

REPORT TO THE AAPM THERAPY PHYSICS COMMITTEE

Report No. 141

September 16, 2011 – April 17, 2012

ADMINISTRATIVE

The RPC grant was renewed for the second year of its three year grant cycle. However, the grant was funded at 73.5% of its award last year. This 26.5% cut in funding has resulted in a direct cost loss of \$513,000. While we are hopeful that some percentage of these funds will be restored, actions have been taken to prepare ourselves for the worst. Beginning September 1, 2012, the institutional annual QA program fee will change to an increasing fee per institution structure based on the number of megavoltage therapy machines (beamlines for proton facilities) at the institution. The fee will actually decrease for the small single machine facilities, but will increase up to a maximum fee of \$3000 for institutions with >8 machines.

In light of the international activities of the NCI, the RPC has been approached and asked to assist with the QA efforts as they pertain to radiotherapy trials with a brachytherapy component. Unless the radiotherapy site is a member of one of the NCI funded cooperative clinical trial study groups, the RPC is receiving funding for the service.

A subcontract with UCSD to provide QA support for an international gynecological clinical trial is still pending. The RO1 proposal was rewritten and resubmitted this past Fall 2011 and we are waiting to hear whether we will be funded.

The VA contract is in its second year of a three year contract to provide QA services to all VA centers.

The MGH subcontract was due to end on December 31, 2011, but a No Cost Extension (NCE) was approved until April 30, 2012. Due to cost savings and delays in performing some of the scheduled work (site visits and NIST calorimetry measurements), funds were still available. We have been given another NCE until the end of 2012.

Under the advice of the NCI, the RPC has created a for fee service that allows institutions to pay for QA services for a fee. OSLD/TLD beam checks and QA phantoms are provided through the MD Anderson Dosimetry Laboratory.

In 2013 all cooperative study groups and associated clinical trial programs such as the RPC will have to resubmit for funding. The therapy and imaging QA offices have been meeting regularly to discuss how to respond to the NCI's FOA as a combined QA group. The new clinical trial QA group will be known as the Imaging and Radiation Oncology Core (IROC) Group. Currently there are 4 working groups, admin/Ops, RT QA, Imaging QA and IT, working on detailing the QA processes performed by each QA office to determine how best to structure the new group. The next face to face meeting will occur in Philadelphia this coming May 8th.

There have been a few personnel changes since the last report.

Stephanie Tabb, a Secretary, resigned in March 2012. Her duties are being assumed by Ms. Espinoza, a clerk, who will be promoted to the secretary role.

Lynn Palmer, Ph.D., a statistician (10%) was realigned for cost savings and due to lack of contributing effort.

Geoffrey Ibbott, Ph.D., Proton Medical Physicist, effort was reduced from 10% to 1% effort for cost savings and because he needed more time as Chairman.

STUDIES AND RESULTS

The RPC currently monitors 1786 megavoltage therapy sites in North America, Europe, and elsewhere in the world, that participate in cooperative group clinical trials funded by the NCI or collaborating with the NCI. The cooperative groups monitored include ACOSOG, ACRIN, CALGB, COG, ECOG, EORTC, GOG, JGOG, KGOG, ANZGOG, NABTT, NCCTG, NSABP, RTOG and SWOG. The RPC is a member of an international QA in clinical trial harmonization group. Dr. Followill is the co-chair of this group with Dr. Coens Hurksman (EORTC). A website has been created for this harmonization group (<http://www.atomic.gr/WQH/>). Today, nearly 99 EORTC members are taking advantage of the RPC's remote audit programs.

1. We received an NCI supplement to provide QA activities for the Outback trial which is a cervical cancer trial administered by ANZGOG.
2. We have been asked to provide some QA for the Aids Malignancy Clinical Trial Consortium (AMC) on a trial treating cervical cancer in women with AIDS. We have submitted a budget and are waiting to hear the final decision.
3. We have assisted with the Gynecological Cancer InterGroup (GCIG), an international organization dedicated to promoting trials to treat gynecological cancer, by providing the RPC electronic facility questionnaire.
4. The KGOG has asked us to provide a cost proposal for performing QA for the Tri-weekly Administration of Cisplatin in Locally Advanced Cervical Cancer (TACO) trial.

The RPC currently is providing QA monitoring services to 210 radiotherapy facilities in 41 different countries as shown below in figure 1.

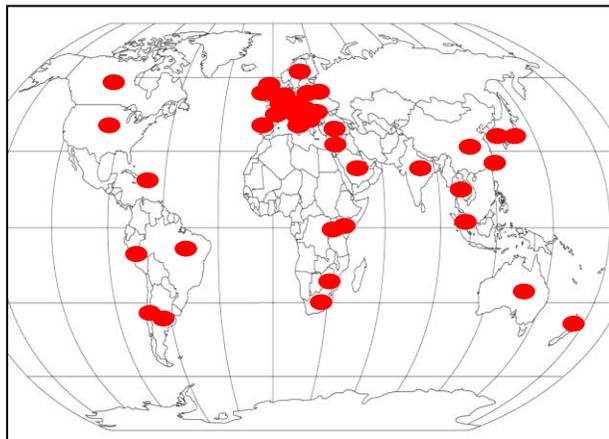


Figure 1. International extent of theRPC QA program audits

RPC Monitoring Activities: The RPC continues to provide its ongoing QA services to the institutions participating in NCI funded clinical trials as listed below.

a) **On-Site Dosimetry Reviews:** RPC physicists continue to make visits to US study group members to conduct on-site dosimetry reviews. A total of 41 radiotherapy sites were visited this past year. This was the largest number of sites and beams measured in over ten years. QA tests for MLC have been incorporated, TG-142 is now used as the QA program standard, and IGRT tests have been designed but not implemented due to a delay in building the QA cubes.

