Self-Study and Evaluation Report

Radiation Oncology Physics Residency Program
Radiation Oncology Center
Washington University School of Medicine
Barnes-Jewish Hospital

prepared for the

Commission on Accreditation of Medical Physics Education Programs, Inc

by

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I. Program Overview

I.A Program Objectives

The Radiation Oncology Physics Residency Program is designed for individuals with an M.S. or Ph.D. (D.Sc.) degree who seek training in clinical radiation oncology physics in preparation for a clinically-oriented career. The Program's objective is to provide clinical training in radiation oncology physics that will prepare the graduate for board certification and a professional career in radiation oncology.

This Residency Program training involves full participation of the physics resident in the clinical routine, under the supervision of experienced radiation oncology physicists. Comprehensive training and experience is provided in the areas of dosimetry, treatment planning, treatment aid design and fabrication, brachytherapy, radiation safety, radiation machine calibration, imaging, special procedures, and quality assurance.

Training from this Program should prepare the graduate for certification in the specialty of Therapeutic Radiological Physics by the American Board of Radiology. Graduates of the Program will have received sufficient clinical training that should prepare them for work as a radiation oncology physicist.

I.B Organizational Structure

The Radiation Oncology Physics Residency Program is an official program within the Washington University Medical Center/Barnes-Jewish Hospital Radiation Oncology Department. Barnes-Jewish Hospital is responsible for all technical components of radiation oncology while Washington University is responsible for all professional components (including the employment of physicians, physicists, physics residents, cancer biologists, bioinformatics faculty, and other academic faculty and staff). In this academic medical center partnership, Barnes-Jewish Hospital and Washington University work together to provide the highest quality of patient care, conduct world-class research, and outstanding instruction in our education and training programs. The Department of

Radiation Oncology is governed by Barnes-Jewish Hospital and the Washington University School of Medicine (WUSM) rules and policies. The physics residency program faculty consists of faculty within the Medical School and staff of the Barnes-Jewish Hospital Department of Radiation Oncology.

The Washington University Medical Center is a federation of several institutions owned by the University and other independent institutions. It is the central radiation therapy and diagnosis facility for all of the complex of hospitals and clinics associated with Washington University School of Medicine which combined have nearly 2000 beds. The Radiation Oncology Department resides in the new Siteman Cancer Center (that opened in November 2001). Our facility is a designated NCI Comprehensive Cancer Center facility. The Physics Residency Program utilizes other facilities within the Washington University Medical Center including Barnes-Jewish Hospital South, the Clinical Sciences Research Building, and 4511 Forest Park Medical Center Building (WUSM). The geographical relationship of these institutions within the Washington University Medical Center is shown in **Attachment 1**.

The Department of Radiation Oncology operates one of the largest clinical services in the country. Thirteen staff radiation oncologists and twelve physician residents are involved in the provision of patient care and intramural and cooperative group clinical protocols. The physician faculty is responsible for the treatment of approximately 2,200 new cancer patients per year, representing 50% of all cancer patients in the St. Louis area, or about 30% of all cancer patients in the State of Missouri requiring this form of treatment.

The Physics Division of the Department of Radiation Oncology includes 12 radiation oncology physicists, 2 computer scientists, 12 dosimetrists, 3 brachytherapy technicians, 4 clinical engineers, and 5 physics residents (see **Attachment 2**). The Physics Division is organized into three main activity sections: research (Dr. Low), education (Dr. Klein), and clinical (Sasa Mutic). The clinical activities include specific services: treatment planning, brachytherapy imaging, Trilogy (localization), stereotactic, protons, QA, and Tomotherapy. All physics faculty participate in the various education and training

programs that include the Physics Residency Program, Physician Residency Program, Dosimetrist Training Program through Southern Illinois University (SIU), and Therapist Training Program (SIU and St. Louis University).

Statements from the senior medical and administration heads indicating strong support for the Radiation Oncology Physics Residency Program can be found in **Attachment 3**.

I.C History of Program Development

It is well established in radiation oncology that patient care relies not only on physicians, but also on radiation oncology physicists and other technical personnel. Whereas, physicians have established residency programs, physicists have in the past lacked organized clinical training beyond individual apprenticeships or self-training on the job. This was probably adequate in the early days of physics involvement in radiation oncology. However, as radiation oncology has become increasingly more sophisticated and complex, this strategy is no longer acceptable. The practice of hiring inadequately trained medical physicists, who are allowed to perform patient related tasks, must be discontinued.

