



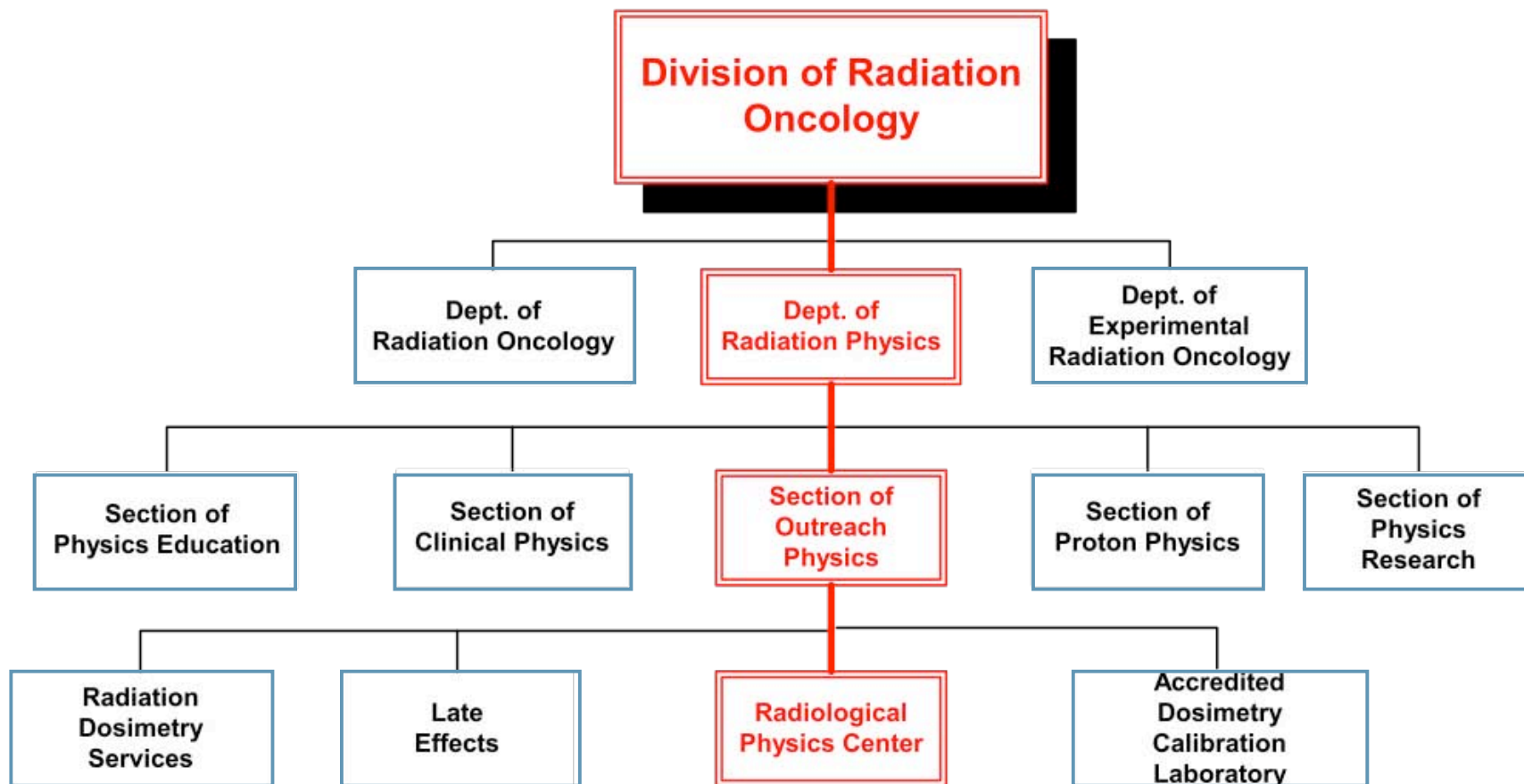
# **QA Activities**

*in Collaboration with the*

## **Advanced Technology Consortium**



November 6, 2007  
Geoffrey S. Ibbott, Ph.D.  
RPC Staff



# Brief Background

Formed by agreement between AAPM and CRTS

Founded in 1968 to monitor institution participation in clinical trials

Funded continuously by NCI as structure of cooperative group programs have changed

Now 40 years of experience of monitoring institutions and reporting findings to study groups and community



# 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.*
- We do this by assessing the institution's radiotherapy programs, helping the institutions implement remedial actions, assisting the study groups in developing protocols and QA procedures, and informing the community of our findings.

# RPC's Conventional Monitoring



## Annual checks of machine output

- ◆ 1,532 institutions, 13,729 beams measured with TLD (2006)



## On-site dosimetry reviews

- ◆ ~ 40 institutions visited annually (600 beams measured)



## Credentialing

- ◆ Phantoms, benchmarks, questionnaires, rapid reviews



## Treatment record reviews

- ◆ Review for GOG, NSABP, NCCTG, RTOG (brachy)