The electronic transfer of site visit data to the RPC database has been implemented. Where it used to take 30 minutes per beam to enter all of the visit data for that beam, it only takes a fraction of a second. This will result in a huge efficiency move by the RPC.

b) **Visits to Proton Therapy Centers:** In response to a mandate from the NCI, the RPC has developed procedures and assembled the equipment to conduct on-site dosimetry visits to proton facilities. These visits are conducted for the purpose of approving centers for the use of protons in NCI sponsored clinical trials. Funding from MGH has been obtained to continue the proton site visits. The Loma Linda proton center was visited and a revisit was made to the University of Florida. Re-visits have been scheduled to MDACC and MGH. Hampton River has not indicated any desire to participate in clinical trials as of yet.

To date, we have approved 7 proton centers for the use of protons in clinical trials as seen in Table 1. Loma Linda is in the review process but we are hopeful that they will be approved soon.

PROTON FACILITY APPROVAL								
RTF #	NAME	STATUS	FQ	E Data		Site Visit	Phantom	Approved
				Transfer	TLD			
2610	Pennsylvania	Active	Yes	Yes	Yes	Yes	Yes	Yes
3180	Florida	Active	Yes	Yes	Yes	Yes	Yes	Yes
3913	MGH	Active	Yes	Yes	Yes	Yes	Yes	Yes
3912	Midwest	Active	Yes	Yes	Yes	Yes	Yes	Yes
3419	M D Anderson	Active	Yes	Yes	Yes	Yes	Yes	Yes
4240	ProCure OK	Active	Yes	Yes	Yes	Yes	Yes	Yes
3914	Loma Linda	Active	Yes	Yes	Yes	Under review	under review	No
4533	ProCure IL	Active	Yes	Yes	Yes	Yes	Yes	Yes
4125	Shizuoka	Active	Yes	-	Yes	No	-	-
	Hampton	inactive	No	-	No	No	-	-

Table 1. Proton facility approval status as of April 11, 2012.

The RPC's proton therapy advisory group (E. Klein, M. Moyers and Z. Li) met at the RPC in February 2012 and revised the NCI's proton guidelines. These guidelines are being circulated for comments to several individuals involved in clinical trial proton therapy. It's NCI's belief that the group has met its charge of revising the guidelines and if the group is to continue to exist, it should do so as an advisory group to the RPC regarding the RPC's proton QA activities.

The funding from the MGH federal share funds was also to be used to develop a national standard for proton beam calibrations in collaboration with NIST. As such, the first proton ion chamber

comparison was performed in November 2011 with all 9 proton facilities sending a representative to the MDACC proton center. NIST is expected to perform calorimetry measurements at the MDACC this coming June 2012.

- c) **VA Agreement:** We are halfway into the second year of the agreement with the Veterans Administration to provide remote audits and on-site dosimetry reviews at an increased frequency to VA radiation therapy facilities. To date all VA sites have received OSLD beam checks annually, 17 sites of the 35 VA radiotherapy centers have been site visited and another 18 sites irradiated the RPC phantoms sent to them.
- d) **OSLD/TLD:** Shipments of OSLD beam output checks have been performed for nearly two years now and the transition has gone smoothly. The reporting time back to the institution has decreased with OSLD and the efficiency in reading the OSLD has improved dramatically. A publication on the uncertainty of the OSLD is under preparation. We are in the process of commissioning the third batch of OSLD (16,000 nanodots) that should last us for 3-4 years.

We are still seeing that 12-15% of the institutions sent OSLD have one or more beams outside of our 5% beam output criteria. The repeat percentage is the same as observed for reference beam output checks during onsite dosimetry review visits using the 3% criterion as seen in Table 2.

Reference Beam Calibration		
Percent of Inst. with ≥ 1 beam out of Criteria (since 2000)		
	Photons	Electrons
TLD ($\pm 5\%$)	7-11%	6-12%
Visits ($\pm 3\%$)	13%	15%

Table 2. Percent of institutions with one or more reference beam outputs outside the RPC criterion.

Projects are underway to implement a remote audit for Ir-192 HDR brachytherapy and to incorporate OSLD in the proton beam checks. Another project, to use OSLD in the RPC's pelvic phantom, accounting for their directional dependence is being completed.

We also purchased part of a TLD crystal to provide us with TLD for the RPC phantoms and our Tomotherapy and Gamma Knife beam check phantoms. It is our goal over the next year and a half is to minimize our use of TLD.