The lack of proper clinical training of medical physicists reached a serious level in the late 1980's. There was, (and continues to be) an acute shortage of qualified clinical physicists, i.e., physicists with adequate clinical training and board certification. There was (and continues to be) a growing abundance of physics graduates with little or no clinical training applying (and being hired) for hospital positions. The American Association of Physicists in Medicine (AAPM) recognized this problem and in 1988-89 developed a comprehensive document entitled AAPM Report Number 36, "Essentials and Guidelines for Hospital-Based Medical Physics Residency Training Programs", which described the educational and administrative requirements for a hospital-based residency training program. The AAPM Report recommended two years of clinical physics training beyond an M.S. or Ph.D. degree in physics or a closely related field. The organization of the recommended program was patterned after physician residency

programs. In the words of the Committee that developed the recommendations, "this document will hopefully encourage the development of a high quality clinical medical physics instructional environment on a nationwide basis and make an important contribution to the protection of the public health, safety, and welfare." In 2006, AAPM Report 90, an update to Report 36, was published and is being followed by our program. The program director, Eric E. Klein, was an author on Report 90.

In light of these developments, the Barnes-Jewish Hospital/Washington University Medical Center Radiation Oncology Center formalized their previous "post-doctoral" training approach and established the Radiation Oncology Physics Residency Program in 1992. Dr. James A. Purdy was the founding Director for the Physics Residency Program and Eric Klein was Co-Director until 2003, when he became Director. Daniel A. Low, Ph.D. and Director of Medical Physics is now the Assistant Program Director.

This program received CAMPEP accreditation in October 1997 and re-accreditation in 2003. This revised self-study fully updates our program information as part of our application to maintain our accreditation for an additional 5 years.

Since the Program's beginning, 21 physicists have completed their residency training. In addition, there are five physicists currently receiving their physics residency training in this program. The program is equipped for up to six residents. All of our past graduates, except one, are practicing radiation oncology physicists, and have received their board certification or are in the process of obtaining certification. The exception is the individual who has an academic position in health physics. **Attachment 4** provides a list of all physics residents accepted into the program showing their present employment and board certification status.

Our program has been recognized for its excellence as evidenced by prior recipients of the ASTRO/AAPM Physics Residency Program, Varian/AAPM and Elekta/AAPM Fellowship Awards. In total, 7 two-year awards were received by our program. Unfortunately, these fellowship awards no longer exist.

II. Training Requirements

II.A Requirements for Program Completion

In order to complete the Physics Residency Program, the Physics Resident must:

- Successfully complete the clinical rotations listed in the tables of Attachment 13.
- Pass the special training sessions and didactic courses listed in below and discussed in the next section
  - Orientation (first 2 weeks of 1st year)
  - Radiation Safety Exam (within 30 days beginning 1st year
  - Physics Resident Course (Sept-Mar. during 1st year)
  - Radiation Biology Course (April of 1st year)
  - Biostatistics Course (once per week for 5 weeks in April of 1st year)
  - Academic Update Conference (every Friday 8-9:00 am for 2 years)
  - Participate/attend the conferences and special lectures listed below
  - Patient Management Conference (Monday, Tuesday, Wednesday for 2 years)
  - Current Case Review Conference (every Tuesday 8:00-9:00)
  - Morbidity conference (one Thursday a month 12:00-1:00)
  - New Topic Conference (every Thursday 12:00-1:00)
  - Physician Resident Lecture (MD) Education Course (each Thursday 7:30-8:30)
  - Physics Resident Seminars (physics resident presentation once a month Sept.-June).
  - Physician Resident Physics Seminars (once a month)
  - Machine Operation and Safety Orientation (during 1st month)
  - Annual Radiation Safety on-line training (presentation by WU Radiation Safety once a year)
  - Annual Fire, Chemical, Biohazard on-line training (yearly presentation by Environmental Safety)
- Prepare handout for 3 assigned topics for presentation at Physics Resident Seminar
- Pass end-of-rotation exams (3 in 1st year, 3 in 2nd year)
- Completion of comprehensions (1 per month in 1st year)

- Completion of site reports (15 in the 1st year)
- Pass Year 1 Oral Exam
- Pass Year 2 Oral Exam

The resident is given a certificate upon completion of the program. An example is provided as **Attachment 5**.

II.B Training Essentials - Design and Content

During the first year, the physics resident attends didactic lectures, special training sessions, conferences, and participates directly in the clinic through a series of treatment planning, special procedures, and brachytherapy rotations. The resident works closely with staff physicists and dosimetrists to observe and participate in conventional and IMRT treatment planning, image acquisition, fusion, registration, dose calculations, design and fabrication of patient treatment aids such as cerrobend blocks, multileaf collimation, aperture settings, compensating filters, and special bolus; treatment machine calibrations; patient and phantom dose measurements, quality assurance procedures, brachytherapy procedures, and other physical and technical tasks performed in the clinic. During this time, the resident should develop basic radiation oncology physics skills and also should develop an overall understanding of the radiation oncology physicist's and dosimetrist's role in the clinic.

At the beginning of the second year, the successful physics resident is given more responsibility (but always under the direct supervision of a physics faculty member). During the second year, the resident should develop confidence and continue the development of the necessary skills and experience to be prepared for independent clinical physics practice.