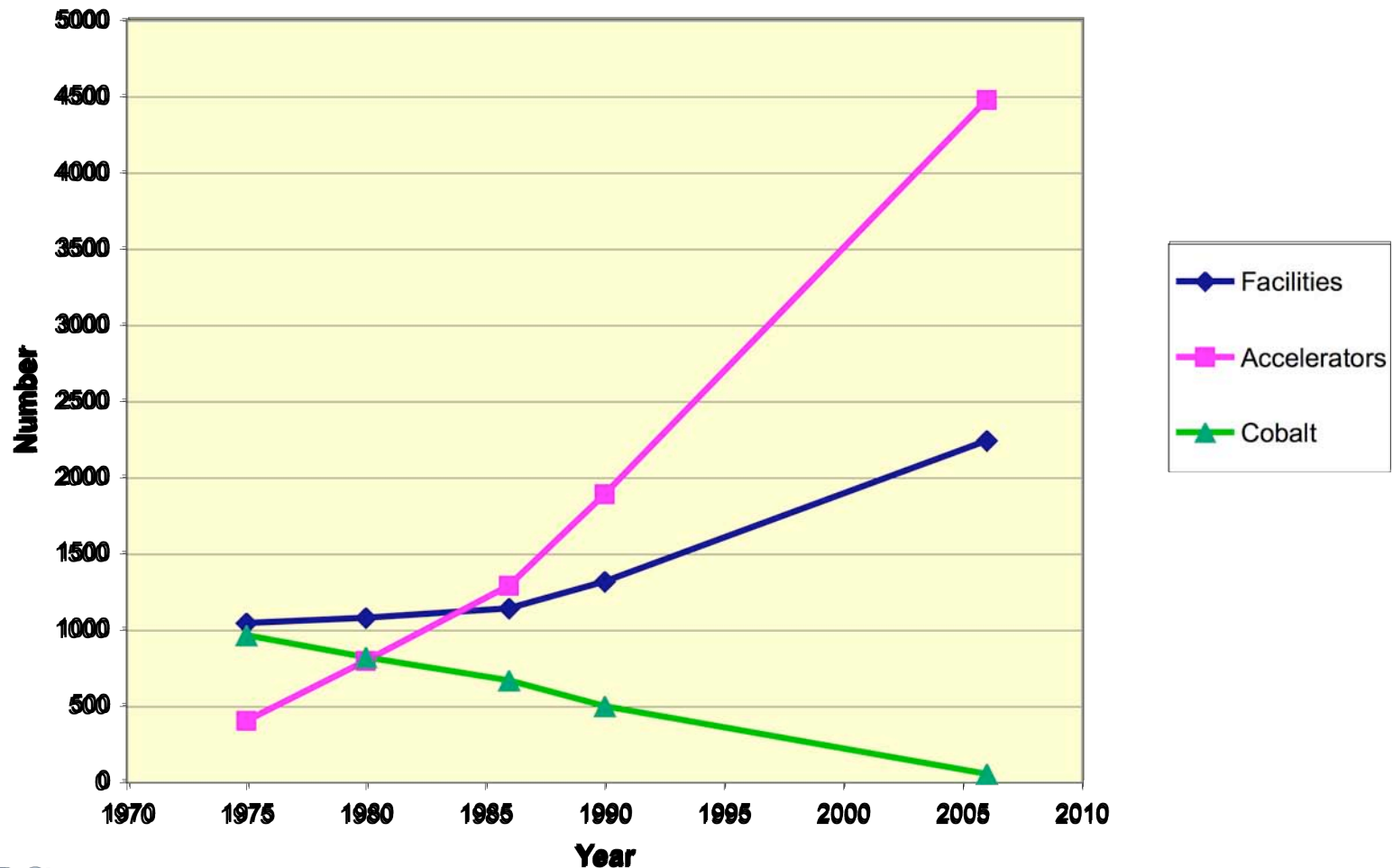


## Independent recalculation of patient dose

- ◆ Continue to find errors

# US Institutions & Machines

Radiotherapy Trends: 1975-2007



Patterns of Care, Owen, IJROBP, 1994;  
Ballas, Int. J. Radiation Oncology Biol. Phys. 66, 2006



Search RPC by Google

Tel: 713-745-8989

Home About us Newsletter Credentialing Institutions Monitored On-Site Audits FAQ Contact us Links Site map

Office Hours: 8 A.M. to 5 P.M. M-F Central time. Holidays

Services
Forms
Publications
Brachy Sources
Research/TG-51
Upcoming Meetings



Credentialing Open:

RTOG 0617 (NCCTG N0628, CALGB 30609) – This protocol is ready for you to get your IRB approval and become credentialed.

Highlights from COG: The RPC sends representatives to the fall group meeting of COG and brings back the latest group news.

Cancer Deaths Down: Report released by the American Cancer Society show death rate decreased 2.1%.



Radiation Dosimetry Services offers mailed dosimeters and anthropomorphic phantoms for dosimetry QA.



The ADCL at M. D. Anderson Cancer Center is fully accredited for external beam and brachytherapy calibrations. FAQ about ADCL



Accuracy of two heterogeneity dose calculation algorithms for IMRT in treatment plans designed using an anthropomorphic thorax phantom.

Davidson S, Ibbott G, Prado K, Dong L, Liao Z, Followill D.



RPC physicist Andrea Molineu receives Department of Radiation Physics Award

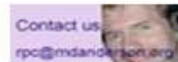


Publication on Physics of Clinical Trials

We recommend AAPM Report 86 for physicists who want to know more about the conduct of clinical trials and their physics and QA requirements.



Short Courses Physics courses related to therapeutic radiology offered at the University of Texas M. D. Anderson Cancer Center.



Updated on: 11/2/2007 You are visitor #28789.

