stewart, H. Michael Jr.	MS, Radiation Health Physics	D.M. Hamby
Tack, Krystina	MS, Radiation Health Physics	K. A. Higley
Tavakoli, Farsoni	PhD, Radiation Health Physics	D. M. Hamby
Yao, You	PhD, Nuclear Engineering	Q. Wu
Yoo, Yeon-Jong	PhD, Nuclear Engineering	J. N. Reyes
Young, Eric	MS, Nuclear Engineering	J. N. Reyes

Administrative, Business and Clerical Staff

Andrew Klein, Director (7-1-04 to 2-28-05)
OSU Radiation Center

Steve Reese, Acting Director (3-01-05 to 4-30-05)
Director (5-1-05)
OSU Radiation Center

Shirley Campbell, Business Manager
Radiation Center and Nuclear Engineering and Radiation Health Physics

Robin Keen, Administrative Assistant
Radiation Center and Nuclear Engineering and Radiation Health Physics

Erin Cimbri, Custodian

Teresa Culver, Office Specialist
ATHRL–Nuclear Engineering and Radiation Health Physics

Joan Stueve, Office Specialist
Nuclear Engineering and Radiation Health Physics

Julie Dolan, Office Specialist
Media and Communications Assistant

LaVon Mauer, Office Specialist
Radiation Center

Reactor Operations Staff

Andrew Klein, Director (7-1-04 to 2-28-05)
Steve Reese, Director (3-01-05-present)
Steve Reese, Reactor Administrator (7-1-04 to 2-28-05)
S. Todd Keller, Interim Reactor Administrator (3-01-04-present)
Gary Wachs, Reactor Supervisor, Senior Reactor Operator
Steven Smith, Senior Reactor Operator
S. Todd Keller, Senior Reactor Operator

Radiation Protection Staff

Scott Menn, Senior Health Physicist
Jim Darrough, Health Physicist
Emily Doughtry, Physics Monitors (Student)
Benjamin Fahlgren, Physics Monitors (Student)
Ceris Hamilton, Health Physics Monitors (Student)
Emily Hertel, Physics Monitors (Student)
Jesse Juarez, Health Physics Monitors (Student)
Sarah Kleeb, Health Physics Monitors (Student)

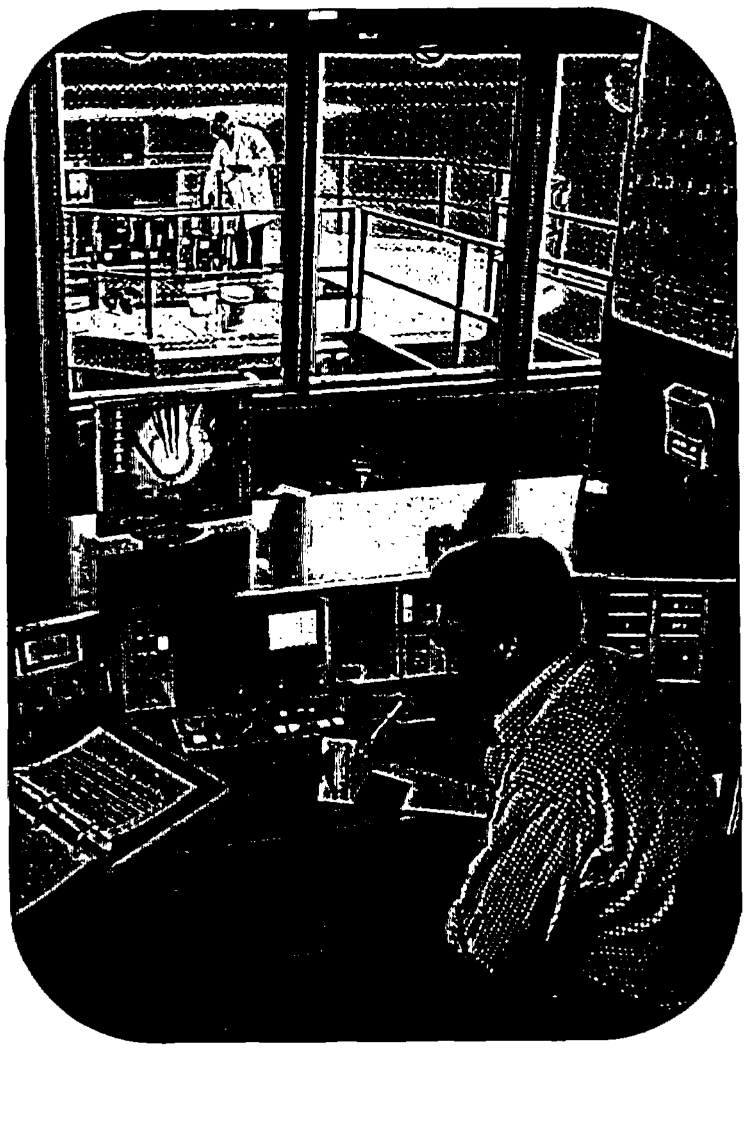
Scientific Support Staff

Mike Conrady, Analytical Support Manager
Alena Paulenova, Radiochemistry Research Manager
Leah Minc, Neutron Activation Analysis Manager
Steve Smith, Scientific Instrument Technician
*Erwin Sch*ütfort, Research Projects Assistant
Matthew Conrady, Nuclear Instrumentation Support (Student)
Donald Coomes, Nuclear Instrumentation Support (Student)
Corey Darrough, Nuclear Instrumentation Support (Student)
Katherine Gray, Neutron Activation Analysis Technicians (Student)
Mike Kennedy (Student)
Konrad Kuleska (Student)

Reactor Operations Committee

Name	Affiliation
John Ringle, Chair	Nuclear Engineering and Radiation Health Physics
Steve Binney	Nuclear Engineering and Radiation Health Physics
Ralf Busch	Mechanical Engineering
Rainier Farmer	Radiation Safety
David Hamby	Nuclear Engineering and Radiation Health Physics
Todd Keller	Radiation Center
Andrew Klein	Radiation Center and Nuclear Engineering and Radiation Health Physics
Scott Menn	Radiation Center
Todd Palmer	Nuclear Engineering and Radiation Health Physics
Wade Richards	McClellan Nuclear Radiation Center/NIST
Steve Reese	Radiation Center
Annette Von Jouanne	Electrical and Computer Engineering
Gary Wachs	Radiation Center

Part III
Facilities



Facilities

Research Reactor

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 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.

The two main uses of the OSTR are instruction and research.

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 educating 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 of this report.

During this reporting period the OSTR accommodated a number of different OSU academic classes and other academic programs. In addition, portions of classes from other Oregon universities were also supported by the OSTR. Table III.D.1, provides detailed information on the use of the OSTR for instruction and training.

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.

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.

Analytical Equipment

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. Additional equipment for classroom use and an extensive inventory of portable radiation detection instrumentation are also available.

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.

Radioisotope Irradiation Sources

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.

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.

Laboratories and Classrooms

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 two 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 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 450EF 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).

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

Instrument Repair and Calibration Facility

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 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 Department of Energy, the Oregon Public Utilities Commission, the Oregon Health Sciences University, the Army Corps of Engineers, and the U. S. Environmental Protection Agency.

Library

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 of a number 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.

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.C.1
Gammacell 220 ^{60}Co Irradiator Use
(1118 Ci: 7/1/04)

Purpose of Irradiation	Samples	Dose Range (rads)	Number of Irradiations	Use Time (hours)
Sterilization	wood, stents, soil, bioflex strips, flower seeds, medical devices, mouse diet, syringes	2.0×10^4 to 4.0×10^6	44	1521
Biological Studies	anticancer vaccine, spleen cells	1.0×10^3 to 3.0×10^3	17	0
Botanical Studies	pollen, bean seeds, flower seeds	5.0×10^3 to 8.0×10^4	37	13
Material Evaluation	electronic components, minerals, silicon polymers, grape seed cork and oil	5.0×10^4 to 7.0×10^7	11	1572
Totals			96	3,106

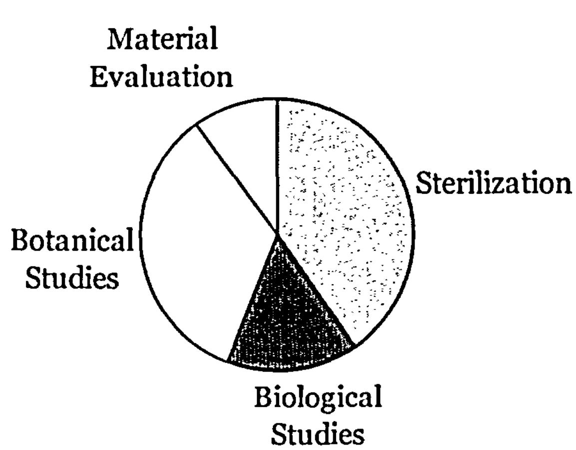


Table III.D.1

Student enrollment in courses which are taught or partially taught at the Radiation Center

Course	Credit	Course Title	Number of Students			
			Summer 2004	Fall 2004	Winter 2005	Spring 2005
Nuclear Engineering and Radiation Health Physics Department Courses						
NE/RHP114*	2	Introduction to Nuclear Engineering and Radiation Health Physics	--	29	--	--
NE/RHP115	2	Introduction to Nuclear Engineering and Radiation Health Physics	--	--	24	--
NE/RHP116*	2	Introduction to Nuclear Engineering and Radiation Health Physics	--	--	--	23
NE/RHP234	4	Nuclear and Radiation Physics I	--	39	--	--
NE/RHP235	4	Nuclear and Radiation Physics II	--	--	36	--
NE/RHP236*	4	Nuclear Radiation Detection and Instrumentation	--	--	--	35
NE319	3	Societal Aspects of Nuclear Technology	--	--	81	--
NE/RHP401	1-16	Research	--	--	--	1
NE405H	1-16	R&C/Used Nuclear Fuel: Garbage or Gold	--	--	--	--
NE405	1-16	Reading and Conference	--	--	--	--
RHP405	1-16	Reading and Conference	--	--	--	--
NE/RHP406	1-16	Projects	1	4	5	6
NE/RHP407	1	Nuclear Engineering Seminar	--	28	30	30
NE/RHP410	1-12	Internship	3	4	2	6
NE/RHP415	2	Nuclear Rules and Regulations	--	28	--	--
NE416**	4	Radiochemistry	--	--	--	1
NE450	3	ST/ Nuclear Medicine	--	--	--	--
NE451**	4	Neutronic Analysis and Lab I	--	12	--	--
NE452**	4	Neutronic Analysis and Lab II	--	--	16	--
NE453**	4	Neutronic Analysis and Lab III	--	--	--	--
NE457**	3	Nuclear Reactor Laboratory	--	--	--	--
NE467	4	Nuclear Reactor Thermal Hydraulics	--	15	--	--
NE474	4	Nuclear Systems Design I	--	--	16	--
NE475	4	Nuclear Systems Design II	--	--	--	16

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

Table III.D.1 *(continued)*

Student enrollment in courses which are taught or partially taught at the Radiation Center

Course	Credit	Course Title	Number of Students			
			Summer 2004	Fall 2004	Winter 2005	Spring 2005
NE/RHP479	1-4	Individual Design Project	--	--	--	--
NE/RHP481	4	Radiation Protection	--	24	--	--
NE/RHP482*	4	Applied Radiation Safety	--	--	19	--
RHP483	4	Radiation Biology	--	--	--	--
RHP487	3	Radiation Biology	--	--	--	--
RHP488	3	Radioecology	--	4	--	--
NE/RHP490	4	Radiation Dosimetry	--	--	--	18
RHP493	3	Non-reactor Radiation Protection	--	--	--	--
NE/RHP499	1-16	St/Environmental Aspects Nuclear Systems	--	--	--	--
NE/RHP501	1-16	Research	2	5	2	2
NE/RHP503	1	Thesis	2	8	8	15
NE/RHP505	1-16	Reading and Conference	1	--	--	1
NE/RHP506	1-16	Projects	--	--	--	--
NE/RHP507/607	1	Nuclear Engineering Seminar	--	23	19	16
NE/RHP510	1-12	Internship	3	--	--	--
NE/RHP515	2	Nuclear Rules and Regulations	--	15	--	--
NE526	3	Computational Methods for Nuclear Reactors	--	--	--	8
NE/RHP535	3	Nuclear Radiation Shielding	--	--	--	--
NE/RHP539	3	ST/Nuclear Physics for Engineers and Scientists	--	9	--	--
NE/RHP543	3	Hi-Level Radioactive Waste Management	--	--	--	--
NE/RHP549	3	Low Level Waste	--	--	--	--
NE550	3	Nuclear Medicine	--	--	--	--
NE551**	4	Neutronic Analysis and Lab I	--	3	--	--
NE552**	4	Neutronic Analysis and Lab II	--	--	2	--
NE553**	4	Neutronic Analysis and Lab III	--	--	--	7

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

Table III.D.1 *(continued)*

Student enrollment in courses which are taught or partially taught at the Radiation Center

Course	Credit	Course Title	Number of Students			
			Summer 2004	Fall 2004	Winter 2005	Spring 2005
NE557**	3	Nuclear Reactor Laboratory	--	--	--	--
NE559	1	ST/Nuclear Reactor Analysis: Criticality Safety	--	--	--	--
NE567	4	Advanced Nuclear Reactor Thermal Hydraulics	--	2	--	--
NE568	3	Nuclear Reactor Safety	--	5	--	--
NE569	1-3	ST/Thermal Hydraulic Instu-mentation	--	--	--	7
NE574	4	Nuclear Systems Design I	--	--	3	--
NE575	4	Nuclear Systems Design II	--	--	--	3
NE/RHP581	4	Radiation Protection	--	8	--	--
NE/RHP582*	4	Applied Radiation Safety	--	--	8	--
RHP583	4	Radiation Biology	--	--	11	--
NE585	3	Environmental Aspects Nuclear Systems	--	--	--	--
RHP585	3	Environmental Aspects Nuclear Systems	--	--	--	--
NE/RHP586	3	Advanced Radiation Dosimetry	--	--	--	--
RHP588	3	Radioecology	--	8	--	--
RHP589	1-3	ST/Radiation Protection and Risk Assessment	--	--	--	--
RHP593	3	Non-Reactor Radiation Protec-tion	--	--	--	--
NE599	1	ST/Principles of Nuclear Medi-cine	--	--	--	--
NE/RHP601	1-16	Research	--	--	--	--
NE/RHP603	1-16	Thesis	1	9	11	10
NE/RHP605	1-16	Reading and Conference	--	--	--	--
RHP610	1-12	Internship	--	--	--	--
NE654	3	Neutron Transport Theory	--	--	--	--
NE667	3	Advanced Thermal Hydraulics	--	--	--	2