During the two-year period, the physics resident will receive didactic instruction in the following areas:

- Basic Radiological Physics
- External Beam Radiation Oncology Physics

- IMRT
- Advanced special procedures (e.g. TBI, IMRT, stereotactic radiosurgery,…)
- Imaging for Planning and Localization
- Brachytherapy Physics
- Radiation Safety
- Radiation Biology
- Clinical Radiation Oncology
- Statistics
- Physician Resident (MD) Education Course

Most topics are covered in the Physics Residents Course attended by our physician and physics residents. This Resident Physics Course is taught each year and lectures are given 2 days a week 7:30 AM - 8:30 AM in our Perez Conference Room located in the new CAM building. The course utilizes the textbook by Faiz Khan, Radiation Therapy Physics, 4th Ed, published by Williams and Wilkins. It is supplemented by handouts provided by the lecturer. The lectures are posted on a shareable drive. Homework is assigned and typically 3 to 4 exams and a final exam are given. A complete listing of lectures and topics covered is provided in **Attachment 6**.

The Radiation Biology Course typically follows the Physics Course each year and is customized for physics residents. The course utilizes the textbook by Eric Hall, Radiation Biology for the Radiologist, 4th Edition, published by J.P. Lippincott. It is supplemented by handouts provided by the lecturer. Physics residents must pass a final exam for this course to complete their residency training program. A complete listing of lectures is provided in **Attachment 6-7**.

Instruction in anatomy and physiology is provided by a number of means. This subject area is covered by the residents attendance of Patient Management Conference, Physician Resident Education Course (Treatment Techniques) Morbidity Conference, and Current Case Review Conference. Over the two year period, these conferences provide the resident exposure to a considerable number of patient related case management discussions involving the use of simulation films, port films (KV and MV),

CT scans, MR scans, and PET scans in which anatomical and physiological issues are discussed. In addition, our clinic currently provides one of the largest conventional and IMRT planning and virtual simulation services in the country. This form of image based planning provides the resident with a rich experience in radiologic anatomy. In addition, one of the changes we have implemented since our 1997 accreditation is that we now require the physics resident to prepare detailed reports for selected treatment sites that review pertinent anatomy (critical organs, primary tumor sites, and nodal regions), oncological aspects, and related technical parameters related to a particular treatment site. Each report is reviewed by a clinical physicist for thoroughness. The clinical physicist will review with the resident any inadequacies and remedies. The suggested outline, sites, and an example of such a report are included in **Attachment 8**. First year residents will cover all major treatment sites.

The Academic Update Conference, which is conducted every Friday morning 8:00 - 9:00 AM, provides the physician and physics residents a series of didactic lectures covering the clinical physics and biological aspects of radiation oncology. The clinical topics are spread over a two-year period and are designed to essentially cover the material found in the textbook by Perez and Brady (Principles and Practice of Radiation Oncology, 5th edition, J.P. Lippincott). A complete listing of the Academic Update topics over the last two year period is provided in **Attachment 9**.

The clinical rotations are the core element of the 1st year of residency training. They have 4 core elements to them; a) the actual assigned rotation, b) the assigned readings, c) assigned comprehensions with assigned faculty, and d) testing.

a) For each rotation, there are particular training essentials that include references. The training essentials may or may not include a check-off list of mastered tasks, depending on the rotation.
b) There are mandatory minimal readings that are assigned for each rotation, additional suggested readings as part of the comprehensions and training essentials.

c) The comprehensions were developed in 2007 to foster faculty-resident interaction, and to ensure the resident understands the background and details. The comprehensions are assigned coinciding with the rotations. Resident and the assigned Faculty are to meet 3-4 times in the scheduled month to discuss the particular subject. If the resident is struggling, additional meetings can be scheduled.

d) At the close of each rotation, there is a short exam that covers the rotation and the comprehension. This is conducted by 2 faculty members. If the faculty feels additional studying and reading is necessary, the resident will do so and retake the exam. The resident will have a total of 3 chances to pass the rotation-based exams. If unsuccessful, the resident will enter a probation period.

In the 2nd year, the specific rotations also end with a short exam based on the rotation. Additional readings are typically assigned following the exam. If the resident does not pass the rotation-based exam, the resident may take part or all of the exam over again with instructions as to deficient items. The resident will have a total of 3 chances to pass the rotation-based exams. If unsuccessful, the resident will enter a probation period.

A summary of the rotations is presented in Attachment 13. In addition and example of the training essentials for treatment planning (and check-off list) is presented in **Attachment 10**.

In addition to the clinical physics rotations and didactic lectures, the physics resident is assigned topics for 3 seminar presentations each year. The physics resident, working closely with an assigned staff physicist advisor, is expected to prepare a detailed handout with a well researched bibliography that contains both "classic" papers and state-of-the-art references. The past two year schedule is included as **Attachment 11** along with a sample handout prepared by a physics resident.