# Credentialing Status Inquiry

## ***CREDENTIALING FOR ADVANCED TECHNOLOGY PROTOCOLS***

This questionnaire is will help determine if your institution is credentialed to participate on a protocol. If there are any questions please contact the RPC at (713) 745-8989 or [rpc@mdanderson.org](mailto:rpc@mdanderson.org)

Facility Name:

Provide the Facility's member number: RTOG #:  RTF#<sup>1</sup>:

Name of person completing this form:

Email address:

Are you a:  Radiation Oncologist  Physicist  Dosimetrist  Clinical Coordinator

Which protocol are you interested in being credentialed for?

Has your institution successfully irradiated an RPC phantom?  Yes  No

If yes, which phantom?

IMRT Head & Neck  IMRT Pelvis  Stereotactic Lung  Stereotactic Liver





# Questionnaires

- Facility Questionnaire determines if equipment and QA procedures are adequate
- Knowledge Assessment tests physician knowledge about the protocol

# Web-based forms



**Office Hours:**  
8 A.M. to 5 P.M.  
M-F Central time.  
**Holidays**

Services
Forms
Publications
Brachy Sources
Research/TG-51
Upcoming Meetings

## CREDENTIALING FOR NSABP/RTOG PBI PROTOCOL KNOWLEDGE ASSESSMENT FORM

This questionnaire is intended to evaluate your understanding of the protocol. If there are any questions please contact the RPC at (713) 745-8989 or [rpc@mdanderson.org](mailto:rpc@mdanderson.org)

**Quotes are not allowed.**

Facility Name:

Check the appropriate box and provide the Facility's member number:  RTOG#   NSABP#

Fill in the Facility's identification: NCI#  RTF#<sup>1</sup>  <sup>1</sup>RTF# is required and may be obtained by clicking [here](#)

Name of Radiation Oncologist completing this form: First  Last

CTEP# of Radiation Oncologist completing this form

Identify the PBI Technique(s) to be used:  MammoSite  Multi-catheter Brachy  3D Conformal EBRT

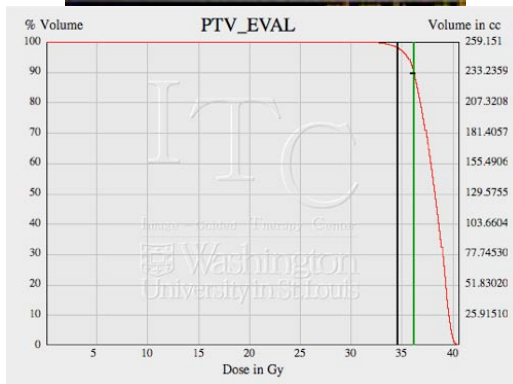
**(Complete this section and the appropriate sections(s) on pages 2 - 4.)**

**Data to submit:** List the digital data to be submitted for each patient:

•



# 3D CONFORMAL RADIATION THERAPY (3D CRT)

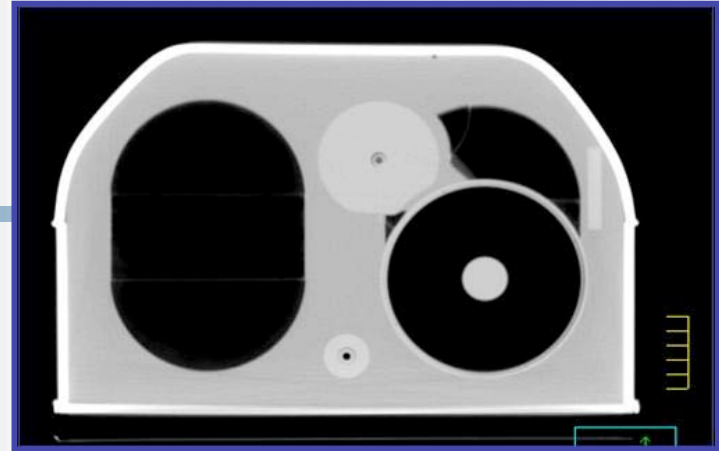


- 💡 Evaluate 3D treatment planning process and ability to provide documentation
- 💡 ~700 institutions credentialed to date
- 💡 545 through NSABP/RTOG partial breast irradiation protocol