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

Table III.D.1 *(continued)*

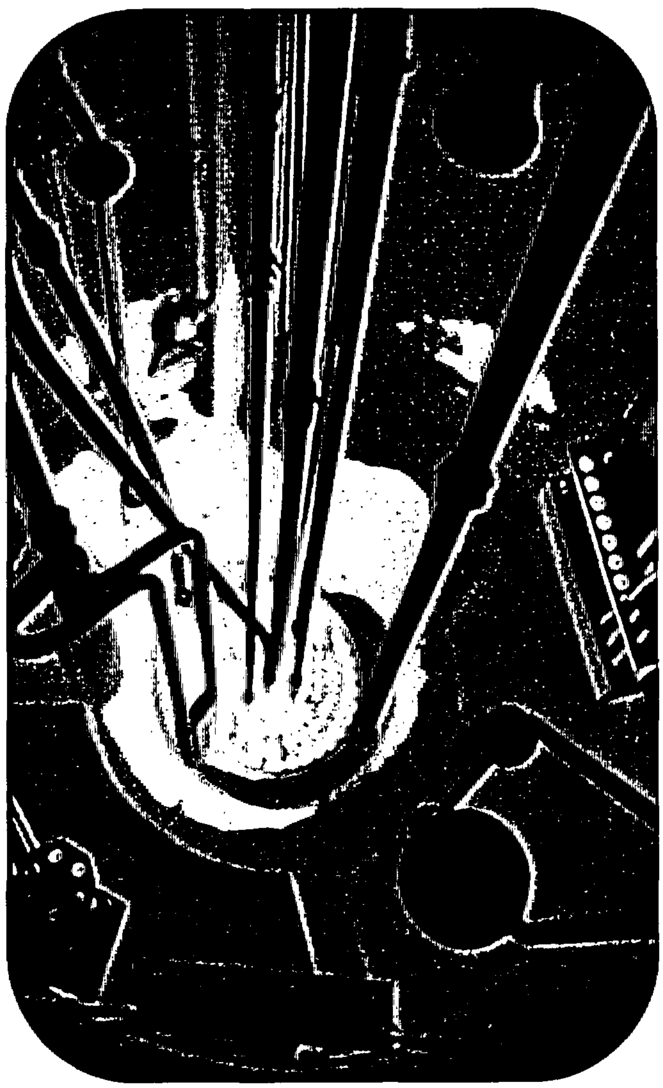
Student enrollment in courses which are taught or partially taught at the Radiation Center

Course	Credit	Course Title	Number of Students			
			Summer 2004	Fall 2004	Winter 2005	Spring 2005
Courses from Other OSU Departments						
CH123*		General Chemistry	--	--	--	285
CH222*	5	General Chemistry (Science Majors)	--	--	290	--
CH225H	5	Honors General Chemistry	--	--	37	--
CH462*	3	Experimental Chemistry II Laboratory	--	--	16	--
ENGR331	4	Momentum, Energy and Mass Transfer	--	--	99	--
GEO300	3	Environmental Conservation	--	140	--	--
PH202	5	General Physics	--	---	246	--
Courses from Other Institutions						
GS105*	LBCC	General Science	--	--	35	--

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



Reactor

Operating Status

Reactor power generation for the operating period between July 1, 2004 and June 30, 2005 totaled 973 kWH of thermal power. This is equal to 40.1 MWD of generation, and results in a cumulative thermal output by the OSTR FLIP core of 1108 MWD from August 1976 through June 30, 2005.

The productivity of the reactor irradiation facilities is based on reactor operation in relation to use categories. Greater productivity is achieved by utilizing a greater number of irradiation facilities at the same time. Tables IV.A.3 through 5 provide this years detail on reactor use and other tracked data.

A normal nine-hour, five-day per week schedule sets the total available reactor operating hours. Critical reactor operation averaged 47.6 % of each day. Of the 2277 total available annual operating hours, 1084 hours were at power, 485 hours were spent conducting facility startup and shutdown operation, 392 hours were expended for maintenance and sample decay delays and 316 hours the reactor was not operating for reasons other than listed above.

Table IV.A.1 provides information related to the OSTR annual energy production, fuel usage and use requests. Table IV.A.2 summarizes statistics for the original 20% enriched fuel loading.

Experiments Performed

Approved Experiments

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

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-31	TRIGA Flux Mapping.
B-32	Argon Production Facility.
B-33	Irradiation of Combustible Liquids in Rotating Rack.

Of these available experiments, three were used during the reporting period. Table IV.B.1 provides information related to the frequency of use and the general purpose of their use.

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, () 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.

B-30 NAA of Jet, Diesel, and Furnace Fuels.

C-1 PuO_2 Transient Experiment.

Unplanned Shutdowns

There were four 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.

Changes 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.

10 CFR 50.59 Changes to the Reactor Facility (Evaluated)

03-06, 04-03, 04-05 and 04-06, Construction and alterations to the Neutron Radiography Facility

①

Description
This series of evaluations cover the construction, alterations and configuration plans for the new radiography facility built on the Beam Port #3 centerline. Construction changes coincided with changes in construction methods and operating characteristics maturing with the projected mission of the facility. A pour-in-place and modular mix was finally decided on. Interlocks and operating restrictions were initially developed and interim measures agreed upon to conduct initial component testing while awaiting the arrival of ordered components. The final installation and testing of the system and its interlocks was based on accumulated actual operating knowledge.

Safety Analysis
The possibility of high radiation level outside the shield structure was evaluated. External scram inputs, door interlocks and the impact of consuming free reactor building volume were examined to ensure that no adverse effects were created.

04-02, Conduit Penetration of the D-104 Wall

②

Description
The addition of instrument and power cable conduit penetrations are periodically necessary for upgrading instrument installation with in the control room and the surrounding spaces. These conduit penetrations in the reactor building wall allow cables to be routed in a more efficient and unobstructed manner.

Safety Analysis
Properly sealed conduit penetrations retain the integrity of the reactor building volume consistent with leakage currently present around doors and other penetrations.

05-01, Neutron Radiography Facility Radiation Field Measurement

③

Description
Radiation levels adjacent to the NRF doors when open at power will be measured to allow meaningful set points for the installed ARMs to be determined.

Safety Analysis
Administrative control for this assessment was determined to fall under "strict supervision by safety-cognizant staff members." Power will be raised slowly and constant monitoring at the highest activity areas will be continuously conducted.

05-04, Removal of Calibration Requirement for the Left Hand Drawer Temperature Meter

④

Description
One of the original dual function meters used on the operating console has the ability to display information from two different measuring channels. When not selected to monitor fuel temperature (normal condition), this meter acts to display log power of the reactor. Requirements for calibration of this meter were removed from the calibration sheet.

Safety Analysis
The instrument is redundant and not used operationally. Additionally, the instrument is not part of the scram circuit and, therefore, would not decrease reactor safety.

05-05, Replacement of the Primary Water Level Monitor

⑤

Description
Replacement of the current optical level sensors with a continuously indicating "sono" type level probe was screened for 10CFR50.59 evaluation and determined to meet one of the screening criteria. Past experiences with the optical type probes revealed a tendency to generate spurious alarms due to bubble buildup on the probes due to dissolved gases in the primary water. The use of the reflected sound detector which generates a continuous level indication in the control room was adopted instead.

Safety Analysis
Although the safety analysis revealed no adverse impact, the system alteration constituted a change to the described SCC system and was included in the evaluation process.

10 CFR 50.59 Changes to the Reactor Facility (Screened)

Screen 05-01, Reactor Bay Wall Penetrations

①

Description
A penetration of the south wall of the Reactor Bay was needed for the installation of a conduit. This conduit carries signal cable between the console and reactor instrumentation. This change did not require an evaluation.

Justification
The change will not adversely affect the confinement building design function, effectiveness, or design basis. Because of the small size of the penetration, the leakage rate will not measurably increase and the structural integrity of the wall will not be diminished.

Screen 05-02, Replacement of the Primary Tank Water Level Monitor

②

Description
The primary tank water level monitoring system needed to be replaced with a "sono" type monitoring instrument. The old system was based upon optical light sensors which were susceptible to false positive alarms due to the formation of air bubbles on the housing of the instrument. The new system eliminated the false alarms and provides continuous level indication to the operator in the control room in addition to the high and low water level alarms. This change did require an evaluation.

Justification
The new system involves a new method of performing the measurement. It therefore automatically requires an evaluation to be performed.

Screens 05-03 and 05-04, Addition of Mechanical Stops for the Left Hand Drawer Switches

③

Description
The mechanical stops (notched washers) for three switches on the Left Hand Drawer of the reactor console were discovered to be bent and inoperable. This allowed the operator to move the switches to undefined positions and rendering the associated monitoring instruments inoperable. This modification simply involved using the original mechanical stops by straightening the notch such that it functions as intended. Only one mechanical stop was needed on each switch. This change did not require an evaluation.

Justification
The intent of this activity was to prevent to operator from moving any of the above three switches into an unmarked and inoperable position. This returned the three switches to their original condition. The change could not adversely affect the function of the instruments.

10 CFR 50.59 Changes to Reactor Procedures

Numerous changes to procedures related to reactor operation were prompted by facility changes and the periodic review of the Reactor Operations Committee (ROC).

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

04-08, Revision to OSTROPs 6, 11 and 12

Description
Changes to OSTROPs 6 and 11 corrected grammatical and reference errors ①
noted during the ROC review process. OSTROP 12 changes involved the alteration to the procedure for removing the Transient rod operating mechanism for control rod removal during inspection The new procedure eliminated the need for disconnecting the control rod connecting rod coupling below the mechanism, reducing the effort and possibility of loss of small parts within the reactor core.

Safety Analysis

No impacts on safety criteria were noted. This change updates the procedure to reflect current facility operations.

05-02, Changes to OSTROP 6

Description
This change adds the 10 CFR 50.59 Screening Process to the OSTR Adminis- ②
trative Procedure. Describes how and which changes are to be handled under the new process.

Safety Analysis
Complies with new criteria for regulatory review process.

05-03, Changes to OSTROP 18

Description
Provided for the encapsulation of samples using a sealed aluminum con- ③
tainer rather than a welded aluminum container. Many experimenters' samples are unable to withstand the high temperatures associated with welding. Approved sealant is available for this purpose.

Safety Analysis
No impacts on safety criteria were noted. This change updates the procedure to reflect current facility operations.

Surveillance and Maintenance

Non– Routine Maintenance

August 2004

Added cellular phone to control room communications system as backup to emergency communications repertoire.

First look at construction of core model parts.

Installation and configuration of the Neutron Radiography Facility continued throughout this period.

September 2004

SIT installed new brackets for holding upgraded RONAN alarm panel.

November 2004

Facility Services replaced bearings on D 100 control room exhaust fan.

January 2005

Replaced reactor bay supply system heater coil due to leak.

March 2005

SIT re-engineered sample retrieval pole and reel assembly to eliminate slip ring problems of the past.

April 2005

Pacific Power called to repair phase to ground fault on 4160 VAC feeder line from street transformer.

May 2005

Cleaned and lubricated unloader valves on the Corkin air compressor. Valves were failing to properly control output air pressure.

SIT installed new type of reactor tank level indicator using "sono" type of detector.

June 2005

Replaced SHIM rod nylon bearings with Teflon type due to binding on draw tube.

Experienced problem with safe channel power indicator due to failure of the test switch mechanical stops. Internal mechanical stops adjusted on three console switches to correct improper operation.

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 identified by shading are required by the OSTR technical specifications.

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
Operating Hours (critical)	1205	1208	1172	1352	1170	1136	1094	1158
Megawatt Hours	946	1042	993	1001	1025	1013	928	1002
Megawatt Days	39.4	43.4	41.4	41.7	42.7	42.2	38.6	41.8
Grams ^{235}U Used	49.5	54.4	51.9	52.3	53.6	53.0	48.5	52.4
Hours at Full Power (1 MW)	904	1024	980	987	1021	1009	909	992
Numbers of Fuel Elements Added or Removed (-)	0	0	0	-2	0	-1,+1	-1	0
Number of Irradiation Requests	407	403	387	373	290	301	286	297

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

Operational Data for FLIP Core	July 1, 1992 Through June 30, 1993	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
Operating Hours (critical)	1180	1248	1262	1226	1124	1029	1241	949
Megawatt Hours	1026	1122	1117	1105	985	927	1115	852
Megawatt Days	42.7	46.7	46.6	46.0	41.0	38.6	46.5	35.5
Grams ^{235}U Used	53.6	58.6	58.4	57.8	51.5	48.5	58.3	44.6
Hours at Full Power (1 MW)	1000	1109	1110	1101	980	921	1109	843
Numbers of Fuel Elements Added or Removed (-)	0	0	0	-1[5]	-1, +[7]	0	-1[5]	0
Number of Irradiation Requests	329	303	324	268	282	249	231	234

Table IV.A.1 *(continued)*

OSTR Operating Statistics (Using the FLIP Fuel Core)

Operational Data for FLIP Core	July 1, 2001 Through June 30, 2002	July 1, 2002 Through June 30, 2003	July 1, 2003 Through June 30, 2004	July 1, 2004 Through June 30, 2005	July 1, 2005 Through June 30, 2006	July 1, 2006 Through June 30, 2007	July 1, 2007 Through June 30, 2008	July 1, 2008 Through June 30, 2009
Operating Hours (critical)	1029	1100	977	1084				
Megawatt Hours	917	1025	966	973				
Megawatt Days	38.2	42.7	40.2	40.1				
Grams ^{235}U Used	47.7	50.5	48.0					
Hours at Full Power (1 MW)	912	1025	965	972				
Numbers of Fuel Elements Added or Removed (-)	-1[(5)]	0	-1[(5)]	0				
Number of Irradiation Requests	239	215	207	279				

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

Table IV.A.3

Present OSTR Operating Statistics

Operational Data for FLIP Core	Annual Values (2004/2005)	Cumulative Values for FLIP Core
MWH of energy produced	973	26,625
MWD of energy produced	40.1	1,108.3
Grams ^{235}U used	55.7	1,383.8
Number of fuel elements added to (+) or removed from (-) the core	0	78 + 3 FFCR[1]
Number of pulses	25	1,409
Hours reactor critical	1084	26,404
Hours at full power (1 MW)	972	26,203
Number of startup and shutdown checks	240	7,897
Number of irradiation requests processed	279	9,254
Number of samples irradiated	1674	114,504

(1) Fuel Follower Control Rod. These numbers represent the core loading at the end of this 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)	55	13,247
OSU Research	324	10,107
Off-campus research	1,111	21,431
Forensic services	0	234(2)
Reactor preclude time	933	23,645
Facility time(3)	57	7,174
Total Reactor Use Time	2,480	75,838

(1) See Tables III.A.1 and III.D.1 for teaching statistics (reactor tours are not logged as use).
(2) 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.
(3) The time OSTR spent operating to meet NRC facility license requirements.