Physics residents participate in all department conferences in which the physics faculty is expected to attend. These include (1) Patient Management Conference, (2)

Resident Education Course, (3) Special Physics Seminars, (4) Academic Update Conference, (5) Morbidity Conference, and (6) Current Case Review Conference. An example of the weekly posting of conference schedules is provided in **Attachment 12**.

Examples of past clinical rotation assignments, reports, lecture handouts, and examinations are available for review. Evaluationsby the resident of the clinical rotations are discussed in regularly scheduled meetings held with the resident.

II.C Program Length and Sample Training Plans

The length of the residency education program is two years and the training calendar starts on July 1 of each year. In special cases, the start date can be delayed. Thus far we have not distinguished between those physicists entering with didactic training in medical physics, as evidenced by graduation from an accredited medical physics graduate education program, and those entering without didactic training in medical physics. We require all to follow the training program outlined in **Attachment 13**. Detailed descriptions of the clinical physics rotations, didactic coursework, and physics resident seminar assignments were provided in **Attachments 6-12**. As part of the orientation, the AAPM Code of Ethics document (PP 24-B) will be handed out and discussed with the Program Director. This training program has resulted in a 100% success rate for our graduates obtaining board certification. During the second year of residency, there is one month allocated for either clinical research and special rotation, or “catch-up”. Clinical research projects and special rotations must be approved by the Program Director. A resident who is struggling will use the month for ‘catch-up,” i.e. an additional rotation.

II.D Training Administration

Training program review is an ongoing task and the responsibility of the Program Director, Associate Directors, and the Physics Residency Committee. The training essentials and clinical physics rotations are generally reviewed once a year. Part of the review is to incorporate changes as suggested by faculty or residents. Modifications require submission to the Program Director, with subsequent approval by the Physics

Residency Committee if deemed appropriate. If specific changes to the rotations or comprehensions are to be made to meet the needs of the program, then the Physics Residency Program Director targets the appropriate faculty for that task.

III. Physics Residents

III.A Admissions

All trainees entering the Radiation Oncology Physics Residency program are required to have acquired a strong foundation in basic physics as documented by a master's or doctoral degree in medical physics, physics, engineering, mathematics, or other science with physics training equivalent to a minor in physics.

Interested candidates are provided with a list of material that provides essential information on radiation oncology physics training (see table below). These AAPM documents are free and downloadable: aapm.org/pubs/reports.

Title
"A Guide to the AAPM"
"The Medical Physicist
"The Roles, Responsibilities, and Status of the Clinical Physicist
Report No. 90, "Essentials and Guidelines for Hospital-Based Medical Physics Training Programs"
Report No. 38, "The Role of a Physicist in Radiation Oncology

In addition, a description of our Residency Program and application form **(Attachment 14)** is provided. Applications are due by December 31 of the year preceding the training initiation. Typically 60-85 applications are received each year.

Upon receipt of the candidate's completed application, transcripts, and letters of recommendation (electronically), most of the information packets are forwarded to members of the Physics Residency Committee who then rank the candidates. There is a filtering of the applications conducted by the program director. Incomplete applications or applications for candidates that do not have a remote chance of selection are segregated and not propagated for further review. The scores are summed and the top candidates are contacted by phone to initiate the interview process. Candidates contacted by phone are invited to interview. They are then interviewed by members of the Physics Residency Committee along with other physics faculty. In addition, references may be contacted by phone to supplement the recommendation letters. The Physics Residency Committee then meets and reviews the interview results and any other pertinent information regarding the applicants, and then rank orders the candidates making the final cut. It is a purely democratic process where global scoring determines the candidates for interview or ultimate selection. There are meetings for all involved to attend to openly discuss candidates, especially if the cutoff scoring is very close for the selected and non-selected, or if there are large scoring discrepancies. Position(s) are first offered to the top interested candidate(s). If the selected candidate(s) declines the offer, or does not respond in a timely fashion, the position is offered to the next ranked candidate. A letter is sent to all unsuccessful candidates thanking them for their interest in our Residency Program and encouraging them to continue to seek admittance to this field of training.

The interview process is performed in accordance with the equal opportunity standards of Washington University.

Attachment 4 lists the names of all residents admitted to our Residency Program, their degrees, their field of study, year graduated, and the university awarding the degree. Detailed records about applicants and residents admitted to the program for the previous 3 years are available for review.

III.B Recruitment Efforts

In the past, an announcement for the Physics Resident positions has been made in January of the year training is to commence. This is accomplished via the AAPM Job Placement Announcement (**Attachment 15**). The advertisement describes the training program and provides instructions concerning application to the program. In addition, a letter and application is sent to the Program Director at each AAPM-listed graduate and post-doctoral granting programs (http://aapm.org/education/noncampep.asp) informing them of openings in our training programs and urging them to encourage their graduates to apply to our program.