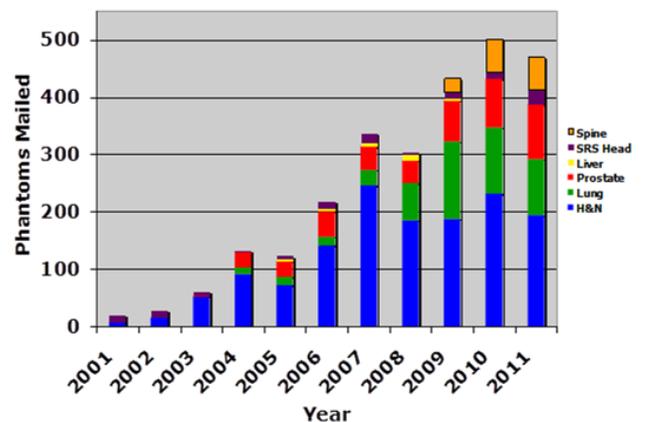
- e) **Credentialing Processes:** The RPC participates in the credentialing of institutions for protocols involving advanced technologies including HDR brachytherapy, IMRT, stereotactic radiosurgery (SRS), stereotactic body radiation therapy (SBRT) and proton therapy. This activity is partially supported by a subcontract from the Advanced Technologies for Clinical Trials grant. Credentialing activities include, but not limited to, questionnaires, knowledge assessments, benchmark cases and phantom irradiations. Nearly 500 phantoms were shipped in 2011 all around the world. The historical pass rate now is between 65% - 85% depending on the phantom. We are now using a gamma index analysis for the prostate, H&N, spine and lung phantoms. The new acceptance criteria for the IMRT H&N and prostate, approved by the RTOG medical physics committee, is one that incorporates both the TLD results ($\pm 7\%$) and an evaluation of the planar dose distributions in the axial and sagittal film planes such that 85% of the pixels pass a gamma index criteria of $\pm 7\%/4\text{mm}$.

Phantom	H&N	Prostate	Spine	Lung
Irradiations	1139	313	120	458
Pass	928 (81%)	265 (85%)	78 (65%)	361 (79%)
Fail	211	48	42	97
Criteria	7%/4mm	7%/4mm	5%/3mm	5%/5mm

The benefits of using the RPC's independent end-to-end audit phantoms for multi-institutional cooperative clinical trials are:

1. Uniform phantoms and dosimeters
2. Standardized analysis
3. Uniform pass/fail criteria
4. Allow institution to institution comparison
5. Established infrastructure in place

The RPC phantom program provides the consistency as needed for clinical trials.



f) **Facility Questionnaire (FQ):** The RPC began using the electronic facility questionnaire this past December 2011. The FQ is password protected and is sent to the institution pre-populated so that the institution only has to make changes and/or additions. We are in the process of adding a few more IMRT questions and will begin to work on the study group specific sections starting with the RTOG first. The electronic FQ has been a valuable tool for the international sites.

g) **Webpage:** The RPC webpage has been updated with a new look that will be updated with new features on a more frequent basis.

h) **Publications:** The RPC submitted 25 abstracts for the upcoming AAPM meeting. During 2011 we had 14 manuscripts published and 10 more have been submitted and are in the review process.

i) **Response to Last Year site visit Recommendations**

1. *Develop the Ir-192 brachytherapy OSLD remote monitoring* – This has been a student project and has been developed. We are in the final feasibility study sending the phantom to 5 sites.
2. *Develop an informatics infrastructure for web-based submission of basic dosimetry data to allow end users to access a review of their data to the RPC standard data* – The RPC will discuss this issue with J Colvin's WG about implementation of this tool. The delay is having the IT support to accomplish this task and the many other IT tasks. When AAPM was asked for funding to make this happen. The response back was that it should be a volunteer effort.
3. *Switch the annual proton beam reference output audit from TLD to OSLD* – A student project last year and was presented at last year's AAPM meeting demonstrated the possibility. We have been waiting for the new batch of OSLD to commission the OSLD for proton beam use. Time at the MDACC proton center is being scheduled.