# RPC Phantoms



**Pelvis (4)**



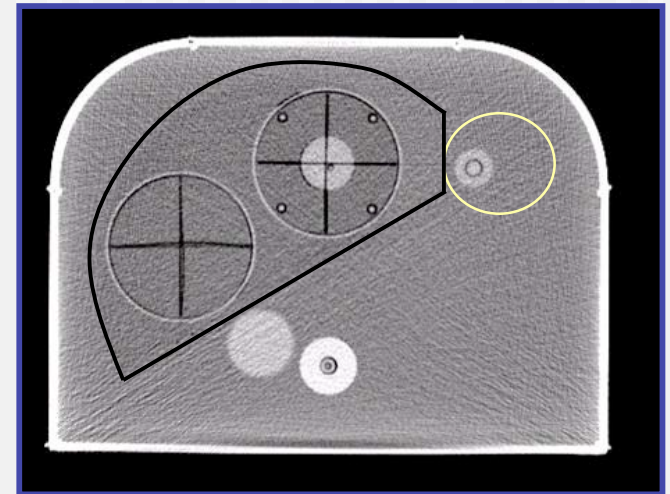
**Thorax (9)**



**H&N IMRT (25)**

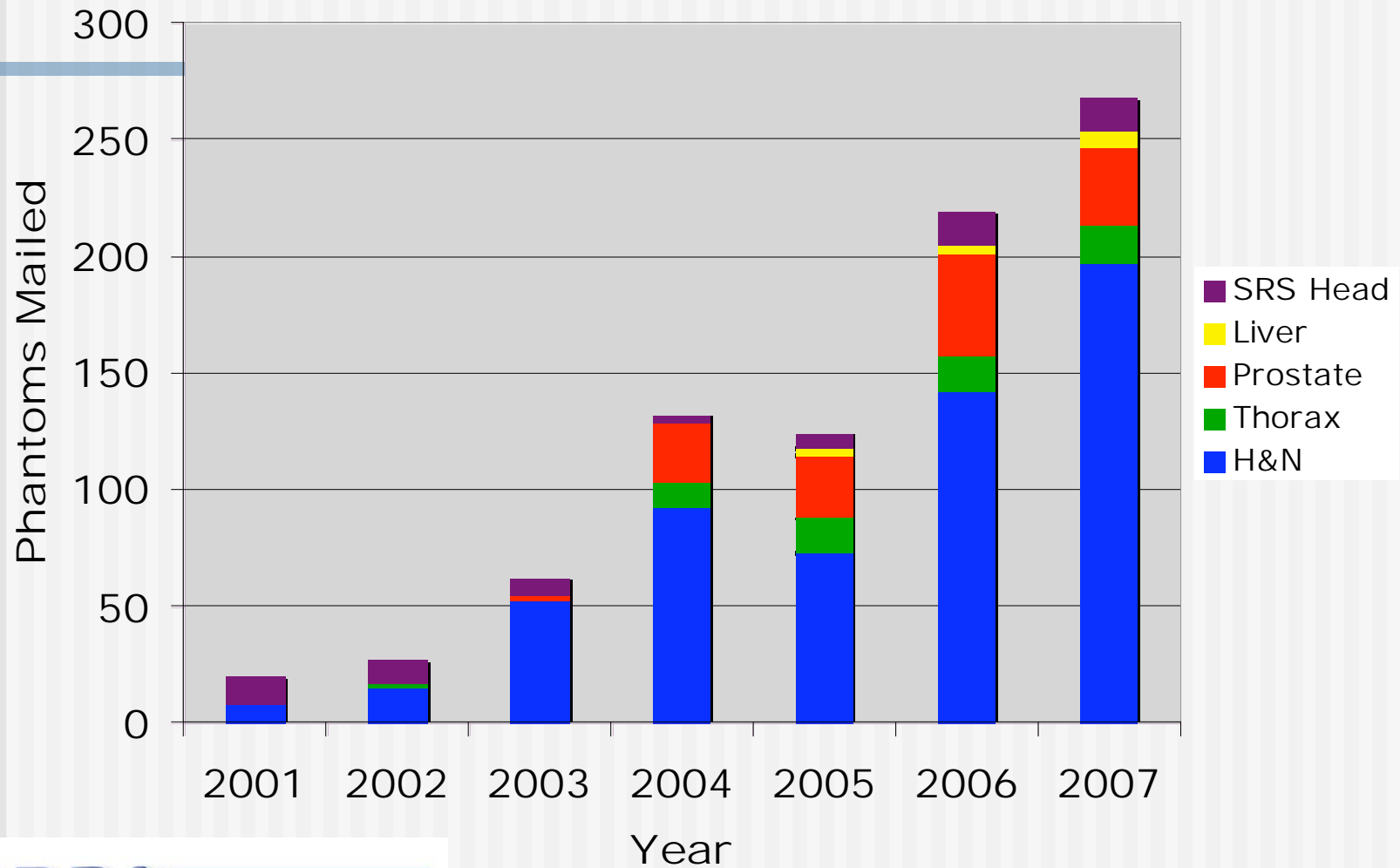


**SRS Head (4)**



**Liver (2)**

# Number of phantom mailings



# IMRT H&N phantom

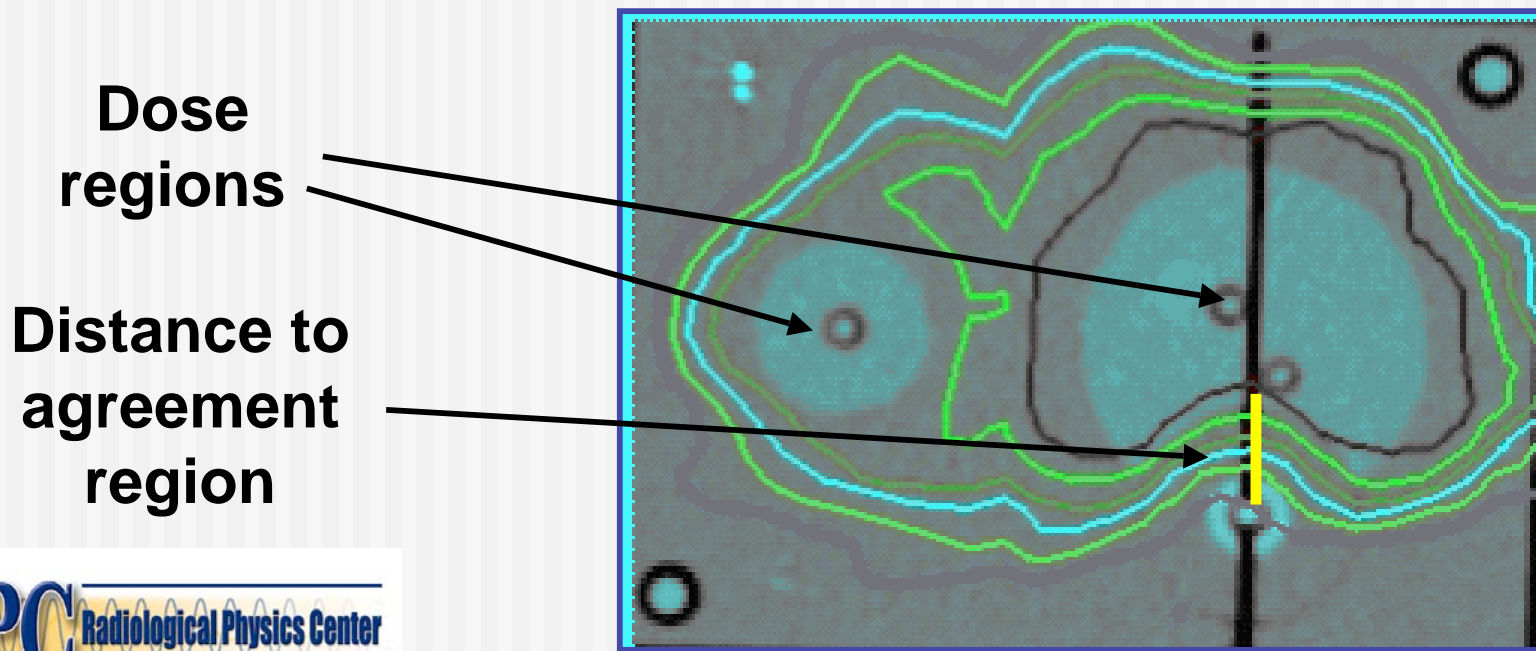
- **Primary PTV**
  - 4 cm diameter
  - 4 TLD
- **Secondary PTV**
  - 2 cm diameter
  - 2 TLD
- **Organ at risk**
  - 1 cm diameter
  - 2 TLD
- **Axial and sagittal radiochromic films**



- **1° PTV treated to 6.6 Gy**
- **2° PTV treated to 5.4 Gy**
- **OAR limited to < 4.5 Gy**