III.C Number of Residents

The Physics Residency Program is designed for a maximum of 6 residents. Five physics residents are funded at this time and their status is as follows:

- Kevin Moore, Ph.D. is a second year physics resident. He entered the Residency Program July 1, 2007 and is expected to finish June 30, 2009.

- Sridhar Yaddanapudi, Ph.D. is a second year physics resident. He formally entered the Residency Program August 1, 2007. He had previously worked as a Clinical Physics Assistant for 8 months in the areas of brachytherapy and IMRT. He took an evaluation exam to determine his level of competency in multiple areas. It was determined from the exam and competency evaluation, he could reduce his first year rotations from 12 to 8 months. He will complete his second year of residency March 31, 2009.

- Maria Mamalui-Hunter, Ph.D. is a first year physics resident. She entered the program January 1, 2008 and is expected to complete her residency by December 31, 2009.

- H. Omar Wooten, Ph.D. is a first year physics resident. He entered the program on July 1, 2008 and is expected to complete his residency by June 30, 2010.

- Geethpriya Palaniswaamy, Ph.D. is a first year physics resident. She entered the program on July 1, 2008 and is expected to complete her residency by June 30, 2010.

III.D Evaluation of Resident Progress

Residents are monitored through the program by the assigned faculty for each clinical rotation. Meetings every six weeks between the physics resident, Program Director, and assigned faculty for the current rotation were instituted to discuss problems related to resident training. This meeting also gives an opportunity for the resident to provide feedback about the program. The meeting is conducted with the Program Director and the Faculty mentoring the resident for the particular rotation. At this meeting, the resident's progress in their current rotation is reviewed, discussed, and if needed altered. The Program Director has an open door policy and encourages the resident to bring sensitive problems to the Director's attention. Near the end of each year of their training, the resident is given an oral examination modeled after the ABMP certification exam. If the resident does not pass the exam, the resident is placed on probation. During that period, the resident is assigned to the area(s) of demonstrated weakness. At the end of the probation period, an oral exam is again conducted. If the resident does not pass this second oral exam, the resident is terminated from the Residency Program. This occurs under the procedures and guidelines of Washington University. **Attachment 13** describes the essentials for completion of particular rotations. A formal evaluation of the program is performed by the resident upon completion.

By the end of the first year, the Physics Resident is expected to function as a Junior-Physicist, with the ability to perform quality assurance tests, patient QA, monitor unit and dose calculations, conventional and IMRT treatment planning, radiation safety procedures, and brachytherapy physics procedures and planning. By the completion of the two year term, the physics resident is expected to be able to perform all radiation oncology physics functions, including full calibrations of treatment machines, checks of dosimetry work (treatment plans, etc.), weekly paper and electronic chart reviews including delivery and imaging for patients, radiation safety procedures, clinical

consultations, and patient-related dosimetry. Every effort is made to include as many residents as possible into commissioning and acceptance testing of simulation, delivery, and localization systems.

III.E New Resident Orientation

New physics residents are provided a two day orientation lecture series followed by a week long rotation in the simulator and dosimetry areas at the beginning of their training. An example of the orientation schedule is provided in **Attachment 16**. In addition, the Program Director and Physics Faculty meet with each new resident at that time to ensure the incoming resident clearly understands the program's requirements, resident administrative procedures, and any other expectations. At this meeting, the resident is made aware of staff and program resources, including treatment machines, treatment planning facilities, laboratories and libraries. Each faculty member gives advice and expectations of the resident.

IV. Program Administration

IV.A Structure Within the Hospital and Medical Center

In accordance with the Principles of Affiliation between Barnes-Jewish Hospital and Washington University School of Medicine, residents are employees of the university and are also subject to Hospital policies and procedures. The direction and content of the physics residency program is developed and administered by the Physics Residency Program Director, an employee of Washington University, assisted by the Physics Residency Committee. Hospital administration and University Administration work together daily to ensure consistency and coordination. The Physics Residency Program Director is Eric E. Klein, Ph.D. and the Radiation Physics Division Director is Daniel A. Low, Ph.D. The Program Director is responsible to the Physics Director, who is responsible to the Chairman of the Radiation Oncology Department.