4. *Implement the electronic facility questionnaire for the RPC's annual remote monitoring program* – The electronic FQ use was implemented in December 2011.
5. *Implement the RPC Virtual site visit* – This implementation has been delayed until the new RPC standard data is generated. The standard data generation was delayed due to completion of the electronic site visit data transfer being delayed.
6. *Begin to perform MLC QA tests during RPC site visits* – This has been implemented as of January 2012. There have been some issues with getting MLC scripts for all makes and models of linacs with differing MLCs.
7. *Begin to perform the IGRT tests during RPC site visits* – This has been delayed due to the need to build the image guidance QA cubes. We had hoped that we would be able to use the standard imaging MiMi phantom, but it was too large. They then offered to build a mini MiMi but the price of it was more than the regular larger MiMi. We made the decision to build our own cubes.
8. *Convert from Office 2003 to Office 2010* – This has been delayed due to required effort needed to rewrite internal software for specific RPC processes such as the onsite dosimetry review visit.
9. *Convert from Oracle 9 to Oracle 11 for the RPC database* – The RPC is currently operating on Oracle 10G platform. The upgrades are limited by what MDACC does since we are on their servers.
10. *Develop a standard set of benchmark cases for each treatment planning system* – This has always been the case. There are multiple cases for the various planning systems.
11. *Work with the study groups to design protocols using volumetric brachytherapy planning* – This is an ongoing task that will require a paradigm change in brachytherapy radiation oncology. More and more institutions are using CT based planning for their brachy insertions.
12. *Develop a new volumetric dose calculation program for external beam RT* – The generic source model Monte Carlo effort is continuing to include Elekta linacs and unflattened beams from the True Beam. We will have to see how the new QA group reorganizes since external beam dose verification may become the responsibility of one of the other QA centers.
13. *Establish collaborations with international GOG study groups* – We have contacts with ANZGOG, JGOG and KGOG. We are assisting the GCIG and are about to assist with the AMC African study. Dr. Followill spoke to the KGOG attendees at the last RTOG meeting regarding RC capabilities. Dr. Followill has been invited to speak in Korea this coming Fall about the RPC and their QA efforts with GOG studies.
14. *Define work priorities and resource allocation for proton center approvals* – With the addition of Paige Summers, she has managed the effort and logistics of performing the proton center approvals. The proton advisory group to the RPC has helped us to make the site visits more efficient. As new proton centers open, they will be prioritized for visits and other QA activities.
15. *Develop a robust web-based environment for electronic credentialing* – Depending on what is exactly meant by this recommendation we believe we are already doing this or have the capability to do so by the issuance of passwords. We already incorporate the use of web-based tools in GOG and NSABP credentialing. If the meaning is to allow individuals to view their credentials, then the issuance of passwords would make that happen.
16. *Work with study groups to require a virtual visit for each institution as a prerequisite for trial participation* – This recommendation is waiting for us to implement the virtual site visit on a large scale so that data can be gathered showing the usefulness of the virtual site visit.

17. *Align the RPC credentialing criteria with AAPM reports* – This may occur once there are AAPM criteria to be aligned with. All RPC criteria must have study group endorsement.
18. *Examine carefully the RPC expansion of QA services to the international community* – The RPC international efforts are only implemented once there is funding provided. This is supported by the RPC NCI project manager.
19. *Generate more white papers* – Our publication rate remains high and is providing very useful information to the radiation oncology community.
20. *Each ad hoc committee evaluation should be structured to include 1) accomplishments over the past 12 months, 2) goals for the next 12 months and 3) long term goals for the remaining life of the grant.* – We have structure this year’s presentations in this manner and will see how it works out.
21. *Collaborate with MDACC research efforts* – Dr. Kry and Followill participate in numerous research projects with graduate students, post-docs and residents on projects from MDACC clinical and research faculty.
22. *Further advance the RPC QA tools and methodologies to better place itself for the grant renewal* – The RPC is continually adapting to changes in the clinical trial arena while using its limited resources to enable those changes. A key research component of the RPC is to determine the viability of incorporating 3D dosimeters into the RPC’s phantoms.

PARTICIPANT FEE:

Institutions invoiced FY12	1655
No XRT/Canceled/Inactive	0
Institutions paid	1286

PUBLICATIONS AND ABSTRACTS

Publications Accepted/Published (2010-present):

1. Langen K, Papanikolaou N, Balog J, Crilly R, Followill D, Goddu S, Grant W, Olivera G, Ramsey C, Shi C. QA for Helical Tomotherapy: Report of the AAPM Task Group 148. *Med Phys* 37(8), 8/2010.
2. Homann K, Gates B, Salehpour M, Followill D, Kirsner S, White R, Buchholz T, Prado K. Use of a Matchline Dosimetry Analysis Tool (MDAT) to Quantify Dose Homogeneity in the Region Between Abutting Tangential and Supraclavicular Radiation Fields. *Journal of Applied Clinical Med Phys* 11(4): 206-21, 2010.
3. Benedict S, Yenice K, Followill D, Galvin J, Hinson W, Kavanagh B, Keall P, Lovelock M, Meeks S, Papiez L, Purdie T, Sadagopan R, Schell M, Salter B, Schlesinger D, Shiu A, Solberg T, Song D, Stieber V, Timmerman R, Tome W, Verellen D, Wang L, Yin F. Stereotactic Body Radiation Therapy: The Report of AAPM Task Group 101. *Med Phys* 37(7):1-24, 2010.
4. Baldock C, Deene YD, Doran S, Ibbott G, Jirasek A, Lepage M, McAuley KB, Oldham M, Schreiner LJ. Polymer Gel Dosimetry. *Physics in Medicine and Biology* 55:R1-R63, 2/2010.
5. Hsu I-C J, Sandler H, Purdy J, Ibbott G, Vigneault E, Ivker R, Pouliot J, Shinohara K. Phase II Trial of Combined High Dose Rate Brachytherapy and External Beam Radiotherapy for Adenocarcinoma of the Prostate: Preliminary Results of RTOG 0321. *Int J Radiat Oncol Biol Phys* 78(3): 751-8, 2010.
6. Erickson BA, Demanes DJ, Ibbott GS, Hayes JK, Hsu IC, Morris DE, Rabinovitch RA, Tward JD, Rosenthal SA. American Society for Radiation Oncology (ASTRO) and American College of Radiology (ACR) Practice Guideline for the Performance of High-Dose-Rate Brachytherapy. *Int J Radiat Oncol Biol Phys* 79(3):641-9, 3/2011. e-Pub 11/2010.
7. Frank SJ, Tailor RC, Kudchadker RJ, Martirosyan KS, Stafford RJ, Elliott AM, Swanson DA, Sing D, Choi J, Mourtada F, Ibbott GS. Anisotropy characterization of I-125 seed with attached encapsulated cobalt chloride complex contrast agent markers for MRI-based prostate brachytherapy. *Med Dosim.* e-Pub 5/2010.
8. Baldock C, Deene YD, Doran S, Ibbott G, Jirasek A, Lepage M, McAuley KB, Oldham M, Schreiner LJ. Polymer Gel Dosimetry. *Physics in Medicine and Biology* 55:R1-R63, 2/2010.
9. Hsu I-C J, Sandler H, Purdy J, Ibbott G, Vigneault E, Ivker R, Pouliot J, Shinohara K. Phase II Trial of Combined High Dose Rate Brachytherapy and External Beam Radiotherapy for Adenocarcinoma of the Prostate: Preliminary Results of RTOG 0321. *Int J Radiat Oncol Biol Phys* 78(3): 751-8, 2010.
10. Erickson BA, Demanes DJ, Ibbott GS, Hayes JK, Hsu IC, Morris DE, Rabinovitch RA, Tward JD, Rosenthal SA. American Society for Radiation Oncology (ASTRO) and American College of Radiology (ACR) Practice Guideline for the Performance of High-Dose-Rate Brachytherapy. *Int J Radiat Oncol Biol Phys* 79(3):641-9, 3/2011. e-Pub 11/2010.
11. Frank SJ, Tailor RC, Kudchadker RJ, Martirosyan KS, Stafford RJ, Elliott AM, Swanson DA, Sing D, Choi J, Mourtada F, Ibbott GS. Anisotropy characterization of I-125 seed with attached encapsulated cobalt chloride complex contrast agent markers for MRI-based prostate