# Criteria for credentialing

- RPC/Inst dose in PTVs: 0.93-1.07
- distance to agreement in high gradient region near OAR:  $\leq 4$  mm



# IMRT H&N phantom results

- **419 irradiations were analyzed**
- **322 irradiations passed the criteria**
  - 68 institutions irradiated multiple times
- **97 irradiations did not pass the criteria**
- **322 institutions are represented**

**Only 76% of institutions passed the criteria on the first irradiation.**



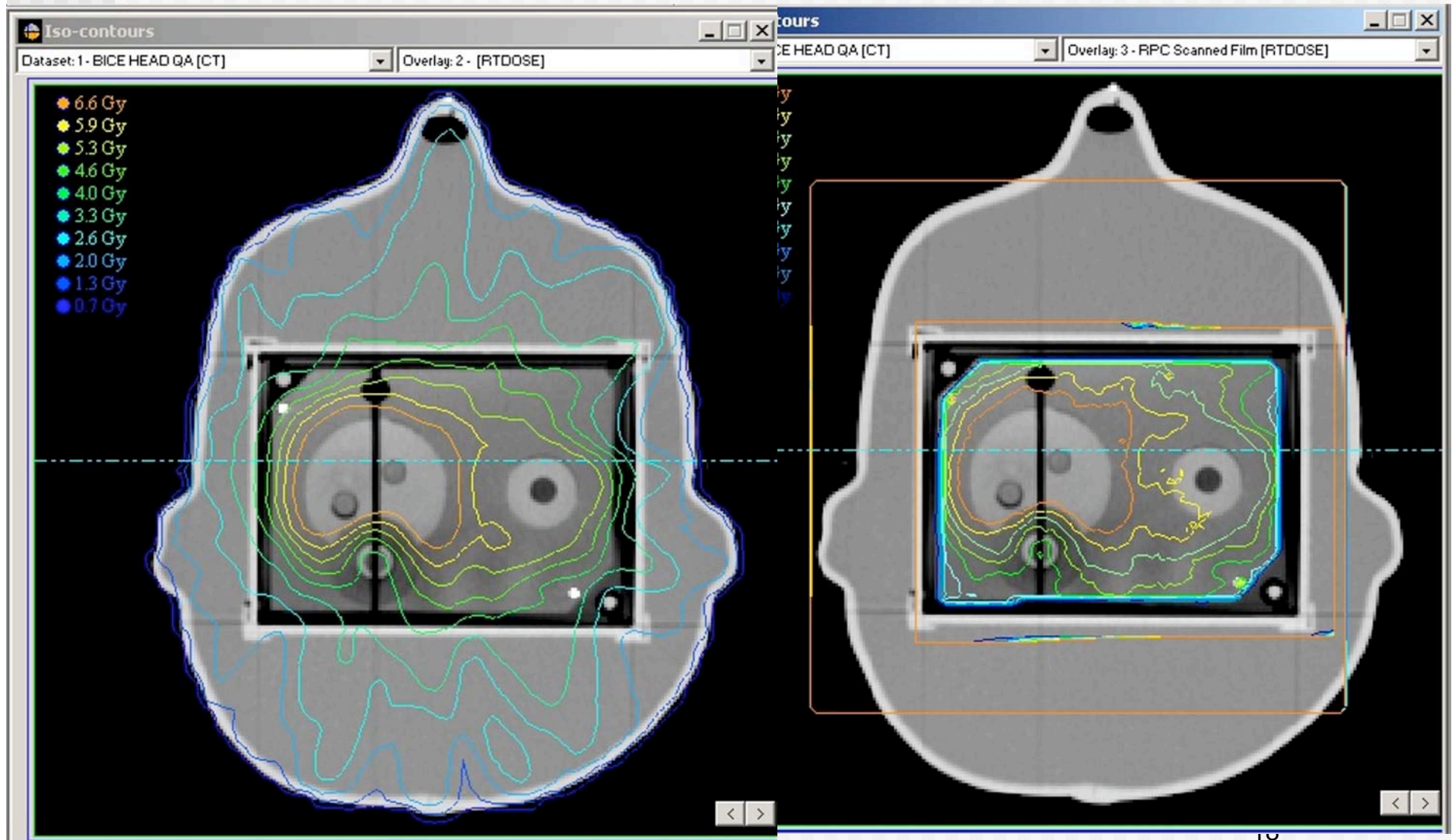
# IMRT H&N phantom results (cont'd)