IV.B Role of Program Director

The Program Director is responsible for program administration. The Program Director follows guidelines established by the Physics Residency Program Committee, WUMC, and BJH in administering the program. Dr. Klein is assisted by Dr. Daniel A. Low, Director of the Physics Division, and Ms. Connie Davis, Secretary to Dr. Klein. Administrative tasks include:

- Correspondence with prospective trainees
- Scheduling of prospective residents visits
- Hospital appointments
- Scheduling of classrooms for faculty lectures
- Scheduling of Physics Residency Committee meetings
- Scheduling of resident meetings
- Preparation of agenda and minutes of Physics Residency Committee and faculty staff meetings.
- Preparation for resident orientation
- Administrative support for residents
- Program correspondence
- Preparation of clinical rotation schedule
- Preparation of lecture schedules
- Scheduling Physics Resident seminars
- Scheduling Oral Exams
- Initiation of Physics Residency Program Review
- Fellowship Grant Applications
- CAMPEP Application/Re-Accreditation

IV.C Role of Physics Residency Committee

The Physics Residency Committee is responsible for the following tasks:

- Resident recruitment
- Admission recommendations
- Monitor physics resident's progress

• Training curriculum
• Orientation program
• Committee meetings
• Oral exams
• Program review

The committee consists of the Program Director, Assistant Director, 3 additional Physics Faculty, a Physician, and a Dosimetrist. The committee meets at least twice annual, once for resident selection, and once for programmatic review. The committee will additionally convene due to emergent situations, for example, decisions on probation or dismissal of a resident.

IV.D Records Available for Review

The following records pertaining to the Radiation Oncology Physics Residency Program are available for review: (1) applications, (2) transcripts, (3) letters of recommendations, (4) applicant review meeting minutes, (5) Physics Course lecture schedule and handout, (6) Cancer Biology Course lecture schedule and handouts, (7) Physics Resident Seminar schedule and handouts, (8) clinical rotation schedules, (9) physics residents' meeting minutes, (10) oral exam results, and (11) evaluation records. These files are maintained and located in the Physics office area. The records for all resident activities (including initial application) and meeting minutes are maintained for for a period not to exceed 10 years. Applications are maintained for a period of 5 years.

IV.E. Testing Methods

As previously mentioned, there are two formal test procedures that take place for the residents. At the end of each rotation, in both the first year and the second year, there are short exams given to the residents based on the rotation and the competent comprehensions within that rotation. The exams are given by two faculty members who were heavily involved in the rotation, which often were the mentoring faculty for the comprehensions within that rotation. The exam is based on the templates used for the comprehensions themselves. The exam passing or failing is subjective, based on the assessment of the examiners involved. In regards to the comprehensions, for each

comprehension there is a tabular check-off sheet that includes particular subjects related to the comprehension, and whether or not the resident comprehended the particular subject, and if not, the assigned reading material pertaining to that particular subject. Examples of the comprehensions are found in **Attachment 17.**

The second more formal and most important examining process is the oral exam at the end of the first year and at the end of the second year. These are typically given one month in advance of the completion of the first or second year. The first year exam is 90 minutes with three faculty participants and one dosimetrist participant, usually Mr. Bertrand, the dosimetrist advisor on the Physics Residency Committee. The subject matter, which also includes the testing format and score sheet is included in **Attachment 18** concerning a comprehensive, end of year oral exams. The resident must pass all the subjects, along with rotational accomplishments, to go to their second year. If the resident fails one or two of the subjects, then a conditional exam will be given within 30 days for the resident to be able to pass those particular subjects. This is usually a shorter exam concentrating on those one or two subjects. If the resident fails the exam by failing in three or more subjects, the entire exam is given again within 30 days. If the resident fails three or more subjects again, then the resident is dismissed from the program according to Washington University rules. If the resident conditions the exam by not passing or two subjects, a conditional exam is given, and entry into the second year is delayed. This conditional exam is then given within 15 days of the first exam.

The second year exam is given 30 days or more before completion of the program, and there are eight subjects to be mastered. If the resident fails five or more subjects, the resident must take the entire exam again within 15 days. If the resident fails only one or two subjects, then a conditional exam will be given, also within 15 days. If by the end of the second exam, whether it is a full or conditional exam, the resident still had not completed all subjects, then there is potential that the residency will have to be increased in time in order for the resident to come up to competency to master all the particular subjects within the year two exam.

V. Resources

V.A Staff

The faculty of the Radiation Oncology Physics Residency Program represents the foundation and strength of our Program. All of our faculty have appointments at Washington University and provide clinical support to the Barnes-Jewish Hospital radiation oncology clinic. The faculty has a broad teaching expertise and access to a wealth of clinical physics equipment and training resources.

Attachment 19 lists the faculty that contribute to our Program. The faculty comprises a broad range of expertise within radiation oncology physics. The background and role of key physics faculty within the Program are provided in individual biographical sketches found in **Attachment 20**.

The faculty and staff interact regularly through (1) physics faculty meetings, (2) seminars, (3) case conferences, (4) quarterly departmental faculty meetings, (5) hospital or medical school committee meetings, (6) Physics Residency Committee meetings, and (7) annual retreats of the Department's faculty.