brachytherapy. *Med Dosim*. e-Pub 5/2010.

12. Rosenthal SA, Bittner NH, Beyer DC, Demanes DJ, Goldsmith BJ, Horwitz EM, Ibbott GS, Lee WR, Nag S, Suh WW, Potters L, American Society for Radiation Oncology, American College of Radiology. American Society for Radiation Oncology (ASTRO) and American College of Radiology (ACR) Practice Guideline for the Transperineal Permanent Brachytherapy of Prostate Cancer. *Int J Radiat Oncol Biol Phys* 79(2):335-41, 2/2011. e-Pub 11/2010.
13. **Smith B, Bentzen S, Correa C, Hahn C, Hardenberg P, Ibbott G, McCormick B, McQueen J, Pierce L, Powell S, Recht A, Taghian A, Vicini F, White J, Haffty B. Fractionation for Whole Breast Irradiation: An American Society for Radiation Oncology (ASTRO) Evidence-Based Guideline. *Int J Radiat Oncol Biol Phys* 81(1):59-68, 2011.**
14. DeWerd LA, Ibbott GS, Meigooni AS, Mitch MG, Rivard MJ, Stump KE, Thomadsen BR, Venselaar JLM. A dosimetric uncertainty analysis for photon-emitting brachytherapy sources: Report of AAPM Task Group No. 138 and GEC-ESTRO. *Med Phys* 38(2):782-801, 2/2011.
15. Salminen EK, Kiel KD, Ibbott GS, Joiner MC, Rosenblatt E, Zubizarreta E, Wondergem J, Meghzifene A. International Conference on Advances in Radiation Oncology (ICARO):outcomes of an IAEA meeting. *Radiat Oncol* 6(11):11. e-Pub 2/2011.
16. Kerns JR, Kry SF, Sahoo N, Followill DS and Ibbott GS. Angular dependence of the nanoDot OSL dosimeter. *Med. Phys.* 38(7):3955-3962, 7/2011.
17. Scarboro S, Followill DS, Howell RM, Kry SF. Variations in Photon Energy Spectra of a 6 MV Beam and Their Impact on TLD Response. *Med Phys* 38(5):2619-2628, 2011. PMID: PMC3107829.
18. de Gonzalez AB, Curtis RE, Kry SF, Gilbert E, Lamart S, Berg CD, Stovall M, Ron E. Proportion of second cancers attributable to radiotherapy treatment in adults: a cohort study in the US SEER cancer registries. *Lancet Oncol* 12(4):353-60, 4/2011. PMID: PMC3086738.
19. Berrington de Gonzalez A, Curtis R, Kry SF, Gilbert E, Lamart S, Berg CD, Stovall M, Ron E. The proportion of second cancers attributable to radiotherapy treatment in adults: a prospective cohort study in the US SEER cancer registries. *Lancet Oncol* 12:353-60, 2011.
20. Stern RL, Heaton R, Fraser MW, Goddu SM, Kirby TH, Lam KL, Molineu A, Zhu TC. Verification of monitor unit calculations for non-IMRT clinical radiotherapy: Report of AAPM Task Group 114. *Med Phys* 38(1):504-530, 2011.
21. Dieterich S, Cavedon C, Chuang CF, Cohen AB, Garrett JA, Lee CL, Lowenstein JL, d'Souza MF, Taylor Jr DD, Wu X, Yu C. Report of AAPM TG 135: Quality Assurance for robotic radiosurgery. *Med Phys* 38(6): 2914-2936, 2011.
22. Pulliam KB, Howell RM, Followill D, Luo D, White RA, Kry SF. The clinical impact of the couch top and rails on IMRT and arc therapy. *Physics in Medicine and Biology* 56:7435-47, 2011.