Table IV.A.5
OSTR Multiple Use Time

Number of Users	Annual Values (hours)	Cumulative Values for FLIP Core (hours)
Two	383	5,831
Three	59	1,861
Four	9	646
Five	0	149.5
Six	0	59
Seven	0	12
Total Multiple Use Time	451	8,558.5

Table IV.B.1
Use of OSTR Reactor Experiments

Experiment Number	Research	Teaching	Forensic	NRC License Requirement	Other	Total
A-1	11	8	0	5	0	24
B-3	217	3	0	0	0	220
B-23	2	0	0	0	0	2
B-31	30	0	0	0	0	30
B-32	3	0	0	0	0	3
Total	263	11	0	5	0	279

Table IV.C.1
Unplanned Reactor Shutdowns and Scrams

Type of Event	Number of Occurrences	Cause of Event
Manual Reactor Scram	1	Manual operator scram following loss of off-site power
Manual Reactor Scram	1	Stack monitor filter failure alarm – not cleared. Required drive to be adjusted to clear alarm.
Period Scram	1	Period scram during rod calibration procedure (normal core, Shim rod) due to noise immediately following manual scram of regulating rod.
Manual Reactor Scram	1	Safety channel failed to increase while raising reactor power. Manual reactor scram at ~50% power. Cause determined to be inoperable safety channel caused by switch misalignment.

Figure IV.E.1

Annual Surveillance and Maintenance (Sample Form)

OSTROP 13 Rev. 10 SURVEILLANCE & MAINTENANCE FOR THE MONTH OF________________

	SURVEILLANCE & MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED *	DATE COMLETED	REMARKS and INITIALS
1	REACTOR TANK HIGH AND LOW WATER LEVEL ALARMS	MAXIMUM MOVEMENT ± 3 INCHES	UP:________INCHES DN:________INCHES ANN:________				
2	BULK WATER TEMPERATURE ALARM CHECK	FUNCTIONAL					
3	ERP INVENTORY AND INSPECTIONS	ERP App. B					
4	PRIMARY WATER Ph MEASUREMENT	MIN: 5 MAX: 8.5					
5	BULK SHIELD TANK WATER Ph MEASUREMENT	MIN: 5 MAX: 8.5					
6	CHANGE LAZY SUSAN FILTER	FILTER CHANGED					
7	REACTOR TOP CAM OIL LEVEL CHECK	OSTROP 13.10	NEED OIL?______				
8	PROPANE TANK LIQUID LEVEL CHECK	> 50%					
9	PRIMARY PUMP BEARINGS OIL LEVEL CHECK	OSTROP 13.13	NEED OIL?______				
10	WATER MONITOR CHECK						

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

Figure IV.E.2

Quarterly Surveillance and Maintenance (Sample Form)

OSTROP 14 Rev. 8 **SURVEILLANCE & MAINTENANCE FOR THE 1st / 2nd / 3rd / 4th QUARTER OF 20____**

	SURVEILLANCE & MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COMPLETED	REMARKS & INITIALS
1	REACTOR OPERATION COMMITTEE (ROC) AUDIT	QUARTERLY					
2	QUARTERLY ROC MEETING	QUARTERLY					
3	FUEL ELEMENT RADIATION LEVEL MEASUREMENTS IN WATER	≥23 R/hr @ 2' IN WATER					
4	ERP INSPECTIONS	QUARTERLY					
5	KEY INVENTORY	QUARTERLY					
6	ROTATING RACK CHECK FOR UNKNOWN SAMPLES	EMPTY					
7	WATER MONITOR ALARM CHECK	FUNCTIONAL					
8	STACK MONITOR CHECKS (OIL DRIVE MOTORS, H.V. READINGS)	MOTORS OILED					
		PART: 1150 V ±50	____V				
		GAS: 900 V ±50	____V				
9	CHECK FILTER TAPE SPEED ON STACK MONITOR	1"/HR ± 0.2					
10	INCORPORATE 50.59 & ROCAS INTO DOCUMENTATION	QUARTERLY					
11	STACK MONITOR ALARM CIRCUIT CHECKS	ALARM ON CONTACT					
12	ARM SYSTEM ALARM CHECKS	FUNCTIONAL					

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

* Date not to be exceeded is only applicable to shaded 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 Rev. 8 *(continued)*	**SURVEILLANCE & MAINTENANCE FOR THE 1st / 2nd / 3rd / 4th QUARTER OF 20____**						
	SURVEILLANCE & MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COMPLETED	REMARKS & INITIALS
13		a) $4 hours: at console (RO) or as Rx. Sup. (SRO) b) Complete Operating Exercise	a)	b)			

* Date not to be exceeded is only applicable to shaded 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 Rev. 12 SEMI-ANNUAL SURVEILLANCE AND MAINTENANCE FOR 1st /2nd HALF 20____

	SURVEILLANCE & MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]		TRANS	SAFE	SHIM	REG	LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COPLETED	REMARKS & INITIALS
1	FUNCTIONAL CHECKS OF REACTOR INTERLOCKS	NEUTRON SOURCE COUNT RATE INTERLOCK					NO WITHDRAW					
							≥5 cps					
		TRANSIENT ROD AIR INTERLOCK					NO PULSE					
		PULSE PROHIBIT ABOVE 1 kW					≥1 kW					
		TWO ROD WITHDRAWAL PROHIBIT					1 only					
		PULSE MODE ROD MOVEMENT INTERLOCK					NO MOVEMENT					
		MAXIMUM PULSE REACTIVITY INSERTION LIMIT					# $2.50					
		PULSE INTERLOCK ON RANGE SWITCH					NO PULSE					
2	SAFETY CIRCUIT TEST	PERIOD SCRAM					≥3 sec					
3	CONTROL ROD WITHDRAWAL, INSERTION & SCRAM TIMES		TRANS	SAFE	SHIM	REG	≤2 sec					
		SCRAM										
		WITHDRAWAL					≤50 sec					
		INSERTION					≤50 sec					
4	TEST PULSE	PULSE #____ $____ ____MW ____°C					≤20% CHANGE	PULSE #____ $____ ____MW ____°C				
5	REACTOR BAY VENTILATION SYSTEM SHUTDOWN TEST						DAMPERS CLOSE IN ≤5 SECONDS	1st FLOOR 4th FLOOR				
6	CALIBRATION OF THE FUEL ELEMENT TEMPERATURE CHANNEL						±20C					
7	EMERGENCY RESPONSE PLAN INVENTORY						ERP, App. B					
8	CLEANING & LUBRICATION OF TRANSIENT ROD CARRIER INTERNAL BARREL											
9	LUBRICATION OF BALL-NUT DRIVE ON TRANSIENT ROD CARRIER											

* Date not to be exceeded is only applicable to shaded items. It is equal to the date completed last quarter plus four months.

Figure IV.E.3 *(continued)*

Semi-Annual Surveillance and Maintenance (Sample Form)

OSTROP 15 Rev. 12 ***(continued)*** **Semi-Annual Surveillance and Maintenance for 1st/2nd Half 20____**

	SURVEILLANCE & MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]		LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COPLETED	REMARKS & INITIALS
10	LUBRICATION OF THE ROTATING RACK BEARINGS		10W OIL					
11	CONSOLE CHECK LIST		OSTROP 15.XI					
12	INVERTER MAINTENANCE		See User Manual					
13	STANDARD CONTROL ROD MOTOR CHECKS		LO-17 Bodine Oil					
14	ION CHAMBER RESISTANCE MEASUREMENTS WITH MEGGAR INDUCED VOLTAGE	SAFETY CHANNEL	NONE (Info Only)					
		%POWER CHANNEL	NONE (Info Only)					
15	FISSION CHAMBER RESISTANCE CALCULATION $R = \frac{800\text{ V}}{\Delta I}$	@ 100 V. I = AMPS @ 900 V. I = AMPS ΔI = AMPS R = ____________ Ω	NONE (Info Only)					
16	FUNCTIONAL CHECK OF HOLDUP TANK WATER LEVEL ALARMS		OSTROP 15.XVIII	HIGH FULL GREEN LIGHT				
17	INSPECTION OF THE PNEUMATIC TRANSFER SYSTEM	BRUSH INSPECTION						
		SOLENOID VALVE INSPECTION	FUNCTIONAL					
		SAMPLE INSERTION TIME CHECK	≤6 SECONDS					

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

OSTROP 16.0 Rev. 10 — **Annual Surveillance and Maintenance for 20_____**

[SHADE INDICATES LICENSE REQUIREMENT]			LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COMPLETED	REMARKS & INITIALS
1	BIENNIAL INSPECTION OF CONTROL RODS:	FFCRS	OSTROP 12.0					
		TRANS						
2	ANNUAL REPORT		NOV 1		OCT 1	NOV 1		
3	CONTROL ROD CALIBRATION:	NORMAL	OSTROP 9.0					
		CLICIT						
		ICIT/DUMMY						
4	REACTOR POWER CALIBRATION		OSTROP 8.0					
5	CALIBRATION OF REACTOR TANK WATER TEMP TEMPERATURE METERS t		OSTROP 16.5					
6	CONTINUOUS AIR MONITOR CALIBRATION:	Particulate Monitor	RCHPP 18					
		Gas Monitor						
7	STACK MONITOR CALIBRATION	Particulate Monitor	RCHPP 18 & 26					
		Gas Monitor						
8	AREA RADIATION MONITOR CALIBRATION		RCHPP 18.0					
9	DECOMMISSIONING COST UPDATE		N/A	N/A		AUGUST 1		
10	SNM PHYSICAL INVENTORY		N/A	N/A		OCTOBER 1		
11	MATERIAL BALANCE REPORTS		N/A	N/A		NOVEMBER 1		
12	STANDARD CONTROL ROD DRIVE INSPECTION		OSTROP 16.13					
13	HEU TO LEU CONVERSION REPORT		10 CFR 50.64		MAR 10	MAR 27		

Figure IV.E.4

Annual Surveillance and Maintenance (Sample Form)

OSTROP 16.0 Rev. 10 (continued) **Annual Surveillance and Maintenance for 20_____**

	SURVEILLANCE AND MAINTENANCE [SHADE INDICATES LICENSE REQUIREMENT]		LIMITS	AS FOUND	TARGET DATE	DATE NOT TO BE EXCEEDED*	DATE COMPLETED	REMARKS and INITIALS
14	EMERGENCY RESPONSE PLAN	CFD TRAINING						
		GOOD SAM TRAINING						
		ERP REVIEW						
		ERP DRILL						
		FIRST AID FOR:						
		FIRST AID FOR:						
		EVACUATION DRILL						
		AUTO EVAC ANNOUNCEMENT TEST						
		ERP EQUIPMENT INVENTORY						
		BIENNIAL SUPPORT AGREEMENTS						
15	PHYSICAL SECURITY PLAN	OSP/DPS TRAINING						
		PSP REVIEW						
		PSP DRILL						
		LOCK/SAFE COMBO CHANGES						
		AUTHORIZATION LIST UPDATE						
		SPOOF MEASUREMENTS						
16	REACTOR TANK AND CORE COMPONENT INSPECTION		NO WHITE SPOTS					
17	EMERGENCY LIGHT LOAD TEST		RCHPP 18.0					
18	FUEL ELEMENT INSPECTION FOR SELECTED ELEMENTS (B1, B2, B3, B5, B6, C3, C5, D5, D6)		PASS GO/NO GO		Pulse #______ Date________			
19	FUNCTIONAL TEST OF THE REACTOR WATER LOW LEVEL ALARM		~3 INCHES	_____INS ___ANN				

20	REACTOR OPERATOR LICENSE CONDITIONS OPERATOR NAME	ANNUAL REQUALIFICATION				BIENNIAL MEDICAL		EVERY 6 YEARS LICENSE		
		WRITTEN EXAM		OPERATING TEST		DATE DUE	DATE COMPLETED	APPLICATION		EXPIRATION DATE
		DATE DUE	DATE PASSED	DATE DUE	DATE PASSED			DUE DATE	DATE MAILED	

Part V
Radiation Protection

Protection

Introduction

The purpose of the radiation protection 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, a Health Physicist, 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 Department of Energy Rule No. 345-30-010, which requires an annual report of environmental effects due to research reactor operations.

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).

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.

Liquid Effluents

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 Ra-

diation Center and reactor made one liquid effluent release to the sanitary sewer. All Radiation Center and reactor facility liquid effluent data pertaining to this release are contained in Table V.B.1.a.

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.

Airborne Effluents Released

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

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.

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

Particulate Effluents

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.

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 OSU Radiation Safety. Until this waste is disposed of by the Radiation Safety Office, 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 OSU 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.

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.

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.

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 Monitor Radiation Center (MRC) designator show the room number or location.

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.

Environmental Survey Data

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

Gamma Radiation Monitoring

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.

During this reporting period, each fence environmental station utilized an LIF TLD monitoring packet supplied and processed by Global Dosimetry Solutions, Inc. Service (GDS), Irvine, California. Each GDS packet contained three LIF TLDs and was exchanged quarterly for a total of 108 samples during the reporting period (9 stations x 3 TLDs per station x 4 quarters). The total number of GDS TLD samples for the reporting period was 108. A summary of the GDS TLD data is also 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 back-ground radiation, which is about 110 mrem per year for Oregon (Refs. 1, 2).

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 monitoring station is located 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). The total number of GDS TLD samples for the reporting period was 204. A summary of GDS TLD data for the off-site monitoring stations 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).

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 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 taken during this reporting period is 86 (16 soil samples, 14 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 back-ground from the gross beta counting rate, followed by application of an appropri-ate 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 concentration and the range of 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.

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.

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	Collect and analyze TRIGA primary, secondary, and make-up water. Exchange personnel dosimeters and inside area monitoring dosimeters, and review exposure reports. Inspect laboratories. 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 Radio-Nuclides in the Waste	Specific Activity For Each Detectable Radionuclide in the Waste, Where The Release Concentration Was>1 x 10^{-7} ($\mu Ci\ ml^{-1}$)	Total Quantity of Each Detectable Radionuclide Released in the Waste (Curies)	Average Concentration Of Released Radioactive Material at the Point of Release ($\mu Ci\ ml^{-1}$)	Percent of Applicable Monthly Average Concentration for Released Radioactive Material (%)[3]	Total Volume of Liquid Effluent Released Including Diluent[4] (gal)
September 2004	0	N/A	0	0	0	0	1750
Annual Total for Radiation Center	0	N/A	0	0	0	0	1750
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 the absolute minimum radioactive wastes disposed to the sanitary sewer. There were no liquid effluent released during months no 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—10.2401, 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.