The faculty-resident interactions occur at (1) clinical physics rotations, (2) classroom environment, (3) seminars, (4) private appointments to discuss the designated comprehensions, clinical rotation, or personal problems, and (5) social activities (Division parties, etc.). In addition to the routine meetings, the residents also have access to the Program Director and Division Director to discuss sensitive personal or training problems. We feel there is relatively open communications between residents, faculty, Program Director, and the Division Director.

For an estimated Program capacity of 6 residents and a planned 14 radiation oncology physics faculty, our resident to faculty ratio is approximately 1:2. In addition, there are 12 dosimetrists and 3 brachytherapists who all play an active role in resident training during their 1st year. We have chosen to limit our program to four residents (therefore a ratio of 1:3, resident to faculty) to maintain quality.

V.B Financial

V.B.1 Residents Financial Burden

The typical financial burden of a physics resident based on actual data provided by the residents are as follows:

	Resident A	Resident B
Rent	$700/mth	$700/mth
Car Insurance	$1,000/year	$800/year
Health Insurance	$45/mth	$45/mth
Utilities	$50/mth	$75/mth
Books	$120	$0
Food	$60/week	$75/week
Gas	$15/week	$30/week
Parking	$50/mth	$42/mth

V.B.2 Resident Funding

Effective July 1, 2008, the following funding levels are in effect for physics residents:

- 1st year Physics Resident: $45,000
- 2nd year Physics Resident: $46,350

The support for the residency program comes from the clinical hospital contract. The hospital does receive funding from CMS as part of the GME pool of funding, by the paramedical education pathway.

In addition to direct compensation, physics residents are afforded benefits consistent with other hospital employees including medical and dental insurance, paid vacation and holiday benefits (3 weeks), 5 paid meeting and/or interview days in their second year, sick pay benefits, and disability insurance. The expense of these benefits is shared between the physics resident and Barnes-Jewish Hospital.

The residents are funded up to $1,200 so each attends a national meeting in their second year. The AAPM also provides $1,000 per year for our accredited program. At the beginning of the second year, the resident receives a book allowance of $500 to be spent within 90 days.

V.C Facilities

The Physics Residency Program has significant facility resources available to it, which include the clinical treatment and treatment planning resources, dosimetry instrumentation, computers, software, research laboratories, classrooms, and libraries.

V.C.1 Resident Offices, Classrooms, and Conference Rooms

The Physics Residency Program provides office space for each resident in the program. The Resident Office, for medical and physics residents, is currently located in Siteman Cancer Center's Radiation Oncology Department. The room is allocated for the capacity of 4 physics residents. **Attachment 21** shows the data sheet distributed to residents at the beginning of the program that contains room location and phone number of all key faculty in the Physics Residency Program. Residents are provided a cubicle including a desk, file cabinet and bookcase, computer terminal connected to LAN, telephone access, and standard office supplies. Residents have access to departmental copying equipment. The Physics residents are also provided with a library account for electronic access to journals and journal searches (Medline, OVID).

Ample space is available for resident advisory meetings, didactic lectures, exams, seminars, and oral examinations. Three meeting rooms/classrooms are in the department. They each contain whiteboards, LCD video projectors, and computer connections for LCD projection. Additional conference rooms are available in the SCC if needed.

V.C.2 Clinical Facilities, Laboratories, and Shops

The residents have access to a myriad of laboratory and shop facilities including: (1) a dosimetry instrumentation lab in the physics research area; (2) a brachytherapy lab in the Brachytherapy Suite; and (3) other research labs and offices in the Clinical Science Research Building. Residents submit work orders to a campus machine shop as required. In all, the availability of dosimetry and clinical treatment areas and equipment is more than adequate to serve the needs of the residency training program. Clinical facilities are listed in **Attachment 22**. Procedures are in place that (1) allow the resident reasonable access time to clinical equipment, (2) provide residents sufficient training and technical support to ensure safe and proper use of equipment, and (3) to ensure equipment is left in the proper state for clinical use.

Treatment planning and external beam delivery equipment utilized in the training program include 4 Varian linear accelerators (including 2 Trilogy units), 2 Elekta Precise linear accelerators, 2 Tomotherapy planning and delivery Units, a Gamma Knife planning and delivery system, a 50 kVp contact therapeutic x-ray unit, 2 Philips Brilliance CT-simulators (16-slice-large and 64-slice-small "bore"), a 1.5T MRI simulator, 26 Pinnacle TP workstations, 8 Varian Eclipse/Helios workstations, and a conventional x-ray simulator. In early 2009, we take delivery of the world's 1st compact, single room proton machine. Specialized equipment and features include the DMLC-IMRT delivery, Helical Tomotherapy Planning, linac and Gamma Knife stereotactic radio-surgery/therapy, and image guidance provided by on-board x-ray imaging, portal photon imaging, video surface imaging, internal transponders, and kV-CT systems. Clinical rotations are also provided within our HDR, LDR, prostate seed, and radiopharmaceutical program, including image guided interstitial, intracavitary and surface implant planning and delivery.