23. Howell RM, Kry SF, Burgett E, Hertel NE, Followill D. Erratum: Secondary neutron spectra from modern Varian, Siemens, and Elektra linacs with multileaf collimators [Med Phys 36(9):4-27-38]. *Med Phys* 38(12):6789, 2011.
24. Neubauer E, Dong L, Followill DS, Garden AS, Court LE, White RA, Kry SF. Assessment of shoulder position variation and its impact on IMRT and VMAT doses for head and neck cancer. *Radiat Oncol* 7:19, 2012. e-Pub 2/2012. PMID: PMC3311611.
25. Beyer GP, Kry SF, Espenhahn E, Rini CJ, Boyles E, Mann GG. Evaluation of an implantable MOSFET dosimeter designed for use with hypo-fractionated external beam treatments and its applications for breast and prostate treatments. *Med. Phys.* 38:4881-4887, 2011.
26. Smith BD, Bentzen SM, Correa CR, Hahn CA, Hardenbergh PH, Ibbott GS, McCormick B, McQueen JR, Pierce LJ, Powell SN, Recht A, Taghian AG, Vicini FA, White JR, Haffty BG. Fractionation for Whole Breast Irradiation: An American Society for Radiation Oncology (ASTRO) Evidence Based Guideline. *Int. J. Radiation Oncology Biol. Phys* 81(1):59-68, 2011.
27. Oldham M, Thomas A, O'Daniel J, Juang T, Ibbott G, Adamovics J, Kirkpatrick JP. A Quality Assurance Method that Utilizes 3D Dosimetry and Facilitates Clinical Interpretation. *Int J Radiat Oncol Biol Phys.* e-Pub 2/2012.
28. Bekelman JE, Deye JA, Vikram B, Bentzen SM, Bruner D, Curran WJ, Dignam J, Efstathiou JA, Fitzgerald TJ, Hurkmans C, Ibbott GS, Lee JJ, Merchant TE, Michalski J, Palta JR, Simon R, Ten Haken RK, Timmerman R, Tunis S, Coleman CN, Purdy J. Redesigning Radiotherapy Quality Assurance: Opportunities to Develop an Efficient, Evidence-Based System to Support Clinical Trials-Report of the National Cancer Institute Work Group on Radiotherapy Quality Assurance. *Int J Radiat Oncol Biol Phys.* e-Pub 3/2012.

ABSTRACTS

1. Deye J, Ibbott G, Michalski J, Tucker S, Xiao Y, Deasy J. Opportunities and Considerations for Multi-institutional Clinical Trials Research. *Med Phys* 37(6):3431, 2010.
2. Ibbott, G. Credentialing for *Clinical* Trials. *Med Phys* 37(6):3334, 2010.
3. Shiu A, Drzymala E, Alvarez P, Followill D, Taylor R. Investigation of Large Discrepancies in Dose Rates of Gamma-Knife Units at Various Institutions. *Med Phys* 37(6):3305, 2010.
4. Kisling K, Yaldo D, Followill D, Kry S, Scarboro S, Frank S, Howell R. Evaluation of RapidArc Dose Delivery Using Radiological Physics Center Phantoms. *Med Phys* 37(6):3238, 2010.
5. Molineu A, Hernandez N, Alvarez P, Followill D, Ibbott G. Results from Multiple Radiations of an Anthropomorphic Spine Phantom. *Med Phys* 37(6):3400, 2010.
6. Scarboro S, Kry S, Howell R, Followill D. Variations in 6MV Photon Energy Spectra Impact the Response of TLD. *Med Phys* 37(6):3330, 2010.