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
TRIGA Reactor Facility	N/A	---	---	---
Radiation Center Laboratories	2	^{14}C	8.98E x 10^{-6}	10/7/04
TOTAL	2	^{14}C	8.98 x 10^{-6}	10/7/04

(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.

Table V.B.2

Monthly TRIGA Reactor Gaseous Waste Discharges and Analysis[1]

Month	Total Estimated Activity Released (Curies)	Total Estimated Quantity of Argon-41 Released[2] (Curies)	Estimated Atmospheric Diluted Concentration of Argon-41 at Point of Release (μCi/cc)	Fraction of the Technical Specification Annual Average Argon-41 Concentration Limit (%)
July	0.21	0.21	1.81E-08	0.45
August	0.16	0.16	1.38E-08	0.35
September	0.13	0.13	1.17E-08	0.29
October	0.06	0.06	5.51E-09	0.14
November	0.11	0.11	1.01E-08	0.25
December	0.12	0.12	1.07E-08	0.27
January	0.15	0.15	1.27E-08	0.32
February	0.19	0.19	1.77E-08	0.44
March	0.18	0.18	1.52E-08	0.38
April	0.12	0.12	1.11E+00	0.28
May	0.12	0.12	1.03E-08	0.26
June	0.14	0.14	1.26E-08	0.31
TOTAL ('04-'05)	1.70	1.70	1.25E-08	0.31

(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
TRIGA Reactor Facility	15.25	^{46}Sc, ^{54}Mn, ^{58}Co, ^{75}Se, ^{124}Sb, ^{24}Na, ^{60}So, ^{150}Eu, ^{3}H, ^{51}Cr	1.13×10^{-3}	6/1/05
Radiation Center Laboratories	9.5	^{14}C, ^{3}H, ^{60}Co, ^{75}Se, ^{137}Cs, ^{54}Mn	5.68×10^{-5}	11/1/05
TOTAL	24.75	See Above	1.1868E-3	---

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

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	117	422	165	1189	702	2532
Key Facility Research Personnel	0	<4	0	59	0	84
Facilities Services Maintenance Personnel	0	N/A	0	44	0	N/A
Laboratory Class Students	<7	5.88	27	28	56	252.84
Campus Police and Security Personnel	0	N/A	0	N/A	0	N/A
Visitors	<7	N/A	10	N/A	113.1	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 x β(γ) (mrem)	Dose Equivalent(1)(2) Neutron (mrem)
MRCTNE	D104: North Badge East Wall	164	ND
MRCTSE	D104: South Badge East Wall	133	ND
MRCTSW	D104: South Badge West Wall	341	ND
MRCTNW	D104: North Badge West Wall	83	ND
MRCTWN	D104: West Badge North Wall	157	ND
MRCTEN	D104: East Badge North Wall	286	ND
MRCTES	D104: East Badge South Wall	1252	ND
MRCTWS	D104: West Badge South Wall	286	ND
MRCTTOP	D104: Reactor Top Badge	401	ND
MRCTHXS	D104A: South Badge HX Room	414	ND
MRCTHXW	D104A: West Badge HX Room	142	ND
MRCD-302	D302: Reactor Control Room	240	ND
MRCD-302A	D302A: Reactor Supervisor's Office	58	N/A
MRCBP1	D104: Beam Port Number 1	120	ND
MRCBP2	D104: Beam Port Number 2	185	ND
MRCBP3	D104: Beam Port Number 3	599	ND
MRCBP4	D104: Beam Port Number 4	431	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]	
		x β(γ) (mrem)	Neutron (mrem)
MRCA100	A100: Receptionist's Office	13	N/A
MRCBRF	A102H: Front Personnel Dosimetry Storage Rack	11	N/A
MRCA120	A120: Stock Room	137	N/A
MRCA120A	A120A: NAA Temporary Storage	15	N/A
MRCA126	A126: Radioisotope Research Lab	37	N/A
MRCCO-60	A128: ^{60}Co Irradiator Room	189	N/A
MRCA130	A130: Shielded Exposure Room	12	N/A
MRCA132	A132: TLD Equipment Room	26	N/A
MRCA138	A138: Health Physics Laboratory	21	N/A
MRCA146	A146: Gamma Analyzer Room (Storage Cave)	248	N/A
MRCB100	B100: Gamma Analyzer Room (Storage Cave)	67	N/A
MRCB114	B114: Lab (^{226}Ra Storage Facility)	1,494	ND
MRCB119-1	B119: Source Storage Room	282	N/A
MRCB119-2	B119: Source Storage Room	358	N/A
MRCB119A	B119A: Sealed Source Storage Room	5,658	1,808
MRCB120	B120: Instrument Calibration Facility	76	N/A
MRCB122-2	B122: Radioisotope Storage Hood	25	N/A
MRCB122-3	B122: Radioisotope Research Laboratory	33	N/A
MRCB124-1	B124: Radioisotope Research Lab (Hood)	26	N/A
MRCB124-2	B124: Radioisotope Research Laboratory	85	N/A
MRCB124-6	B124: Radioisotope Research Laboratory	25	N/A
MRCB128	B128: Instrument Repair Shop	0	N/A
MRCC100	C100: Radiation Center Director's Office	0	N/A
MRCC106A	C106A: Staff Lunch Room	11	N/A
MRCC106B	C106: Custodian Supply Storage	12	N/A
MRCC106-H	C106H: East Loading Dock	21	N/A
MRCC118	C118: Radiochemistry Laboratory	0	N/A

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 β(γ) (mrem)	Neutron (mrem)
MRCC120	C120: Student Counting Laboratory	0	N/A
MRCF100	F100: APEX Facility	0	N/A
MRCF102	F102: APEX Control Room	0	N/A
MRCB125N	B125: Gamma Analyzer Room (Storage Cave)	235	N/A
MRCN125S	B125: Gamma Analyzer Room	0	N/A
MRCC124	C124: Classroom	25	N/A
MRCC130	C130: Radioisotope Laboratory (Hood)	11	N/A
MRCD100	D100: Reactor Support Laboratory	11	N/A
MRCD102	D102: Pneumatic Transfer Terminal Lab	163	ND
MRCD102-H	D102H: 1st Floor Corridor at D102	57	ND
MRCD106-H	D106H: 1st Floor Corridor at D106	143	N/A
MRCD200	D200: Reactor Administrator's Office	161	ND
MRCD202	D202: Senior Health Physicist's Office	163	ND
MRCBRR	D200H: Rear Personnel Dosimetry Storage Rack	25	N/A
MRCD204	D204: Health Physicist Office	136	ND
MRCATHRL	F104: ATHRL	22	ND
MRCD300	D300: 3rd Floor Conference Room	119	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 4 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.

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/hr)		Contamination Levels[1] (dpm/cm²)	
	Average	Maximum	Average	Maximum
TRIGA Reactor Facility:				
Reactor Top (D104)	<1	70	<500	1,428
Reactor 2nd Deck Area (D104)	2.52	33	<500	<500
Reactor Bay SW (D104)	<1	10	<500	21,304
Reactor Bay NW (D104)	<1	22	<500	2,679
Reactor Bay NE (D104)	<1	130	<500	10,535
Reactor Bay SE (D104)	<1	7	<500	1,086
Class Experiments (D104, D302)	<1	<1	<500	<500
Demineralizer Tank & Make Up Water System (D104A)	<1	20	<500	<500
Particulate Filter--Outside Shielding (D104A)	<1	1.5	<500	<500
Radiation Center:				
NAA Counting Rooms (A146, B100)	<1	1.10	<500	<500
Health Physics Laboratory (A138)	<1	<1	<500	<500
^{60}Co Irradiator Room and Calibration Rooms (A128, B120, A130)	<1	17.18	<500	<500
Radiation Research Labs (A136) (B108, B114, B122, B124, C126,, C130, C132A)	<1	9.00	<500	<500
Radioactive Source Storage (B119, B119A, A120A)	1.48	18.40	<500	<500
Student Chemistry Laboratory (C118)	<1	<1	<500	<500
Student Counting Laboratory (C120)	<1	1.10	<500	<500
Operations Counting Room (B136, C125)	<1	1.00	<500	<500
Pneumatic Transfer Laboratory (D102)	<1	7.00	<500	<500
RX support 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 GSD TLDs[1, 2] (mrem)
MRCFE-1	88 ± 2
MRCFE-2	83 ± 2
MRCFE-3	79 ± 2
MRCFE-4	81 ± 2
MRCFE-5	77 ± 1
MRCFE-6	84 ± 2
MRCFE-7	80 ± 0
MRCFE-8	80 ± 0
MRCFE-9	79 ± 3

(1) Average Corvallis area natural background using GDS TLDs totals 72 ± 8 mrem for the same period.

(2) ± 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 (See Figure V.E.2)	Total Recorded Dose Equivalent (Including Background) Based on GDS TLDs[4] (mrem)
MRCTE-2	57 ± 3[1]
MRCTE-3	91 ± 3
MRCTE-4	60 ± 2[3]
MRCTE-5	62 ± 2[1]
MRCTE-6	78 ± 4
MRCTE-7	67 ± 4[1]
MRCTE-8	94 ± 4
MRCTE-9	89 ± 3
MRCTE-10	60 ± 2[2]
MRCTE-12	90 ± 3
MRCTE-13	62 ± 2[1]
MRCTE-14	55 ± 3[1]
MRCTE-15	74 ± 3
MRCTE-16	64 ± 7[1]
MRCTE-17	79 ± 2
MRCTE-18	59 ± 4[1]
MRCTE-19	87 ± 2
MRCTE-20	67 ± 5[1]
MRCTE-21	72 ± 4
MRCTE-22	73 ± 1

(1) Totals were for three quarters.

(2) Average Corvallis area natural background using GDS TLDs totals 74 ± 8 mrem for the same period.

(3) One quarter readings were lost or damaged.

(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	5.30E-08 ± 1.27E-08[2]	µCi ml-1
4-W	Water	5.06E-08 ± 7.33E-09[2]	µ Ci ml-1
11-W	Water	4.83E-08 ± 3.00E-09[2]	µCi ml-1
19-RW	Water	5.78E-08 ± 4.00E-08[2]	µCi ml-1
3-S	Soil	2.14E-05 ± 2.72E-08[1]	µCi g-1 of dry soil
5-S	Soil	1.01E-05 ± 4.69E-06	µCi g-1 of dry soil
20-S	Soil	1.40E-05 ± 9.89E-06	µCi g-1 of dry soil
21-S	Soil	2.30E-05 ± 1.01E-05	µCi g-1 of dry soil
2-G	Grass	2.87E-04 ± 2.67E-04	µCi g-1 of dry ash
6-G	Grass	2.87E-04 ± 1.22E-04	µCi g-1 of dry ash
7-G	Grass	3.43E-04 ± 4.72E-05	µCi g-1 of dry ash
8-G	Grass	2.96E-04 ± 1.37E-04	µCi g-1 of dry ash
9-G	Grass	2.58E-04 ± 2.46E-04	µCi g-1 of dry ash
10-G	Grass	3.29E-04 ± 3.73E-04[1]	µCi g-1 of dry ash
12-G	Grass	2.85E-04 ± 1.85E-04	µCi g-1 of dry ash
13-G	Grass	2.03e-04 ± 2.53E-04	µCi g-1 of dry ash
14-G	Grass	3.52E-04 ± 6.06E-04	µCi g-1 of dry ash
15-G	Grass	1.35E-04 ± 1.05E-04	µCi g-1 of dry ash
16-G	Grass	2.61E-04 ± 4.65E-05	µCi g-1 of dry ash
17-G	Grass	1.49E-04 ± 7.93E-05	µCi g-1 of dry ash
18-G	Grass	2.00E-04 ± 2.56E-04	µCi g-1 of dry ash
22-G	Grass	2.32E-04 ± 2.95E-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 Beta-Gamma Concentration and Range of Values for Soil, Water, and Vegetation Samples

Sample Type	Average Value	Range of Values	Reporting Units
Soil	1.71E-05	6.69E-06 *to* 4.12E-05	µCi g of dry soil
Water	5.20E-08	4.7E-08 *to* 8.84E-08	µCi cc
Vegetation	2.58E-04	3.26E-05 *to* 8.02E-04	µCi g 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				
		Exempt	Limited Quantity	Yellow II	Yellow III	Total
Berkeley Geochronology Center Berkeley, CA USA	8.13E-07	1	6	0	0	7
Cal State Fullerton Fullerton, CA USA	4.57E-09	0	1	0	0	1
Columbia University Palisades, NY USA	5.59E-07	2	1	0	0	3
Idaho State University Pocatello, ID USA	2.59E-05	0	1	9	0	10
Kansas State University Manhatten, KS USA	4.21E-06	0	6	1	0	7
Lawrence Berkeley National Laboratory Berkeley, CA USA	8.51E-06	0	0	1	0	1
Massachussets Institute of Technology Cambridge, MA USA	2.47E-07	0	1	0	0	1
Nu-Trek, Inc Poway, CA USA	1.76E-07	1	0	0	0	1
Oregon Health and Science University Portland, OR USA	2.22E-05	0	0	1	0	1
Oregon State University Corvallis, OR USA	7.79E-06	0	0	2	0	2
Oregon State University Oceanography Dept. Corvallis, OR USA	5.83E-06	0	0	3	0	3
Plattsburgh State University Plattsburgh, NY USA	1.97E-08	1	1	0	0	2
Rutgers Piscataway, NJ USA	3.12E-06	2	5	0	0	7
Stanford University Stanford, CA USA	1.61E-07	0	2	0	0	2
Syracuse University Syracuse, NY USA	7.06E-08	1	1	0	0	2

Table V.F.1 (continued)
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				
		Exempt	Limited Quantity	Yellow II	Yellow III	Total
Tracerco Houston, TX USA	3.78E-02	0	0	0	4	4
Union College Schenectady, NY USA	4.14E-07	3	3	0	0	6
University of California at Berkeley Berkeley, CA USA	4.30E-07	0	0	2	0	2
University of California at Santa Barbara Santa Barbara, CA USA	2.60E-07	0	3	0	0	3
University of Florida Gainesville, FL USA	1.42E-07	1	1	0	0	2
University of Michigan Ann Arbor, MI USA	2.18E-06	0	0	1	0	1
University of Southern California Los Angeles, CA USA	5.05E-09	0	1	0	0	1
University of Washington Seattle, WA USA	9.32E-10	0	1	0	0	1
University of Wisconsin-Madison Madison, WI USA	5.81E-06	2	3	2	0	7
University of Wyoming Laramie, WY USA	2.77E-09	2	0	0	0	2
Totals	3.78E-02	16	37	22	4	79

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	
		Limited Quantity	Total
JL Shepherd & Associates San Fernando, CA USA	0.00E + 00	0	0
PGE Trojan Nuclear Plant Rainier, OR USA	9.00E – 07	1	1
Totals	9.00E - 07	1	1