- 65 failed by absolute dose only
- 13 failed by DTA only
- 19 failed by both absolute dose and DTA

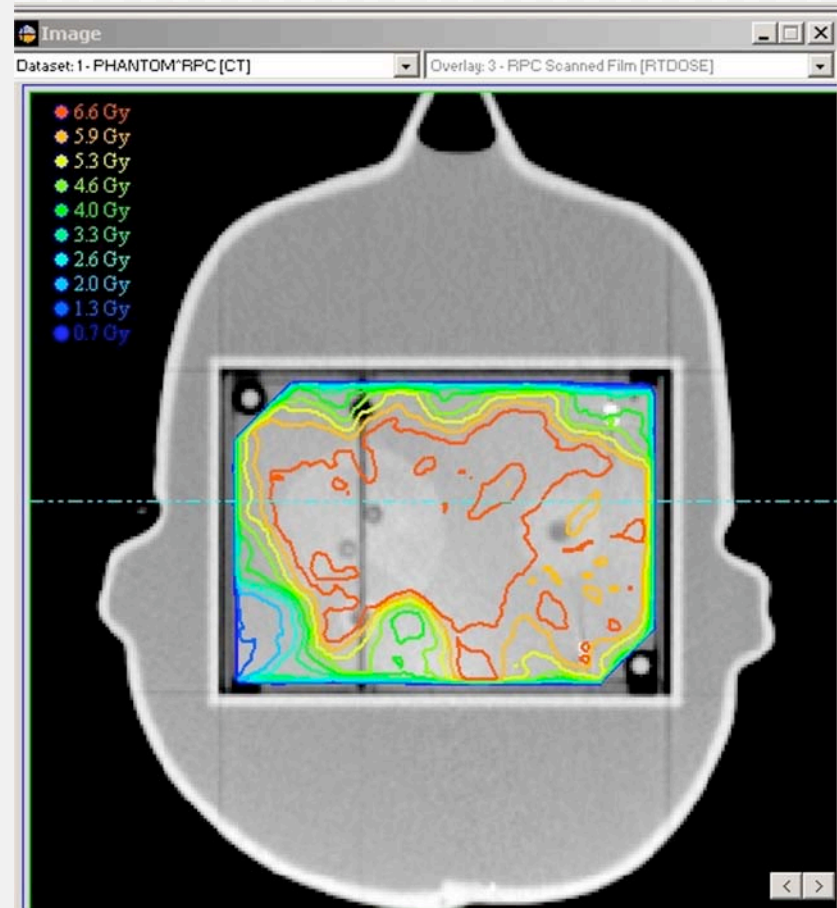
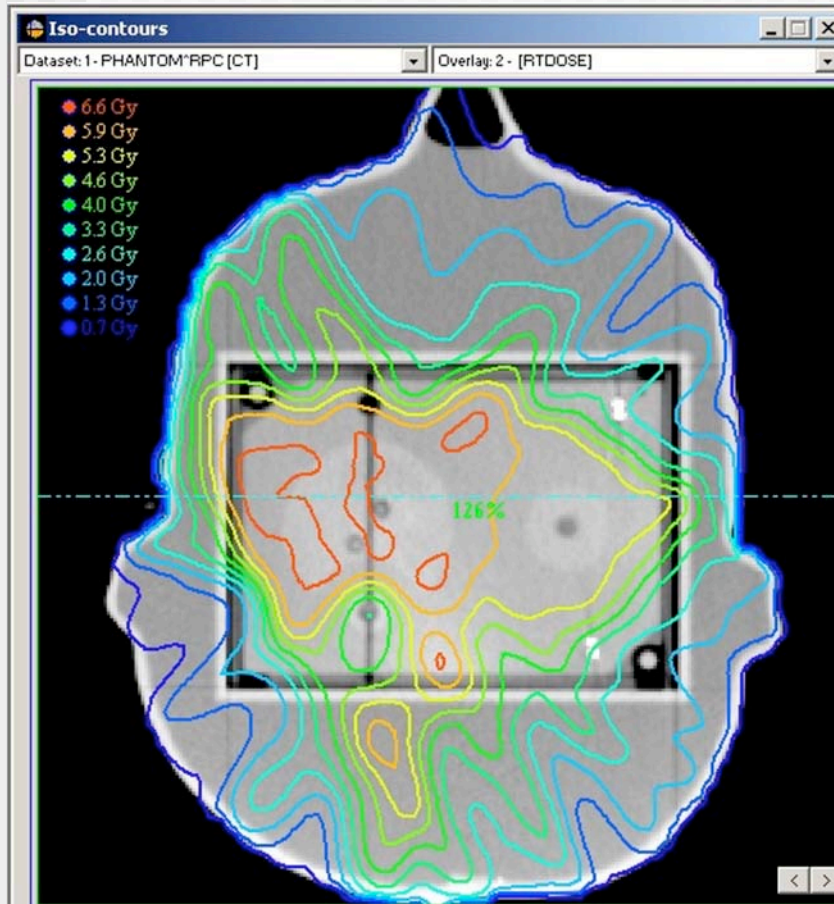
	1PTV	2PTV	Displ.(mm)
mean	0.99	0.98	0.1
std dev	0.050	0.046	2.9
count	1447	721	419
range	0.49-1.15	0.57-1.23	-15 -17