7. Grant R, Ibbott G, Riley B, Sahoo N, Tucker S, Zhu X, Followill D. Effect of Film Orientation on Proton Beam Dosimetry. *Med Phys* 37(6):3296, 2010.
8. Kerns J, Ibbott G, Johnson V, Kry S, Sahoo N, Followill D. Characterization of Optically-Stimulated Luminescent Detectors (OSLDs) in Photon and Proton Beams. *Med Phys* 37(6):3452-3, 2010.
9. Davidson S, Kry S, Cui J, Deasy J, Ibbott G, Vicic M, White R, Followill D. A Custom-Developed Method for Accurate Dose Recalculation of Patient Plans Entered into Clinical Trials. *Med Phys* 37(6):3272, 2010.
10. Caruthers D, Ibbott G, Shiu A, Chang E, White R, Followill D. Commissioning an Anthropomorphic Spine and Lung Phantom for Remote Quality Assurance of Spinal Radiosurgery. *Med Phys* 37(6):3314, 2010.
11. Aguirre J, Alvarez P, Amador C, Tailor A, Followill D, Ibbott G. Validation of the Commissioning of an Optically Stimulated Luminescence (OSL) System for Remote Dosimetry Audits. *Med Phys* 37(6):3428, 2010.
12. Yaldo D, Scarbora S, Sahoo N, Kry S, Kisling K, Followill D, Howell R. Evaluation of the Sensitivity of the Anisotropic Analytical Algorithm (AAA) to the Commissioning Dataset. *Med Phys* 37(6):3255, 2010.
13. Langen K, Papanikolaou N, Balog J, Crilly R, Followill D, Goddu S, Grant W, Olivera G, Ramsey C, Shi C. QA of Radiation Delivery Systems. *Med Phys* 37(6):3374, 2010.
14. Dieterich S, Cavedon C, Chuang C, Cohan A, Garret J, Lee C, Lowenstein J, D'Souza M, Taylor D, Wi X, Yu C. QA of Radiation Delivery Systems – TG135 QA for Robotic Radiosurgery. *Med Phys* 37(6):3374, 2010.
15. Mikell J, Klopp A, Kisling K, Berner P, Price M, Mourtada F. Grid-Based Boltzmann Solver (GBBS) Vs. TG-43 for Ir-192 HDR Intracavity Brachytherapy: A Retrospective Dosimetric Study. *Med Phys* 37(6):3192, 2010.
16. Grant R, Crowder ML, Ibbott GS, Simon J, Frank RK, Rogers J, Loy HM, Adamovics J, Newton J, Oldham M, Stearns S, Wendt RE. Three-Dimensional Dosimetry of a Beta-Emitting Radionuclide Using PRESAGE® Dosimeters. *Journal of Physics: Conference Series* 250(1):012095, 2010.
17. Langen K, Papanikolaou N, Balog J, Crilly R, Followill D, Goddu S, Grant W, Olivera G, Ramsey C, Shi C. QA of Helical Tomotherapy TG-148. *Med Phys* 38(6):3799, 2011.
18. Followill D, Alvarez P, Molineu A, Gillin M, Ibbott G. Evaluation of Lung Treatment Deliveries Using the Radiological Physics Center's (RPC) Thorax Phantom: Monte Carlo Heterogeneity Correction Algorithms Vs. All Other Modern Heterogeneity Correction Algorithms. *Med Phys* 38(6):3614, 2011.
19. Aguirre J, Alvarez P, Ibbott G, Followill D. Analysis of Uncertainties for the RPC Remote Dosimetry Using Optically Stimulated Light Dosimetry (OSDL). *Med Phys* 38(6):3515, 2011.

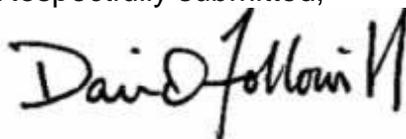
20. Summers P, Followill D, Sahoo N, Poenisch F, Tucker S, Gillin M, Riley B, Ibbott G. Development of An Anthropomorphic Head Phantom for the Assessment of Proton Therapy Treatment Procedures. *Med Phys* 38(6):3569-70, 2011.
21. Tonigan J, Kry S, Dong L, Purdie T, White R, Ibbott G, Followill D. Does IMRT Treatment Plan Complexity Or Mismatched Dosimetry Data Contribute to Dose Delivery Errors Detected Using An IMRT H&N Quality Assurance Phantom? *Med Phys* 38(6):3804, 2011.
22. Han T, Moutada F, Kisling K, Mikell J, Followill D, Howell R. Dosimetric Verification of Deterministic Acuros XB Radiation Transport Algorithm for IMRT and VMAT Plans with the RPC H&N Phantom. *Med Phys* 38(6):3656, 2011.
23. Scarboro S, Followill D, Kerns J, Kry S. The Impact of 6MV Non-Reference Photon Energy Spectra On OSLD Response. *Med Phys* 38(6):3726, 2011.
24. Pulliam R, Howell R, Followill D, Luo D, White R, Kry S. Clinical Impact of Couch Top and Couch Rails On Treatment Dose for IMRT and Arc Therapy. *Med Phys* 38(6):3592, 2011.
25. Faught A, Kry S, Luo D, Molineu A, Galvin J, Drzymala R, Timmerman R, Sheehan J, Gillin M, Ibbott G, Followill D. Design, Development, and Evaluation of a Modified, Anthropomorphic, Head and Neck, Quality Assurance Phantom for Use in Stereotactic Radiosurgery. *Med Phys* 38(6):3526, 2011.
26. Hollan A, Lowenstein J, Harris I, Hall F, Roll J, Followill D. Requirements for Performing a Retrospective Patient Chart Review at the Radiological Physics Center (RPC) for Clinical Trials. *Med Phys* 38(6):3629, 2011.
27. Blatnica A, Ibbott G, Zhu X, Balter P, White R, Followill D. Modification and Implementation of the RPC Heterogeneous Thorax Phantom for Verification of Proton Therapy Treatment Procedures. *Med Phys* 38(6):3525, 2011.
28. Lowenstein J, Roll J, Harris I, Hall F, Hollan A, Followill D. Cervix Brachytherapy Dosimetry: Inconsistencies in Defining Bladder and Rectal Points. *Med Phys* 38(6):3572, 2011.
29. Molineu A, Hernandez N, Alvarez P, Ibbott G, Galvin J, Followill D. Results From 1005 IMRT Irradiations of An Anthropomorphic Head and Neck Phantom. *Med Phys* 38(6):3805, 2011.
30. Zhu A, Carroll M, Adamovics J, Oldham M, Followill D. Investigation of PRESAGE® Dosimeters for Proton Therapy, R Grant, G Ibbott. *Med Phys* 38(6):3571, 2011.
31. Amador C, Molineu A, Smith S, Hernandez N, Followill D, Stovall M. Analysis of Results From An Anthropomorphic Stereotactic Radiosurgery Phantom. *Med Phys* 38(6):3612, 2011.
32. Alvarez P, Aguirre J, Followill D. Evaluation of the OSLD System for Remote Dosimetry Audits Implemented by the RPC. *Med Phys* 38(6):3505, 2011.
33. Cho J, Alvarez P, Followill D, Gillin M, Ibbott G. Proton Linearity and Energy Dependence Studies of Optically Stimulated Luminescent Detectors for Remote Audits of Proton Beam Calibrations by the Radiological Physics Center. *Med Phys* 38(6):3521, 2011.