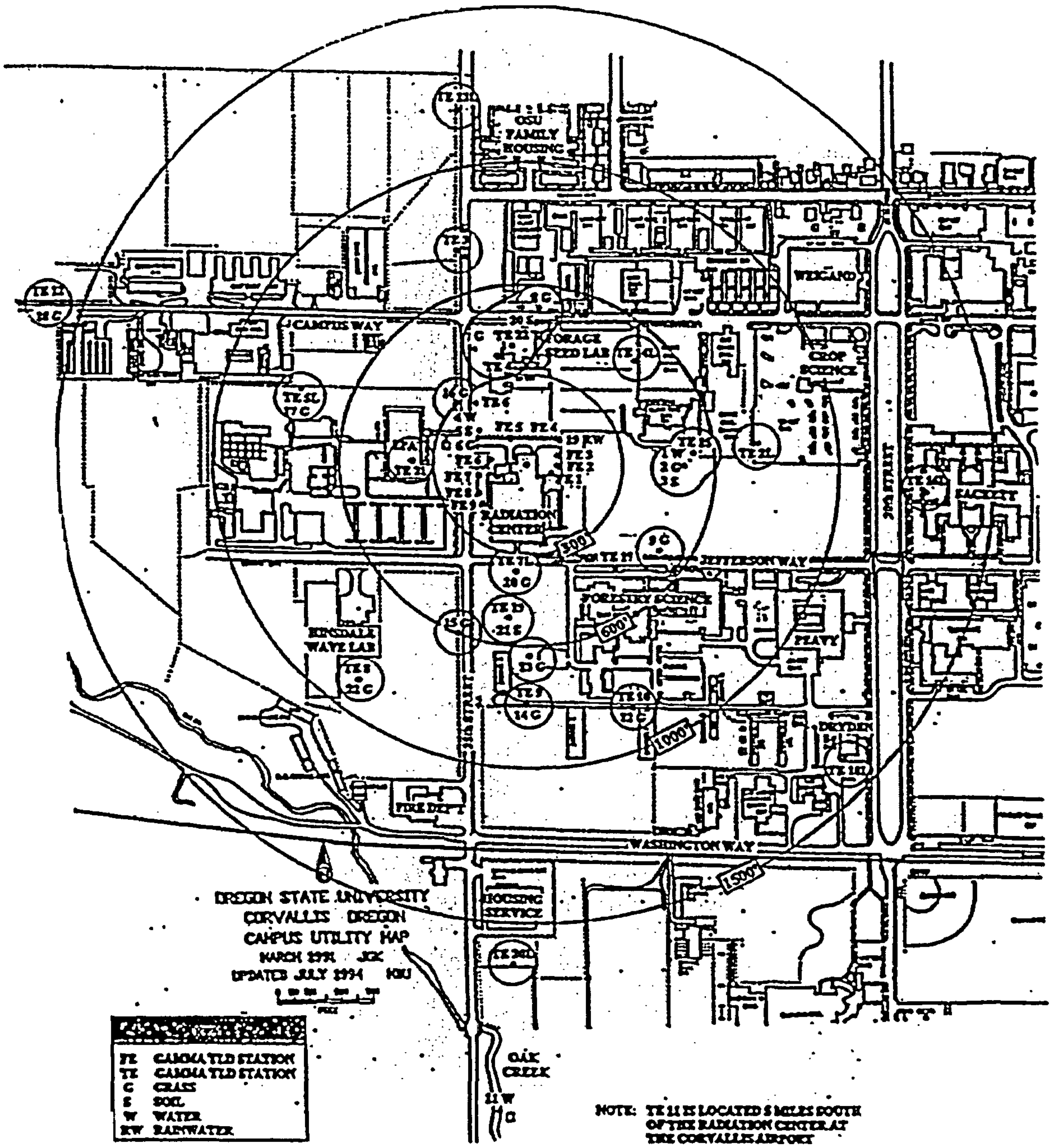
Table V.F.3

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

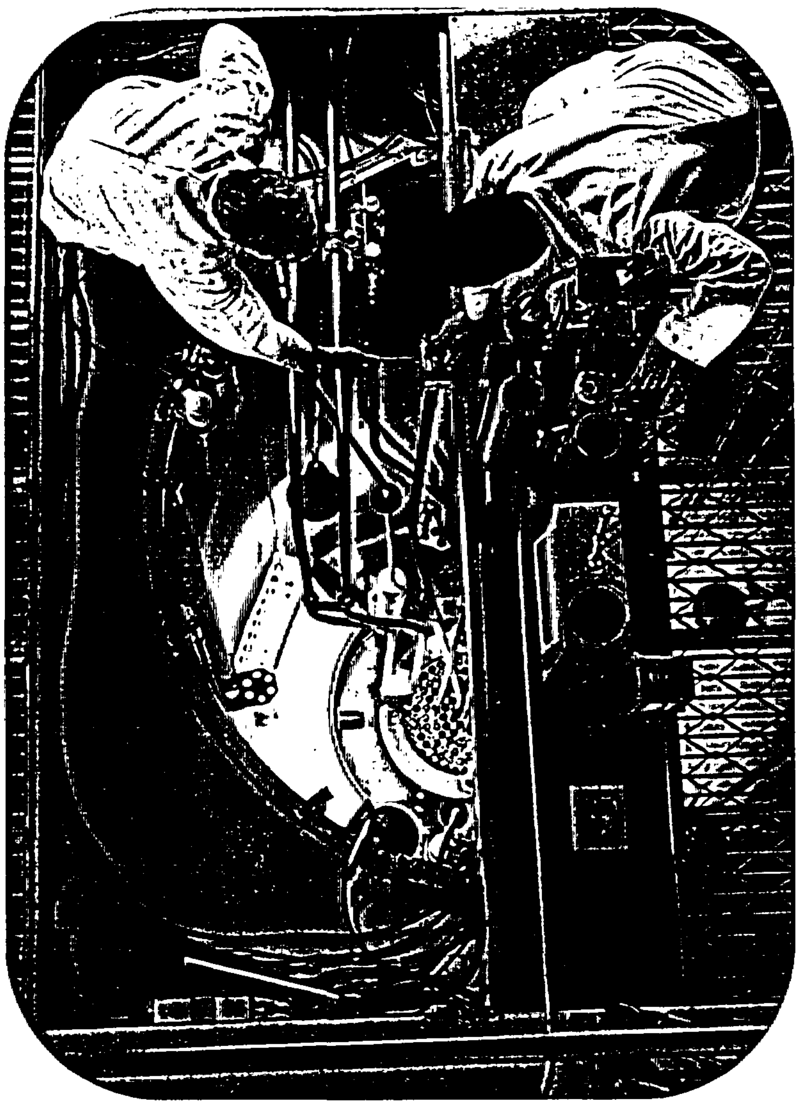
Shipped To	Total Activity (TBq)	Number of Shipments			
		Exempt	Limited Quantity	Yellow II	Total
Geological Survey of Norway Trondheim, NORWAY	2.65E-09	2	0	0	2
TRIUMF Vancouver, British Columbia CANADA	2.15E-05	0	0	1	1
Universita' Degli Studi di Bologna Bologna, ITALY	6.33E-09	1	0	0	1
Universitaet Jena Jena, Germany	2.71E-08	1	0	0	1
Universitat Potsdam Postdam, GERMANY	9.72E-09	0	1	0	1
Universitat Tubingen Tubingen, GERMANY	7.13E-09	1	1	0	2
Universite Paris-Sud Paris, FRANCE	1.99E-06	0	0	1	1
University of Geneva Geneva, SWITZERLAND	8.10E-08	0	2	0	2
University of Queensland Brisbane, Queensland AUSTRALIA	2.38E-06	0	0	2	2
Vrije Universiteit Amsterdam, THE NETHERLANDS	4.81E-07	0	2	0	2
Totals	2.65E-05	5	6	4	10

Figure V.D.1

Monitoring Stations for the OSU TRIGA Reactor



Part VI
Work



Work

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.

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. 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.

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.

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 sam-

ple 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.

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.

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.

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 Department 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 in Corvallis.

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.

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.

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 OSU 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 State of Oregon Radiation Protection Services (RPS) in the event of a radiological emergency within the state of Oregon. In this role, the Radiation Center will provide gamma ray spectrometric analy-

sis of water, soil, milk, food products, vegetation, and air samples collected by RPS radiological response field teams. As part of the ongoing preparation for this emergency support, the Radiation Center participates in inter-institution drills.

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.

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.

Public Relations

The continued interest of the general public in the OSTR is evident by the number of people who have toured the facility. See Table VI.F.1 for statistics on scheduled visitors.

Table VI.C.1

Institutions, Agencies and Groups Which Utilized the Radiation Center

Number of Institutions, Agencies and Groups	Number of Projects	Number of Times of Faculty Involvement	Number of Students Involved	Number of Uses of Center Facilities
* Oregon State University Corvallis, OR USA	26	24	11	121(2)
* Oregon State University Corvallis, OR USA	14	12	0	38
AVI Bio Pharma Corvallis, OR USA	2	0	0	8
* Crescent Valley High School Corvallis, OR USA	2	1	0	10
* Linn Benton Community College Albany, OR USA	1	0	0	3
* Marist High School Eugene, OR USA	1	0	0	1
* University of Oregon Eugene, OR USA	1	1	0	1
* USDOE Albany Research Center Albany, OR USA	1	0	0	1
Nunhems USA, Inc. Brooks, OR USA	1	1	0	33
* Oregon Health Sciences University Portland, OR USA	1	1	0	1
OxiBio Portland, OR USA	1	0	0	2
Providence St. Vincent Hospital Portland, OR USA	2	0	0	21
Rogue Community College Grants Pass, OR USA	1	0	0	1
Heritage University Toppenish, WA USA	1	1	0	4
* Idaho State University Pocatello, ID USA	2	2	0	5
* Berkeley Geochronology Center Berkeley, CA USA	1	0	8	13
M. K. Gems and Minerals Cerritos, CA USA	1	0	0	2
* Nu-Trek, Inc Poway, CA USA	1	0	0	7
* Stanford University Stanford, CA USA	2	2	0	4
* University of California at Berkeley Berkeley, CA USA	3	3	1	3
* University of California at Santa Barbara Santa Barbara, CA USA	2	3	5	3

Table VI.C.1 *(continued)*
Institutions, Agencies and Groups Which Utilized the Radiation Center

Number of Institutions, Agencies and Groups	Number of Projects	Number of Times of Faculty Involvement	Number of Students Involved	Number of Uses of Center Facilities
* University of Southern California Los Angeles, CA USA	1	1	0	1
* University of Wyoming Laramie, WY USA	2	2	2	1
* Tracerco Houston, TX USA	1	0	0	2
* University of Wisconsin Madison, WI USA	2	2	5	11
* Eastern Michigan University Ypsilanti, MI USA	1	1	0	1
* Flink Ink Ann Arbor, MI USA	1	0	0	1
* Great Lakes Environmental Research Lab Ann Arbor, MI USA	1	1	0	5
* University of Michigan Ann Arbor, MI USA	2	4	0	16
* University of Cincinnati Cincinnati, OH USA	1	0	1	2
* Columbia University Palisades, NY USA	2	2	3	5
* George Washington University Washington, DC USA	2	2	0	4
* North Carolina State University Raleigh, NC USA	2	1	1	1
* Plattsburgh State University Plattsburgh, NY USA	2	2	0	2
* Syracuse University Syracuse, NY USA	2	2	2	1
* Union College Schenectady, NY USA	2	2	8	6
* Rutgers Piscataway, NJ USA	3	3	5	12
Arch Chemicals Inc. Cheshire, CT USA	1	0	9	
* Massachusetts Institute of Technology Cambridge, MA USA	2	1	15	1
* University of Florida Gainesville, FL USA	1	1	4	2
Vectron International Norwalk Inc. Norwalk, CT USA	1	0	0	3
* Vrije Universiteit Amsterdam, THE NETHERLANDS	1	1	4	1

Table VI.C.1 *(continued)*

Institutions, Agencies and Groups Which Utilized the Radiation Center

Number of Institutions, Agencies and Groups	Number of Projects	Number of Times of Faculty Involvement	Number of Students Involved	Number of Uses of Center Facilities
* Geological Survey of Norway Trondheim, NORWAY	1	1	0	2
* Universita' di Bologna Bologna, ITALY	1	1	0	1
* Universitat Potsdam Postdam, GERMANY	1	0	0	2
* University of Geneva Geneva, SWITZERLAND	1	1	4	3
* University of Goettingen Gottingen, GERMANY	1	1	3	2
* University of Jena Jena, GERMANY	1	1	0	1
* Unversity of Tubingen Tubingen, GERMANY	2	2	1	1
* University of Queensland Brisbane, Queensland AUSTRALIA	1	1	0	3
Totals:	109	88	83	384

* Project which involves the OSTR.

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

(2) 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 and Radiation Health Physics or Department of Chemistry or projects conducted by Dr. W. D. Loveland, which involve daily use of Radiation Center facilities.

