Mission

The mission of the Radiological Physics Center is to assure NCI and the Cooperative Groups that institutions participating in clinical trials deliver prescribed radiation doses that are clinically comparable and consistent.

Now 42 years of experience of building an infrastructure, establishing communications with institutions, developing relationships with study groups and QA offices, and adding value to the clinical trials program
RPC Programs

- Assurance of constancy of basic machine calibration
- Assurance of validity of treatment planning data
- Assurance of consistency of treatment records
- Credentialing of advanced technology procedures

Assurance of Constancy of Basic Machine Calibration

- RPC monitors 1,768 institutions, of which ~1,600 are in the US
- Increase from 1,338 in 2005 (32%)
- Number of radiation beams has increased more rapidly

![Graph showing US Machines & Facilities over years from 1970 to 2010]
Improvements to Annual TLD Audits

- Monitor ~ 14,000 beams/yr
- Review of instructions
- Conversion from TLD to OSL

Verification of Standard Output

- Photon and electron beams from conventional linear accelerators
- CyberKnife
- TomoTherapy
- Gamma Knife
- Protons
TLD vs OSL

- LiF:Mg,Ti (TLD-100) capsules
- Disposable
- One reading
- Temperature and weight control
- 3 dosimeters per point
- 6 min reading time
- Dosimeter cost per check $2.40

- (Al₂O₃:C) nano dots
- Reusable (dose limit ~ 10Gy)
- Re-readable
- No temp/weight ctrl, light tightness
- 2 dosimeters per point,
- ~ 2 min reading time
- Dosimeter cost per check $1.00

Equipment

OSL

TLD
Distribution of TLD results

**Photons beams**
- Within 7%
- Number of beams: 3051
- Avg. RPC/Inst.: 0.999
- Stdev.: 1.6%

**Electrons beams**
- Within 7%
- Number of beams: 4310
- Avg. RPC/Inst.: 0.998
- Stdev.: 1.7%

Institutions with One or More Unacceptable TLD Measurements
TLD measurements in proton beams

Proton TLD Frequency Distribution

RPC/Istitut

Protons: 109 measurements
Photons: > 6,000 measurements
## Facility Questionnaire

**PART I (Demographics and Technical Survey)**

All textboxes can be edited. Please verify correctness of data. Click **Submit** on the bottom of the page to save and submit your changes/additions. Use the appropriate **button** for the accommodating command. Please make sure to click the **Acknowledge** button at the end of the form to verify that the information are correct to the best of your knowledge.

<table>
<thead>
<tr>
<th>Institution Info</th>
<th>RTF#</th>
<th>CTEP/NCI ID#</th>
<th>Today's Date</th>
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<td>2595</td>
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<tr>
<td>Address</td>
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<tr>
<td>TLD/Oh &amp; Billing Address</td>
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List the main individuals responsible for general questions regarding clinical trials and dosimetry compliance (TLD monitoring) for this cooperative group:

**Physician**
- John Smith: Email
- Telephone
- Fax

**Research Associate**
- Jack Johnson: Email
- Telephone
- Fax

**Dosimetrist**
- Jane Doe: Email
- Telephone
- Fax

**Radiation**
- John Smith: Email

### RPC Phantoms

- **Pelvis (10)**
- **Thorax (13)**
- **Spine (3)**
- **H&N (31)**
- **Liver (2)**
- **SRS Head (4)**
Phantom Results

Comparison between institution’s plan and delivered dose.

<table>
<thead>
<tr>
<th>Phantom</th>
<th>H&amp;N</th>
<th>Prostate</th>
<th>Spine</th>
<th>Lung</th>
<th>Liver</th>
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<td>13</td>
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<td>82%</td>
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<td>7%/4mm</td>
<td>5%/3mm</td>
<td>5%/5mm</td>
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<tr>
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<td>2004</td>
<td>2009</td>
<td>2004</td>
<td>2005</td>
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Phantom notes

- Lung phantoms: Passing rate same for static vs. moving irradiations
- Spine phantoms: Lengthy waiting list. 4 new phantoms under construction

Proton therapy facilities

- Presently 7 clinically-active US proton therapy centers
- ≥2 new centers expected to open this year, perhaps 5 more in next 2 years
- Several trials in development to allow protons
- NCI has provided funds for a consultant to refine visit procedures and lead visits to 5 centers during 2010
Proton Facility Approval

*N* NCI Guidelines mandate –
* Questionnaire - sent to facilities by QARC
* Completed by 4 centers

*TLD monitoring*
* Mailed to 7 US centers + 1 Japanese center

*On-site dosimetry review visits*
* 2 visits completed (initial level of approval)
* 3 visits under way, to be completed this year

*Anthropomorphic phantoms*
* Modifications to existing phantoms

Proton Beam Monitoring
TLD: Output and Depth Dose Measurements

Most measurements at mid-SOBP ± 2 cm

Recent measurements at mid-SOBP and ~distal 90%

AAPM Philadelphia July 2010
Visits - Review of Institution Procedures and Records

- Beam measurements & QA:
  - Profiles - lateral and depth
  - Dose/MU reproducibility
  - Annual QA

- Review of treatment planning
  - Planning procedures
  - Optimization
  - Prescription

- CT procedures
  - Scanning protocols
  - CT # scaling
  - CT # to RLSP conversion

Visits: Measurements on Site

- CT # and conversion to RLSP
- Imaging system quality, dose and alignment
- Anatomical phantom
  - Contouring
  - Planning
  - Dosimetry

- Beam measurements - representative fields for pituitary, spine, lung, prostate
  - Depth dose
  - Dose/MU
  - Lateral profiles (deferred)

Recommendations
Phantoms

- Existing pelvis phantom was modified
  - Irradiated at 2 facilities

- Lung phantom modifications underway
  - Materials tested
  - Dosimetry insert constructed
  - Evaluation of phantom underway

Brain Phantom

- Selected Phantom Lab “Alderson” phantom
  - Materials fall on CT#-RLSP curve
  - Contains realistic bony anatomy
  - Inserts with target and dosimetry will be constructed
Next Steps

- Continue to focus on approving proton centers
- Continue development work on phantoms
- Funding received from NCI through the MGH grant
  - Supports a consultant 0.25 FTE
  - Scheduling visits to 3 additional centers
- Goal is to have at least 5 proton centers approved by end of 2010

International Participation

- RPC has audited international institutions that are members of US study groups, as part of routine audits
- In 2007, RPC was approached by EORTC to consider offering TLD audits to EORTC members, at cost
- Following agreement among RPC, EORTC and NCI, EORTC began recommending RPC’s TLD service to their members
- Subsequent meetings between RPC, EORTC, and other groups have been held to discuss expanding auditing procedures
- RPC now auditing 134 non North-American institutions
  - Including 95 EORTC members
International Clinical Trials

- RTOG (and several other study groups) are expanding trials to international participation

- Through agreements with EORTC, RPC will make phantoms available to international participants in NCI-sponsored clinical trials
  - EORTC staff trained to load/unload dosimeters
  - Proposal for international workshops in development
  - Meeting scheduled at IAEA in November to coordinate QA oversight

Irradiation of RPC Phantoms

- Through various arrangements, 25 international institutions have already irradiated RPC phantoms

- Arrangements are being discussed for providing phantoms to additional institutions in Europe, the Middle East, Australasia and Latin America

- Through agreement with the RTOG and NCI, international non-member institutions participating in RTOG trials will meet the same QA requirements as member institutions
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