34. Kerns J, Kry S, Sahoo N, Followill D, Ibbott G. Angular Dependence of *the NanoDot* Dosimeter. *Med Phys* 38(6):3517, 2011.

BOOK CHAPTERS

1. FitzGerald TJ, Bishop-Jodoin M, Urie M, Ulin K, Ibbott G, Purdy J, Saltz J, Peters L, Schnall M, Deasy J, Bosch W, Knopp M, Schwartz L, White K, Hanusik R, Kessel S, Morano K, Laurie F. Quality Assurance of Clinical Trials in the Management of Cancer in the Head and Neck. In: Head and Neck Cancer: Multimodality Management. Ed(s) Bernier J. Springer: New York, 687-694, 2011.

Respectfully submitted,

A handwritten signature in black ink that reads "David Followill". The signature is written in a cursive, slightly slanted style.

David S. Followill, Ph.D.

YEAR-END FINANCIAL SUMMARY OF THE RADIOLOGICAL PHYSICS CENTER

January 1, 2011 through December 31, 2011

PERSONNEL (salaries and fringe benefits) \$2,143,236.13

8 Physicists, 3.5 Research Dosimetrists, 2 Sr. Physics Assistants, 1 Physics Assistant, 1 Manager of Scientific Computing Resources, 1 Database Administrator, 1 Programmer Analyst I, 1 Radiological Physics Supervisor, 4 Radiological Physics Technicians, 1 Sr. Coordinator of Research Data, 1 Department Administrator, 1 Office Manager, 1 Sr. Administrative Assistant, 1 Administrative Assistant, 1 Secretary, 1 Clerk, and 3 Graduate Research Assistants

TRAVEL \$ 97,985.21

Number of Site Visits	39
Number of Scientific Meetings	24
Number of Study Group Meetings	21
Number of International Meetings	8
Other	2

CONSULTANTS \$11,126.77

CONSUMABLES \$99,910.00

Office supplies, laboratory and record keeping, TLD, TLD supplies, software, etc.

EQUIPMENT \$7,202.40

OTHER EXPENSE \$153,397.55

Postage, telephone, reprints, copying, computer fees, equipment repair, registration fees, tuition, freight/delivery, etc.

SPACE RENTAL AND TUITION \$181,691.17

Total \$2,694,549.23

Indirect Costs @ 26% \$651,783.82

TOTAL RPC EXPENSES \$3,346,333.05

RPC Report to TPC April 2012

<u>Clinical Study Groups</u>	<u>Office Reviewing Patient Records</u>	<u>Special Projects</u>
Gynecologic Oncology Group GOG	RPC	International Participation Rapid Reviews IMRT Credentialing Cervix HDR/LDR IMRT Protocol Compliance Protocol development (RT Section) Radiotherapy manual Electronic Transfer of Patient Records Image Based Treatment Planning IMRT Guidelines Defining Treatment violations
National Surgical Adjuvant Breast and Bowel Project NSABP	RPC	IMRT Guidelines Partial Breast RT Credentialing
North Central Cancer Treatment Group NCCTG	RPC	Rapid Review of Lung Study 3D CRT Credentialing Stereotactic Phantom IMRT Credentialing
Radiation Therapy Oncology Group RTOG	RTOG/RPC	International Participation Rapid Reviews IMRT H&N Phantom Prostate Phantom Prostate Implant Credentialing LDR/HDR Stereotactic Head Phantom Lung Phantom 4D Liver Phantom Cervix HDR/LDR Protocol Compliance Patient Calculation Program Partial Breast RT Credentialing IMRT Benchmark Case Proton Credentialing Lung Benchmark Case Spine Phantom
Southwest Oncology Group SWOG	QARC	3D Benchmark Case
Clinical Trial Support Unit CTSU	QARC, RPC, RTOG	RPC Institution List RTF Numbers TLD Monitoring Review RT Facility

American College of Radiology Imaging Network ACRIN	N/A	Questionnaire Participate in the development of guidelines for quality assurance of institution participating in ACRIN CT Dose Measurements
American College of Surgeons Oncology Group ACOSOG	QARC	RPC Institution List
Cancer and Acute Leukemia Group B CALGB	QARC	TRUS Prostate Approval Collaboration
Children's Oncology Group COG	QARC	3D Benchmark Case IMRT Benchmark Case/Phantom CT/MRI Fusion Benchmark International Participation Proton Credentialing
Eastern Cooperative Oncology Group ECOG	QARC	
European Organization for Research and Treatment of Cancer EORTC	RPC	Annual TLD Auditing Phantom Credentialing