Table V1.C.2
Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	Advisor	Project	Thesis Topic
Albert-Ludwigs-Universitaet					
Link, Katharina	PhD	Mineralogy	Rahn	1595	Fission track dating of Mid-European Rhine graben shoulder uplift
Berkeley Geochronology Center					
Brownlee, Sarah	PhD	Geology	Renne	920	Application of 39Ar/40Ar Geochronology
Chang, Su-chin	PhD	Geology	Renne	920	Application of 39Ar/40Ar Geochronology
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
Morgan, Leah	PhD	Geology	Renne	920	Application of 39Ar/40Ar Geochronology
Paine, Jeffery	MS	Geology	Renne	920	Experimental Studies of 39Ar Recoil and Isotope Fractionation Relevant to 40Ar/39Ar Geochronology
Zhou, Zhensheng	MA	Earth and Planetary Science	Renne	920	Rates and Tempo of Permian-Triassic Boundary Events.
California State University at Fullerton					
Irwin, Christine	MS	Geological Sciences	Armstrong	1625	Uplift of the Puente Hills using fission track data
Columbia University					
Downing, Greg	PhD		Hemming	1705	Application of 39Ar/40Ar Geochronology
Walker, Chris	PhD		Anders	1705	Application of 39Ar/40Ar Geochronology
Massachusetts Institute of Technology					
Barry, T.	PhD	Leicester University	Pringle	1073	Mongolian Basalts/Tectonics
Blecher, J.	PhD	Oxford University	Pringle	1073	Aden Volcanic Differentiation

Table V1.C.2 *(continued)*
Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	Advisor	Project	Thesis Topic
Carn, S.	PhD	Cambridge University	Pringle	1073	Indonesian Volcanics
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
North Carolina State University					
Haynes, Elizabeth	PhD	Marine, Earth, and Atmospheric Sciences	Fodor	1684	Intrusion-related gold systems: petrological and fluid geochemical characteristics of gold-hosted granite plutons.
Oregon State University					
Ashbaker, Eric	MS	Nuclear Engineering and Radiation Health Physics	Reese	1702	Determination of neutron flux and spectrum in various OSTR irradiation facilities
Funatake, Castle	PhD	Environmental and Molecular Toxicology	Kerkvliet	1725	The Effects of 2, 3, 7, 8-Tetrachlorodibenzo-p-dioxin on the Fate of Antigen-Specific T Cells

Table V1.C.2 *(continued)*
Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	Advisor	Project	Thesis Topic
Marshall, Nikki	MS	Environmental and Molecular Toxicology	Kerkvliet	1725	Ex-vivo Suppressive Mechanisms Used by CD4+ T Cells exposed to TCDD during Graft-vs-Host disease
Matteson, Brent	PhD	Chemistry	Paulenova	1751	Actinide Chemistry
Naik, Radhika	PhD	Chemistry	Loveland	1751	Nuclear Chemistry
Sinton, Christopher	PhD	Oceanography	Duncan	444	Age and Composition of Two Large Igneous Provinces: The North Atlantic Volcanic Rifted Margin and the Caribbean Plateau
Sprunger, Peter	PhD	Chemistry	Loveland	1751	Nuclear Chemistry
Stapels, Christopher	PhD	Physics	Krane	1564	Level Structure of Gd-152 Populated in Tb-152 Beta Decay
Rutgers					
Braun, Dave	PhD	Geological Sciences	Turrin	1707	Dating of Plio-Pleistiocene Homid Sites, Kanjera, Kenya
Mollel, Godwin	PhD	Geological Sciences	Turrin	1707	Statigraphy and Chronolgy of the Plio-Plaeistocene Ngorongoro Volcanic Highland
Price, Rachel	MS	Geological Sciences	Turrin	1708	Age of metamorphism in the New Jersey Highland
Quinn, Rhonda	PhD	Geological Sciences	Turin	1707	Dating of Plio-Pleistiocene Homid Sites, Koobi Fora, Kenya
Young, Amy	PhD	UCLA Geology	Turrin	1423	Petrology and geochemical evolution of the Damavand trachyandesite volcano in Northern Iran.
Syracuse University					
Schwabe, Erika	PhD	Earth Sciences	Fitzgerald	1555	Uplift and Exhumation of the West-Central Pyrenees: Constraining the Evolution of an Intraplate Collisional Orogen
Taylor, Josh	MS		Fitzgerald	1555	Low Temperature Thermochronologic Studies in the Adirondack Highlands
University of California at Berkeley					
Herbison, Sarah	PhD	Department of Chemistry	Nitsche	1468	Applications of NAA

Table V1.C.2 *(continued)*

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	Advisor	Project	Thesis Topic
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 Mountains, Southern Nevada
University of Cincinnati					
Davidson, Michelle	PhD	Geology	Killinc	1738	Decompressional Melting as a Mechanism for Differentiation in Columbia River Basalts
University of Florida					
Coyner, Samuel	PhD		Foster	1621	Pb-Pb Geochronology and Thermochronology of Titanite Using MC-ICP-MS
Grice, Warren	MS	Geology	Foster	1621	Style and Timing of Mylonitization, Detachment, Ductile Attenuation and Metamorphism in the Anaconda Metamorphic core Complex, West-Central Montana
Newman, Virginia	MA	Geology	Foster	1621	Exhumation of the Ruby Mountains Metamorphic Core Complex
Restrepo, Sergio	PhD	Geology	Foster	1621	Long-Term vs. Short-Term Erosion Rates in Columbian Tropical Andean Ecosystems: Measuring the Dimension of the Human Impact
University of Geneva					
Baumgartner, Regine	PhD	Geological Sciences	Fontbote	1617	Pulsed High Sulfidation Hydrothermal Activity in the Cerro de Pasco-Colquijirca "super district," Peru
Luzieux, Leonard	PhD	Geological Sciences	Spikings	1617	The Origin and Accretionary History of Basement Forearc Unites in Western Ecuador
Vallejo, Cristian	PhD	Geological Sciences	Spikings	1617	The Syn- and Post-Accretionary History of the Western Cordillera of Ecuador
Villagomez, Diego	PhD	Geological Sciences	Spikings	1617	The Late-Cretaceous to Recent Accretionary History of Western Colombia

Table V1.C.2 *(continued)*
Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	Advisor	Project	Thesis Topic
University of Goettingen					
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 Manchester					
Flude, Stephanie	PhD	Earth Sciences	Burgess	1592	Rhyolite volcanism in Iceland: timing and timescales of eruption
University of Wisconsin					
Barquero-Molina, Miriam	PhD	Geology and Geophysics	Singer	1612	Applications of 39Ar/40Ar Geochronology
Harper, Melissa	MS	Geology and Geophysics	Singer	1612	Applications of 39Ar/40Ar Geochronology
Jicha, Brian	MS	Geology and Geosciences	Singer	1465	Applications of 39Ar/40Ar Geochronology
Jicha, Brian	MS	Geology and Geophysics	Singer	1612	Applications of 39Ar/40Ar Geochronology
Relle, Monica	MS	Geology and Geophysics	Singer	1465	Applications of 39Ar/40Ar Geochronology
University of Wyoming					
Beland, Peter	MS	Geology and Geophysics	Murphy	321	Applications of Fission Track Analysis
McMillan, Beth	PhD	Geology and Geophysics	Murphy	321	Applications of Fission Track Analysis
Unversity of Tubingen					
Danisik, M.	PhD		Danisik	1680	Cooling History and Relief Evolution of Corsica (France) as Constrained by Fission Track and (U-Th)/He Thermochronolgy

Table V1.C.2 *(continued)*

Graduate Student Research Which Utilized the Radiation Center

Student's Name	Degree	Academic Depart	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 ofastronomi-cal and radioisotopic time-scales

Table VI.C.3

List 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
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	Instrument calibration.	Oregon Health Sciences University
488	Farmer	Oregon State University	Instrument Calibration	Instrument calibration.	OSU Radiation Center
519	Martin	US Environmental Protection Agency	Instrument Calibration	Instrument calibration.	USEPA-Corvallis
547	Boese	US Environmental Protection Agency	Survey Instrument Calibration	Instrument calibration.	USEPA, Cincinnati, OH
664	Reese	Oregon State University	Good Samaritan Hospital Instrument Calibration	Instrument calibration.	OSU Radiation Center
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	Instrument calibration.	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	Markos	Army Corps of Engineers	Instrument Calibration	Instrument calibration.	U.S. Army Engineer District, Portland
1073	Pringle	Massachusetts Institute of Technology	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

Table VI.C.3 *(continued)*

List 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
1074	Wijbrans	Vrije Universiteit	40Ar-39 Ar Dating of Rocks and Minerals	40Ar-39Ar dating of rocks and minerals.	Vrije Universiteit, Amsterdam
1075	Teaching and Tours	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 in 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
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
1281	Wilson	Altamont Elementary School	Radiation Effects on Bean Seeds	Irradiation of pinto bean seeds to evaluate radiation dose effects on germination and growth.	OSU Radiation Center
1354	Wright	Radiation Protection Services	Radiological Instrument Calibration	Instrument calibration.	State of Oregon Radiation Protection Services
1366	Quidelleur	Universite Paris-Sud	Ar-Ar Geochronology	Determination of geological samples via Ar-Ar radiometric dating.	Universite Paris- Sud
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
1406	Pate	Tracerco	Production of Argon-41	Production of Argon-41 for various field uses.	Tracerco
1408	Gerdemann	USDOE Albany Research Center	Analysis of titanium powder	Measurement of sodium and chlorine in titanium powder.	USDOE Albany Research Center

Table VI.C.3 *(continued)*

List 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
1415	McGinness	ESCO Corporation	Calibration of Instruments	Instrument calibration.	ESCO Corporation
1423	Turrin	Rutgers	40Ar/39Ar Analysis	Petrology and geochemical evolution of the Damavand trachyandesite volcano in Northern Iran.	Department of Geological Sciences
1431	Patterson	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	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	NAA Laboratory experiment.	University of California at Berkeley
1470	Bolken	SIGA Technologies, Inc.	Instrument Calibration	Instrument calibration.	Siga Pharmaceuticals
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
1502	Teaching and Tours	Portland Community College	Portland Community College Tours/ Experiments	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1503	Teaching and Tours	Non-Educational Tours	Non-Educational Tours	Tours for guests, university functions, student recruitment.	OSU Radiation Center
1504	Teaching and Tours	Oregon State University Educational Tours	OSU Nuclear Engineering & Radiation Health Physics Department	OSTR tour and reactor lab.	USDOE Reactor Sharing
1505	Teaching and Tours	Oregon State University - Educational Tours	OSU Chemistry Department	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1506	Teaching and Tours	Oregon State University - Educational Tours	OSU Geosciences Department	OSTR tour.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
1507	Teaching and Tours	Oregon State University – Educational Tours	OSU Physics Department	OSTR tour.	USDOE Reactor Sharing
1509	Teaching and Tours	Oregon State University – Educational Tours	HAZMAT course tours	First responder training tours.	Oregon Dept of Energy
1510	Teaching and Tours	Oregon State University – Educational Tours	Science and Mathematics Investigative Learning Experience	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1511	Teaching and Tours	Oregon State University – Educational Tours	Reactor Staff Use	Reactor operation required for conduct of operations testing, operator training, calibration runs, encapsulation tests and other.	OSU Radiation Center
1512	Teaching and Tours	Linn Benton Community College	Linn Benton Community College Tours/ Experiments	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1514	Sobel	Universitat Potsdam	Apatite Fission Track Analysis	Age determination of apatites by fission track analysis.	Universitat Potsdam
1519	Dunkl	University of Goettingen	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	Western Oregon University	OSTR 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
1525	Teaching and Tours	Life Gate High School	Life Gate High School	OSTR tour and half-life experiment	USDOE Reactor Sharing
1526	Crawford	Hot Cell Services	Instrument calibration	Instrument calibration.	Hot Cell Services
1527	Teaching and Tours	Oregon State University – Educational Tours	Odyssey Orientation Class	OSTR tour.	USDOE Reactor Sharing
1528	Teaching and Tours	Oregon State University – Educational Tours	Upward Bound	OSTR tour.	USDOE Reactor Sharing
1529	Teaching and Tours	Oregon State University – Educational Tours	OSU Connect	OSTR tour.	USDOE Reactor Sharing
1530	Teaching and Tours	Newport School District	Newport School District	OSTR tour.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
1531	Teaching and Tours	Central Oregon Community College	Central Oregon Community College Engineering	OSTR tour.	USDOE Reactor Sharing
1535	Teaching and Tours	Corvallis School District	Corvallis School District	OSTR tour.	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 - Educational Tours	Naval Science Department	OSTR tour.	USDOE Reactor Sharing
1538	Teaching and Tours	Oregon State University - Educational Tours	OSU Speech Department	OSTR tour.	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	McKay High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1542	Teaching and Tours	Oregon State University - Educational Tours	Engineering Sciences Classes	OSTR tour.	USDOE Reactor Sharing
1543	Bailey	Veterinary Diagnostic Imaging & Cytopathology	Instrument Calibration	Instrument calibration.	Veterinary Diagnostic Imaging & Cytopathology
1544	Teaching and Tours	West Albany High School	West Albany High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1545	Teaching and Tours	Oregon State University - Educational Tours	OSU Educational Tours	OSTR tour.	USDOE Reactor Sharing
1548	Teaching and Tours	Willamette Valley Community School	Willamette Valley Community School	OSTR tour.	USDOE Reactor Sharing
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
1564	Krane	Oregon State University	Measurement of neutron capture cross sections	Measurement of neutron capture cross sections.	USDOE Reactor Sharing
1583	Teaching and Tours	Neahkahnie High School	Neahkahnie High School	OSTR tour.	USDOE Reactor Sharing
1584	Teaching and Tours	Reed College	Reed College Staff & Trainees	OSTR tour.	USDOE Reactor Sharing
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
1594	Teaching and Tours	Jefferson High School	Jefferson High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
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
1601	Crutchley	Josephine County	Instrument Calibrations	Instrument calibration.	Josephine County Public Works
1602	Teaching and Tours	Crescent Valley High School	Crescent Valley High School AP Physics Class	Investigation of arsenic concentrations in soils and bedrock of the Sweet Home area.	USDOE Reactor Sharing
1603	Teaching and Tours	Thurston High School	Thurston High School Chemistry	OSTR tour and half-life experiment.	USDOE Reactor Sharing
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
1611	Teaching and Tours	Grants Pass High School	Grants Pass High School	OSTR tour.	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	Silver Falls School District	OSTR tour.	USDOE Reactor Sharing
1614	Teaching and Tours	Marist High School	Marist High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1615	Teaching and Tours	Liberty Christian High School	Liberty Christian High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1616	Doyle	Evanite Fiber Corporation	Instrument Calibration	Instrument calibration.	Evanite Fiber Corporation
1617	Spikings	University of Geneva	Ar-Ar geochronology	Argon dating of Chilean granites.	University of Geneva
1618	Teaching and Tours	Falls City High School	Fall City High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1619	Teaching and Tours	Sheridan High School	Sheridan High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1620	Teaching and Tours	Eddyville High School	Eddyville High School	OSTR tour.	USDOE Reactor Sharing
1621	Foster	University of Florida	Irradiation for Ar/Ar Analysis	Ar/Ar analysis of geological samples.	University of Florida