# Plan vs. Treatment

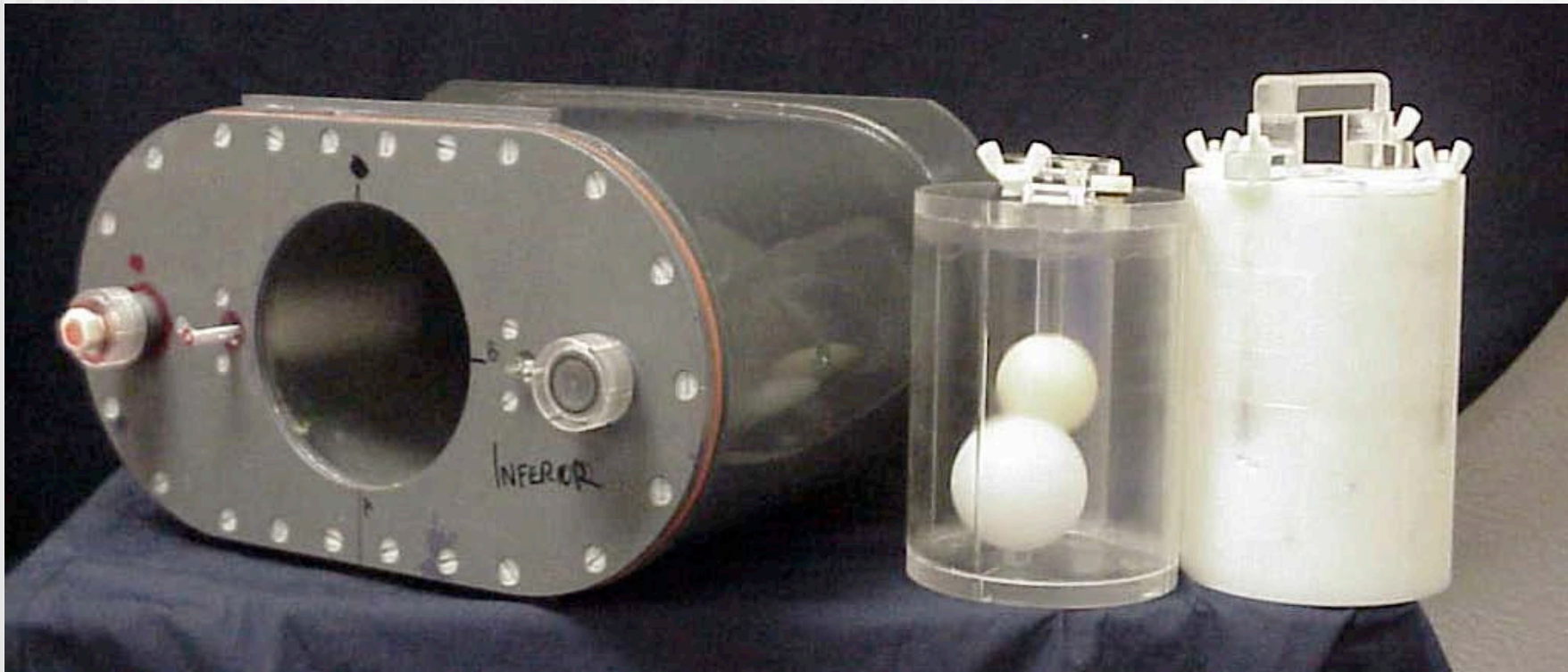
## CERR software to help



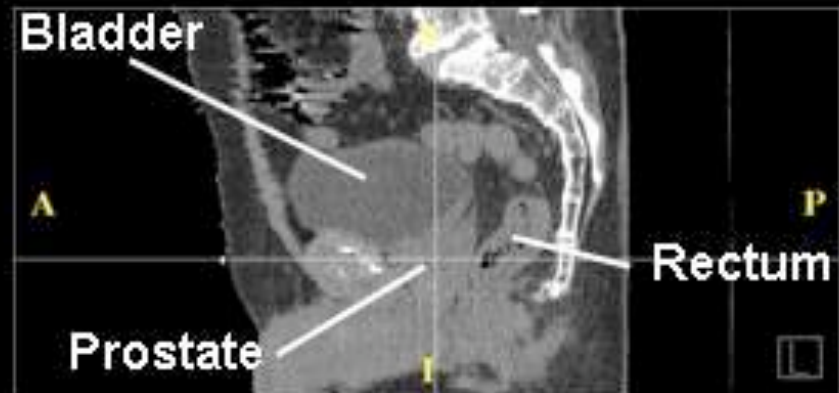
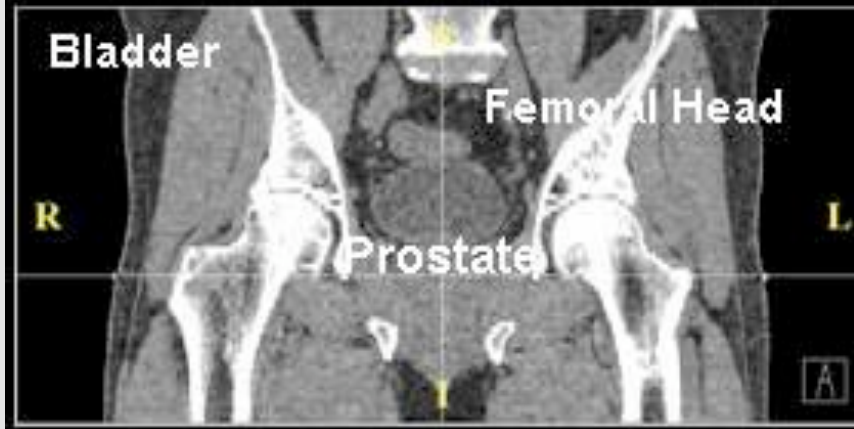
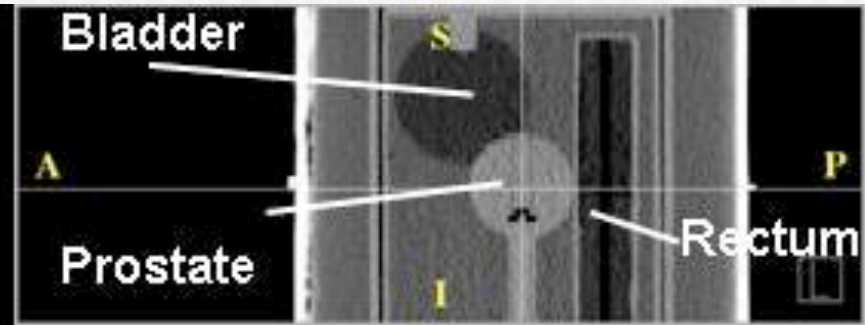