V.D Libraries

The major libraries available to students are the Washington University Medical School Library and the Washington University Main Campus Library. Students also have access to the Division of Radiation Physics' Library in Meeting Room #2 in the Department which maintains bound volumes of Medical Physics, Physics in Medicine

and Biology, and International Journal Radiation Oncology, Biology, and Physics. Medline accounts are available for the residents for manuscript keyword/author searches.

VI. Safety

All first year residents are issued a radiation monitor by WU as part of their new employee procedure.

Incoming residents are required to pass a radiation safety exam within the first month of beginning the program. The exam is based on a radiation safety manual (Attachment 23) included with orientation material**.** In addition, the Washington University Radiation Safety Office provides annual on-line training that all department faculty, staff, and residents are required to complete annually.

All new residents attend a working session during their orientation with our clinical engineers on treatment machine operation and training in the dangers of high voltage.

During the first year, Physics Residents view an on-line lecture intended to make them aware of potential hazards due to chemicals or biohazardous materials. Residents also attend required safety training provided by the Hospital, including fire safety. Materials covered in these lectures are available for review.

VII. Program Review

The Program Director and the Physics Residency Committee are responsible for the ongoing evaluation of the residency program and to implement actions and policies necessary to accommodate change. This application for accreditation affords the opportunity to critically look at our current Program's status and to develop future goals.

VII.A Summary of Strengths and Needs

The Physics Residency program has thus far met our faculty and trainees expectations. Particular strengths include the following:

Strength

- Clinical training facilities are excellent.
- Funding for four resident positions is firm.
- Adequate number of well-qualified and dedicated faculty.
- Strong support for program from the Medical Director and BJH Administration
- The quality of potential residents seeking admission into the program remains high.
- The Physics Residency Program has now established a reputation for producing well-trained clinical physicists. Upon graduation, our graduates are in great demand.
- State-of-the-art imaging and delivery equipment
- Outstanding clinical physicists, many former residents

The new Siteman Cancer Center radiation oncology facility is an all inclusive single floor facility. The Cancer Center has just obtained designation as a NCI Comprehensive Cancer Center. These developments have made a significant impact on our Physics Residency Program by providing a more cohesive training environment, by providing a consolidated radiation oncology clinic, more modern clinical facilities, and expanded training and research facilities.

Needs

The program has made great strides since our last accreditation; particularly we have been able to secure funding for residents to travel to meetings along with book money for each of the residents. These both apply in the second year. Nonetheless, there are some needs for the program: (1) the program has the ability to expand to six residents that being accepting three each year. Furthermore, even now with five residents, it would be desirable to have dedicated space. Currently, the two first-year residents share space with the physician residents in cubicles while the more advanced residents share a faculty office. This works well in terms of interaction with physician residents for first-year residents and physics faculty for second-year residents. However, the second-year residents' space is volatile and may not exist in the upcoming year. Therefore, we need

to secure four dedicated locations for the residents. The most ideal scenario would be that they are all in one large office sharing a room and resources together.

Another need is to strengthen our imaging education. Currently, we have radiation oncology physicists who have expertise and provide didactic education in the areas of imaging. This includes also MR physicist working in radiation oncology. However, we still have some voids regarding physics applied to nuclear medicine, particularly PET scanning, image registration, and fusion. We are looking at ways to strengthen this particular aspect of the training.

Finally, at this time we do not have outreach facilities where residents could rotate for the purpose of demonstrating independence. This is a need that may be fulfilled in the near future with a new county facility that we will be supplying services to and also the potential for Veterans Administration Hospital where again residents could reside on a part-time basis and allow their independence to be tested.

VII.B. Further Development and Improvements

Currently our program is attracting anywhere from 60 to 85 applicants per year. This is independent of whether we have one or two positions open. Annually we accept two new residents. This allows us to have very strong selection of outstanding candidates. Nonetheless, we are never assured we are getting the best candidates for our program. We need to develop a mechanism for being able to interview and better forecast on whether a resident will be successful or not. This is a very difficult task. We have not had the resident candidate lecture. However, this may be a method to help evaluate candidates, which would be a daunting task for resident interviewing and also time for the faculty. In addition, we need to formalize testing to avoid any grey areas in interpretation. This is especially important for the first and second year exams in which the clearer passing or failing has been very subjective in terms of whether someone has outright failed or conditioned an exam. We need to develop ways of making the exam process more consistent and clear cut as to what is deemed a failure of a subject, or an overall outright failure.

Finally, we need to improve our faculty participation, particularly in manner of consistency. The comprehensions have helped in this cause as all faculty members are involved in meeting with residents. Nonetheless, there are still faculty who routinely

teach and enjoy the interaction immensely, while others see residents as simply aids in the work force.