Table VI.C.3 *(continued)*

List 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
1622	Reese	Oregon State University	Flux Measurements of OSTR	Measurement of neutron flux in various irradiation facilities	OSU Radiation Center
1623	Blythe	University of Southern California	Fission Track Analysis	Fission track Thermochronology of Tibetian Geology.	University of Southern California
1625	Armstrong	California State University at Fullerton	Fission Track Irradiations	Measurement of fission track ages to determine erosion amounts and timing.	USDOE Reactor Sharing
1627	Fleischer	Union College	Fission Track Irradiations	The primary project is the use of tracks to study the leaching out of imbedded radionuclides from alpha-activity in materials. The radionuclide could be a decay product of U-238 or Th-232 in studying the geochemistry of natural materials, or of Rn-222 in dealing with environmental materials that are used to assess radon exposures. Here we will use an analogue case – the embedding in the laboratory of U-235 recoils from the alpha activity of Pu-239.	USDOE Reactor Sharing
1628	Garver	Union College	Fission Track Irradiations	Use of fission track to determine age dating of apatites.	USDOE Reactor Sharing
1634	Tollo	George Washington University	REE Geochemistry of Meta- Igneous Rocks using INAA (TBC)	NAA of apatite samples to determine metal composition in ingneous rocks.	USDOE Reactor Sharing
1635	Fodor	North Carolina State University	Geologic NAA	Determination of rare earth elements in ultramafic rocks by NAA.	USDOE Reactor Sharing
1640	Gans	University of California at Santa Barbara	Age dating of Neogene volcanism	Age dating of rock samples from Sierra Nevada, Sonora, Mexico, and Chilean Andes.	USDOE Reactor Sharing
1641	Hughes	Idaho State University	Independent Study of NAA	Development of NAA for Thesis Research.	USDOE Reactor Sharing
1647	Graefe	GeoForschungs Zentrum Potsdam	Fission Track Irradiations	Use of fission track to study zircon.	GeoForschungs Zentrum Potsdam
1648	Stewart	University of Washington	Fission-track Dating of Zircon	Fission-track Dating of Zircon from the Exhumation of Avaloatz Mountains in California.	University of Washington
1653	Teaching and Tours	Madison High School	Madison High School Senior Science Class	OSTR tour.	USDOE Reactor Sharing
1655	Teaching and Tours	Future Farmers of America	OSTR Tour	OSTR tour.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
1656	Mourich	AVI Bio Pharma	Avasive anticancer vaccine mechanism of immuno-protein	Using a mouse model for cancer. Tumor cells are irradiated and then coated with antibodies produced by the vaccine. This complex is used to vaccinate mice to determine if subsequent anti-tumor specific immune responses are generated	AVI Bio Pharma
1657	Teaching and Tours	Richland High School	Richland High School	OSTR tour.	USDOE Reactor Sharing
1660	Reese	Oregon State University	Isotope and Container Testing	Testing of containers and source material.	OSU Radiation Center
1661	Wroblewski	Vectron International Norwalk Inc.	Gamma Irradiation of Parts	Gamma irradiation of parts.	Vectron International
1665	LaFleur	National Council of Stream and Air Improvement	Preparation of Hog Fuel Standard Reference Material	Preparation of an NAA standard of composite wood waste material as a reference material for laboratory analyses.	National Council for Air & Stream Improvement
1666	Teaching and Tours	Douglas High School	Douglas High School AP Physics Class	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1670	Teaching and Tours	Toledo High School	Toledo High School	OSTR tour and half-life experiment.	USDOE Reactor Sharing
1671	Roden-Tice	Plattsburgh State University	Fission Track Dating	Use of fission tracks to determine location of U-235 and Th232 in natural rocks and minerals.	USDOE Reactor Sharing
1672	Brix	Ruhr-Universitat Bochum	Fission track analysis of apatites and zircon.	Fission track analysis of apatites and zircon.	Ruhr-Universitat Bochum
1673	Teaching and Tours	Heal College	Heal College Physics Department	OSTR tour.	USDOE Reactor Sharing
1674	Niles	Oregon Departmentof Energy	Radiological Emergency Support	Radiological emergency support of OOE related to instrument calibration, radiological and RAM transport consulting, and maintenance of radiological analysis laboratory at the Radiation Center.	Oregon Department of Energy
1676	Minc	Oregon State University	NAA of labeled antibodies	Au labeled antibodies are used in cancer studies. NAA tracks the presence of the antibodies in various organs.	University of Michigan
1677	Zuffa	Universita' di Bologna	Fission Track Dating	Use of fission track from U-235 to determine uranium content in rock.	Universita' di Bologna

Table VI.C.3 *(continued)*

List 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
1679	Miyahira	California Institute of Technology	Neutron Damage on Electronics	Interactive irradiations to test the effects of neutron damage upon various electronic components.	Jet Propulsion Laboratory
1680	Danisik	University of Tubingen	Fission Track Dating	Low-temperature geochronology using He and fission track dating.	University of Tuebingen
1681	Yang	University of Michigan	Detection of Metals in Zeolite Catalysts	Use of NAA to detect various metals in zeolite catalysts and sorbents.	USDOE Reactor Sharing
1682	Devi	AVI Bio Pharma	Effect of Gamma Radiation on the Expression of XIAP in Prostate and Lung Cancer Cells	Effect of gamma radiation on the expression of XIAP in prostate and lung cancer cells.	AVI Bio Pharma
1683	Bennion	Idaho State University	Nuclear Engineering Pulsing Lab	Reactor laboratory for ISU NE students.	USDOE Reactor Sharing
1684	Fodor	North Carolina State University	Geochemical Investigation	NAA to determine rare earth composition.	USDOE Reactor Sharing
1685	Dick	Oregon State University	Short-stay Belen ph vs heavy metals experiment	Gamma irradiation of soils.	OSU Crop and Soil Science
1686	Miller	Nunhems USA, Inc.	Production of haploid and dihaploid melon plants induced with irradiated pollen	Irradiated melon pollen will be used to polliate female melon plants to induce parthenogenetic embryos. These embryos will be rescued and cultured for plant production.	Sunseeds
1687	Teaching and Tours	Inavale Grade School	Reactor Tour	General reactor tour.	USDOE Reactor Sharing
1688	Moore	Northwest Construction Surveying & Testing	Instrument Calibration	Instrument calibration.	Northwest Construction Surveying & Testing
1689	Gardner	Oregon State University	Count Gamma Rays from 181Hf	Determination of 181Hf cross section.	USDOE Reactor Sharing
1690	Teaching and Tours	Wilson High School	Reactor Tour	D300 Reactor Tour.	USDOE Reactor Sharing
1691	Teaching and Tours	Lost River High School	Reactor Tour	D300 Reactor Tour.	USDOE Reactor Sharing
1692	Choi	Arch Chemicals Inc.	Screening Tests of Wood Decay	This is to build up basic knowledge on the efficacy of a copper based preservative in preventing decay of wood inhabiting basidiomycetes	Arch Chemical Inc.
1693	Ferguson	Tru-Tec	Radiotracer Production	Production of radioisotopes for use as industrial tracers.	Tru-Tec
1695	Teaching and Tours	Transitional Learning	Reactor Tour	Reactor Tour in D300 only.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
1696	Sayer	Marquess & Associates Inc.	Instrument Calibration	Instrument calibration.	Marquess & Associates Inc.
1697	Teaching and Tours	Crescent Valley High School	Crescent Valley High School AP Physics Class	This project supports the advanced placement physics class at Cresent Valley High School. It will utilize the reactor in ongoing research projects sponsored by Radiation Center staff.	USDOE Reactor Sharing
1699	Teaching and Tours	Philomath High School	Reactor Tour	Tour of NAA and gas chromatograph capabilities in the Radiation Center.	USDOE Reactor Sharing
1700	Frantz	Reed College	Instrument calibration	Instrument calibration.	Reed College
1701	Minc	Oregon State University	NAA of Au labeled Antibodies	Radiolabeling with Au of antibodies in mice.	USDOE Reactor Sharing
1702	Reese	Oregon State University	Neutron Spectrual Analysis	Determination of the neutron flux and spectrum in various OSTR irradiation facilities.	USDOE Reactor Sharing
1705	Hemming	Columbia University	Geochronology by Ar/Ar Methods	Geochronology by Ar/Ar methods.	USDOE Reactor Sharing
1706	Wongsawaeng	University of California at Berkeley	Liquid Metal Bonding Tracer	Irradiated liquid metal is poured in the pellet-cladding gap in a mock nuclear fuel rod. Gold is used as a tracer to study the liquid metal bond integrity.	University of California at Berkeley
1707	Turrin	Rutgers	Ar/Ar Chronology Analysis	Statigraphy and Chronology of the Plio-Pleistocene Ngoronogoro volcanic highland.	USDOE Reactor Sharing
1708	Turrin	Rutgers	Ar/Ar Chronology Analysis	Preliminary analysis on refining the age of the Monon Lake and Laschamp geomagnetic polarity events.	USDOE Reactor Sharing
1710	Frost	University of Wyoming	Determination of Geochemical Provenance of Muru Conglomerates, New Zealand	Major, minor, and trace element of clast in Muru conglomerates may reveal the lithological porvenance of this important tectonic terrane at an extinct subduction zone.	USDOE Reactor Sharing
1712	Bergman	Theragenics Corporation	Brachytheropy Source Activation	Activation of various source material for possible use in brachytheropy.	Theragenics Corporation
1715	Teach	Providence St. Vincent Hospital	Stent Project	Irradiate elastin coated cardio stent devices to reduce thrombic reaction.	Providence NW Hospital
1716	Garcia	M. K. Gems & Minerals	Mineral irradiations to determine color characteristics	Mineral irradiations to determine color characteristics.	M. K. Gems & Minerals

Table VI.C.3 *(continued)*

List 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
1717	Webb	Syracuse University	Ar/Ar Dating	Ar/Ar dating.	Syracuse University
1718	Armstrong	California State University at Fullerton	Fission Track Dating	Fission track age dating of apatite grains from Santa Ana Mountains, California.	Department of Geological Sciences
1719	Teaching and Tours	Portland Community College	OSTR Tour	OSTR Tour for Upward Bound.	USDOE Reactor Sharing
1720	Teaching and Tours	Saturday Academy	OSTR Tour	OSTR Tour.	USDOE Reactor Sharing
1721	Lewis	Oregon State University	Sedimentology of Ocean Sand Using Stable Activatable Tracers	The objective of this project is to analyze gold and silver in medium sized quartz sand. The tracer material is dispersed on the sea-floor, sampled periodically, and analyzed for its Au and Ag content.	USDOE Reactor Sharing
1722	Tollo	George Washington University	Petrologic Evolution of Mesoproterozoic Basement Rocks, Blue Ridge Province, Virginia	The petrologic relationships between granitoids and gneisses of the Mesoproterozoic Basement in the Blue Ridge Province, Virginia are contrained through trace element geochemistry, petrology and detailed field studies.	USDOE Reactor Sharing
1723	Sulzman	Oregon State University	Assessing Mechanisms that control CO2 release from soils.	Assessing Mechanisms that control CO2 release from soils.	OSU Crop and Soil Science
1724	Stebbins-Boaz	Willamette University	Instrument Calibration	Instrument calibration.	Willamette University
1725	Kerkvliet	Oregon State University	Consequences of AhR mediated signaling in T lymphocytes	The basic goal of this project is to understand the cellular and molecular basis for the immune suppression induced by Ah receptor (AhR) ligands.	OSU Environmental and Molecular Toxicology
1726	Teaching and Tours	Oregon State University	ALS 199	Cohort Class.	USDOE Reactor Sharing
1727	Leber	Heritage University	Gamma radiation effects on cork strength	To determine the effects and evaluate the resulting physical and organoleptic properties of grape seed oil corks after gamma irradiation.	Heritage University

Table VI.C.3 *(continued)*

List 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
1728	Minc	Oregon State University	Flux mapping	Flux mapping of irradiation facilities.	OSU Radiation Center
1729	Hendriks	Geological Survey of Norway	Recycling of an Orogen	Study of interactions of the onshore and offshore parts of the Norwegian continental margin near Lofoten and Vesteralen Islands.	Geological Survey of Norway
1730	Reese	Oregon State University	Neutron Radiography	Neutron Radiography using the real-time and film imaging methods.	OSU Radiation Center
1731	Dashwood	Oregon State University	Suppression of Prostate Cancer in Xenograft Model by Histone Deacetylase Inhibitors	One new area in both prevention and treatment involves the use of histone deacetylate inhibitors to turn on tumor suppressor genes. Tumor suppression genes can suprress and reverse cancer cell growth.	Linus Pauling Institute
1732	Balogh	University of Michigan	Biodistribution of Gold Nanocomposites	Irradiation of mouse tissues to evaluate the biodistribution of gold nanocomposites engineered to target cancer cells.	Ford Nuclear Reactor, University of Michigan
1733	Green	OxiBio	Effects of Gamma Radiation on Post-Radiation chemical and Material Properties of Silicone Test Polym	Small test samples of polydimethyl siloxane elastomers cured by platinum addition chemistry. These test samples will then be examined by chemical and material analysis for changes in material properties.	OxiBio Corp.
1734	Retallack	University of Oregon	Origin of Barite Nodules, Cucaracha, Panama	INAA to determine a suite of REE, Ba, Sr, and Nb in barite nodules from middle Miocene paleosols in the Cucaracha Formation, Panama.	OSU Radiation Center
1735	Minc	Oregon State University	INAA of SRMs	INAA to determine inter-lab calibration based on New Ohio Red Clay and NIST SRMs.	OSU Radiation Center
1736	Rauch	Nu-Trek, Inc	GaAs Damage Studies	Determination of the effect of radiation damage on GaAs for use in X-ray detectors.	Nu-Trek, Inc.
1737	Roullet	Oregon Health Sciences University	Silver Activation for Radiolabel	Production of Ag-110m for Radiolabeled Molecules.	Oregon Health Sciences University
1738	Kilinc	University of Cincinnati	INAA of geological samples.	Geochemical analysis of rock and mineral samples for graduate student projects.	USDOE Reactor Sharing
1739	Teaching and Tours	Daly Middle School	Reactor Tour	Reactor Tour.	USDOE Reactor Sharing
1740	Freitag	University of Jena	Fission Track Analysis	Apatite fission track dating to determine uplift history of Tien Shan in Kamchatka.	Universitaet Jena

Table VI.C.3 *(continued)*

List 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
1741	Higley	Oregon State University	SIRAD Evaluation	Determination of neutron response for SIRAD dosimeter in the TC.	USDOE Reactor Sharing
1742	Armitage	Eastern Michigan University	INAA of Bricks and Clays from St. Marys City	INAA of bricks and clays from historic St. Marys City, MD.	USDOE Reactor Sharing
1743	Teaching and Tours	West Salem High School	Reactor Tour	Reactor Tour.	USDOE Reactor Sharing
1744	Niles	Oregon Department of Energy	Gamma Spectroscopy of Columbia River Sediments	Use of gamma spectroscopy to determine radioactive contaminants in the sediments in the Columbia River downstream from Hanford.	Oregon Department of Energy
1745	Girdner	US National Parks Service	C14 Measurements	LSC analysis of samples for C14 measurements.	US National Parks Service
1746	Loveland	Oregon State University	Tantalum Tracer	Produce tantalum tracer for LBNL.	USDOE Reactor Sharing
1747	Teaching and Tours	East Linn Christian Academy	Reactor Tour	Reactor Tour for Chemistry Class.	USDOE Reactor Sharing
1748	Hamby	Oregon State University	Black Bean Nutritional Study	Activation of black bean powder for nutritional study. The chief isotopes are zinc, iron, and sodium.	OSU Radiation Center
1749	Bottomley	Oregon State University	Hot Spots of Nitrogen Cycling in Soil	Grant is focused upon nitrogen cycling in soil at the small scale. We are trying to understand how physical and biological parameters control the fate of ammonium and nitrate in soil.	OSU Crop and Soil Science
1741	Higley	Oregon State University	SIRAD Evaluation	Determination of neutron response for SIRAD dosimeter in the TC.	USDOE Reactor Sharing
1742	Armitage	Eastern Michigan University	INAA of Bricks and Clays from St. Marys City	INAA of bricks and clays from historic St. Marys City, MD.	USDOE Reactor Sharing
1743	Teaching and Tours	West Salem High School	Reactor Tour	Reactor Tour.	USDOE Reactor Sharing

Table VI.C.3 *(continued)*

List 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
1744	Niles	Oregon Department of Energy	Gamma Spectroscopy of Columbia River Sediments	Use of gamma spectroscopy to determine radioactive contaminants in the sediments in the Columbia River downstream from Hanford.	Oregon Department of Energy
1745	Girdner	US National Parks Service	C14 Measurements	LSC analysis of samples for C14 measurements.	US National Parks Service
1746	Loveland	Oregon State University	Tantalum Tracer	Produce tantalum tracer for LBNL.	USDOE Reactor Sharing
1747	Teaching and Tours	East Linn Christian Academy	Reactor Tour	Reactor Tour for Chemistry Class.	USDOE Reactor Sharing
1748	Hamby	Oregon State University	Black Bean Nutritional Study	Activation of black bean powder for nutritional study. The chief isotopes are zinc, iron, and sodium.	OSU Radiation Center
1749	Bottomley	Oregon State University	Hot Spots of Nitrogen Cycling in Soil	Grant is focused upon nitrogen cycling in soil at the small scale. We are trying to understand how physical and biological parameters control the fate of ammonium and nitrate in soil.	OSU Crop and Soil Science
1750	Robbins	Great Lakes Environmental Research Lab	INAA of Great Lakes Sediments	The Environmental Radiotracers (ERT) Project employs natural and artificial radionuclides to identify and model important particle transport processes in diverse systems including the Laurentian and other Great Lakes, smaller freshwater bodies, wetlands and coastal marine environments.	NOAA-GLERL
1751	Loveland	Oregon State University	Tracer Preparation	Tracer preparation for chemistry.	OSU Chemistry / Loveland DOE
1752	Pringle	Massachusetts Institute of Technology	Ar/Ar Irradiations	Irradiations of geological samples for Ar/Ar dating.	Massachusetts Institute of Technology
1753	Rosencrans	Flink Ink	INAA of pigment samples.	INAA of organic-based pigment samples for halogen (Cl, Br, I) by INAA.	Flint Ink
1754	Wolfler	Unversity of Tubingen	Fission Track Irradiations	Fission track age dating.	University of Tuebingen

FigureVI.C.4

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

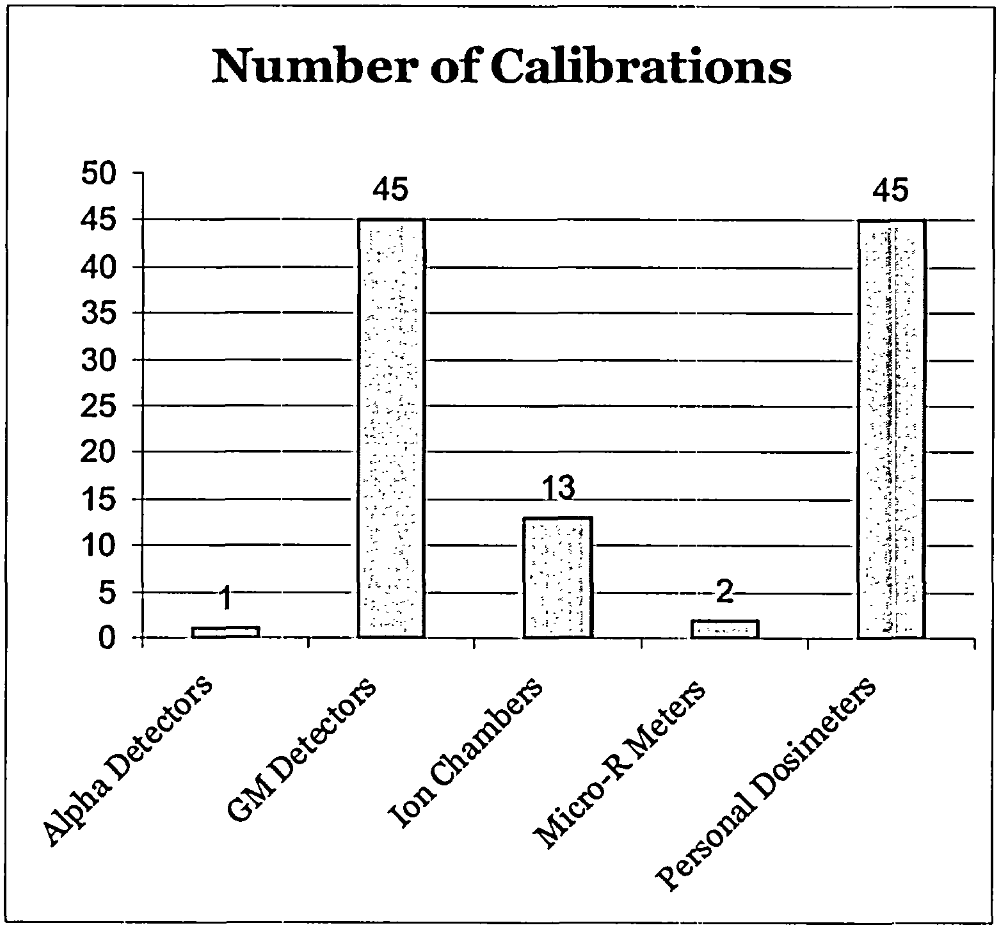


Table VI.C.4
Summary of Radiological Instrumentation Calibrated to Support OSU Departments

Department	Number of Calibrations
OSU Departments	
Animal Science	2
Biochemistry/Biophysics	3
Botany and Plant Pathology	6
Center for Gene Research	1
Chemistry	1
Civil, Construction and Environmental Engineering	3
Crop Science	2
E.M.T.	5
Environmental Engineering	1
Fisheries and Wildlife	1
Food Sciences	2
Forest Science	1
Horticulture	2
Mechanical Engineering	1
Microbiology	5
Nutrition and Food Management	2
Oceanic and Atmospheric Sciences (COAS)	2
Pharmacy	4
Physics	1
Radiation Safety Office	23
R/V Wecoma	1
Veterinary Medicine	1
Zoology	2
Total	72

Table VI.C.5
Summary of Radiological Instrumentation Calibrated to Support Other Agencies

Agency	Number of Calibrations
DOE Albany Research Center	3
ESCO Corporation	7
Good Samaritan Hospital	6
Josephine County Public Works	1
Lebanon Community Hospital	1
Marquess and Ass. Inc.	1
Occ. Health Lab.	1
Oregon Department of Energy	27
Oregon Department of Transportation	5
Oregon Health Sciences University	21
Oregon Public Utilities Commission	5
Oregon State Health Division	57
Quality Testing LLC	1
SIGA Technologies	2
USDA Agricultural Research Service	1
U.S. Environmental Protection Agency	2
Veterinary Diagnostic Imaging Cytopathology	2
Willamette University	1
Total	144

Table VI.F.1

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
7/19/2004	1	Cash, Dr. Alex
7/27/2004	18	PCC Upward Bound
7/27/2004	18	PCC Upward Bound
7/28/2004	25	OSU Saturday Academy
8/23/2004	25	Chem 123- Sec 001A
8/24/2004	15	Chem 123 - Sec 001C
8/24/2004	4	Lawrenz, Phyllis; Janet Cook, Dennis Tollefson
8/25/2004	22	Chem 123 - Sec 001B
8/26/2004	7	Incoming Transfer Students
9/29/2004	1	OSU Government Relations- Liz LaPolt
9/30/2004	6	Advanced Placement Physics
10/1/2004	20	Boy Scouts - Sutherlin
10/2/2004	1	Barbour, Leslie
10/8/2004	15	OSU Saturday Academy
10/8/2004	3	Prospective Undergraduate - Zack McNair & family
10/23/2004	27	Advanced Placement Physics
10/23/2004	27	Advanced Placement Physics
10/26/2004	13	Odyssey (Brent Collins)
10//6/2004	20	Odyssey (Alex Barnett)
10/27/2004	22	Odyssey (Ann Normandy)
10/28/2004	17	Odyssey (Francene Johnson/Kyle Sander)
11/2/2004	1	Dunzik-Gougar, Mary Lou
11/4/2004	7	Cohort Class (Julie Walkin)
11/6/2004	115	Dad's Weekend
11/9/2004	18	Odyssey (Alex Barnett)
11/11/2004	2	U.S. Department of Energy-
11/12/2004	5	Hinman, Adam & family/friends
11/24/2004	3	Family - Josh Palotay et al
11/29/2004	16	OSU Center/Institute/Program Directors
11/29/2004	29	Boy Scouts - Brent Adams
11/30/2004	12	GS 106 & 152
12/8/2004	8	Advanced Placement Physics

Table VI.F.1 *(continued)*
Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
12/9/2004	8	Advanced Placement Physics
1/3/2005	2	Family- Cathy and Mark Hertel
1/3/2005	1	Wagner, Chuck (Enventive, Inc.)
1/6/2005	18	Chem 462
1/11/2005	6	Chem 462
1/13/2005	2	Diltz, Ryan and Bill Smyth
1/13/2005	8	Advanced Placement Physics
1/18/2005	6	Chem 462
1/20/2005	6	Chem 462
1/20/2005	8	Advanced Placement Physics
1/21/2005	8	Advanced Placement Physics
1/24/2005	8	Advanced Placement Physics
1/31/2005	14	Boy Scouts - James Richman
2/8/2005	20	Chem 225 Honors
2/10/2005	11	Chem 225 Honors
2/15/2005	20	Chem 222 - Sec 66
2/15/2005	20	Chem 222 - Sec 13
2/15/2005	20	Chem 222 - Sec 12
2/15/2005	20	Chem 222 - Sec 14
2/16/2004	20	Chem 222 - Sec 33
2/16/2005	20	Chem 222 - Sec 37
2/16/2005	20	Chem 222 - Sec 38
2/17/2005	20	Chem 222 - Sec 42
2/17/2005	20	Chem 222 - Sec 43
2/17/2005	20	Chem 222 - Sec 62
2/17/2005	20	Chem 222 - Sec 78
2/18/2005	4	Prospective Grad Students -CoE Grad Recruiting: Brian Jackson, Christopher Orton, Sarah Kleeb, Mark Shaver
2/21/2005	20	OSU Saturday Academy
2/22/2005	20	Chem 222 - Sec 15
2/22/2005	20	Chem 222 - Sec 17
2/22/2005	20	Chem 222 - Sec 26
2/22/2005	20	Chem 222 - Sec 15

Table VI.F.1 *(continued)*

Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
2/23/2005	20	Chem 205 – sec 32
2/23/2005	20	Chem 222 – Sec 46
2/23/2005	20	Chem 222 – Sec 32
2/24/2004	20	Chem 222 – Sec 46
2/24/2005	20	Chem 222 – Sec 79
2/24/2005	20	Chem 222 – Sec 110
2/24/2005	20	Chem 222 – Sec 63
2/28/2005	20	Chem 205 – sec 22
2/28/2005	20	Chem 205 – sec 26
3/1/2005	20	Chem 222 – Sec 48
3/1/2005	20	Chem 222 – Sec 252
3/1/2005	20	Chem 205 – Sec 12
3/2/2005	20	Chem 205 – Sec 36
3/2/2005	20	Chem 205 – Sec 18
3/3/2005	20	Chem 222 – Sec 52
3/3/2005	20	Chem 205 – Sec 56
3/3/2005	2	Prospective Grad Student – Tyler Martin & Jim Washburn
3/4/2005	8	Regional Champions for the Klamath/Lake Co Region in MathCount
3/8/2005	20	Chem 205 – Sec 16
3/8/2005	20	Chem 205 – sec 14
3/9/2005	20	Chem 205 – Sec 42
3/10/2005	20	Chem 222 – Sec 51
3/10/2005	20	Chem 205 – Sec 54
3/10/2005	1	Prospective Grad Student –James Neeway
3/11/2005	20	GS 106 & 152
3/15/2005	1	Prospective Grad Student –Jeremy Bishop
3/17/2005	10	Home Schoolers
3/17/2005	20	OSU Center/Institute/Program Accountants Group
3/21/2005	1	Prospective Grad Student –Gregory Paine
3/31/2005	15	Natural Resources and Honors Biology
3/31/2005	2	Prospective Grad Student – Kyle Gilham
4/1/2005	3	Family – Brian Woods, wife, etc

Table VI.F.1 *(continued)*
Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
4/4/2005	1	OSU VP Univ. Advancement - Luanne Lawrence
4/6/2005	1	Barometer Personnel - Jenny Moser
4/13/2005	20	Advanced Placement Science
4/13/2005	21	Advanced Placement Science
4/21/2005	20	Engineering Technology
4/21/2005	20	Engineering Technology
4/29/2005	2	Family - Nathan and Dwight Barnett
4/30/2005	118	Mom's Weekend
5/5/2005	2	Poiret, Jim & Luke Hooten
5/5/2005	20	Faulconer-Chapman School 6th Graders
5/5/2005	20	Faulconer-Chapman School 6th Graders
5/5/2005	20	Faulconer-Chapman School 6th Graders
5/5/2005	20	Faulconer-Chapman School 6th Graders
5/6/2005	2	OSU Research Office- John Cassady & Rich Hol-dren
5/6/2005	7	Advanced Placement Physics
5/9/2005	19	College of Engineering Advisory Board
5/9/2005	1	Clark, Sue
5/17/2005	24	Chem 123
5/17/2005	24	Chem 123
5/17/2005	27	Chem 123
5/17/2005	25	Chem 123
5/18/2005	24	Chem 123
5/18/2005	16	Chem 123
5/18/2005	24	Chem 123
5/18/2005	24	Chem 123
5/19/2005	25	Chem 123
5/23/2005	23	Jr/Sr Chemistry Class
5/26/2005	16	Advanced Placement Physics
5/26/2005	16	Advanced Placement Physics
5/27/2005	2	GS 152
5/31/2005	25	Chem 123
5/31/2005	24	Chem 123

Table VI.F.1 *(continued)*
Summary of Visitors to the Radiation Center

Date	No. of Visitors	Name of Group
6/1/2005	32	Chem 123
6/2/2005	10	Boy Scouts - Salem
6/3/2005	3	Jackson,Brian; Jon Emerick, Felix DuBois
6/14/2005	5	Chaney, Roy; Bob, Hinds, Sharon Chaney, Carrie Chaney, Carolyn Baker
	Total	2159

Part VII
Words

Words

Publications

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