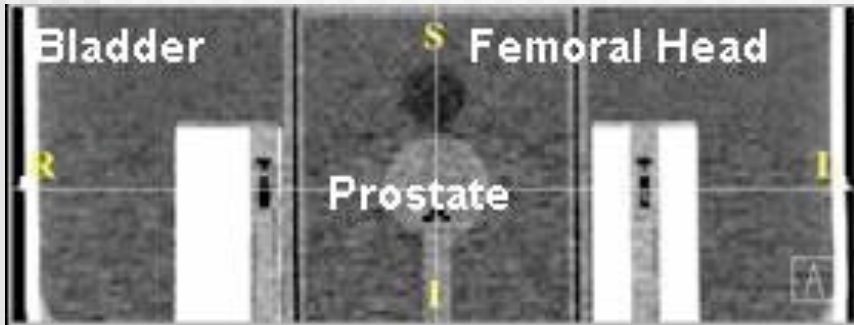
# Examples of failures



# Prostate Phantom



# Prostate phantom



# Explanations for Failures

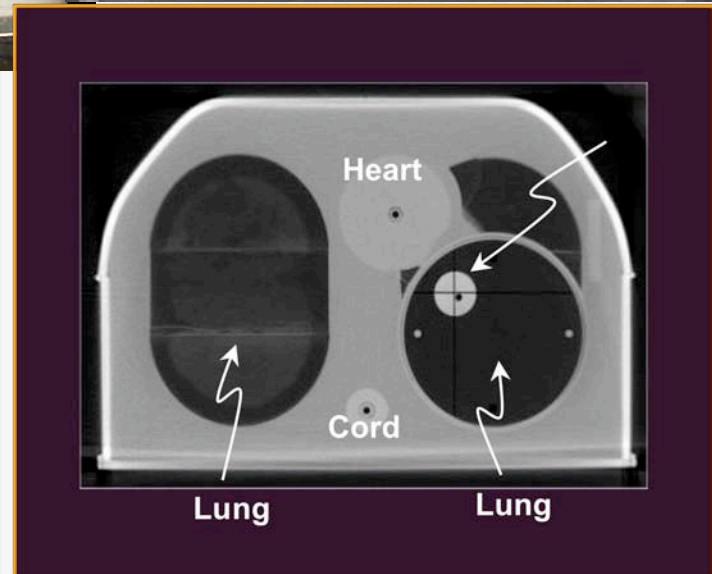
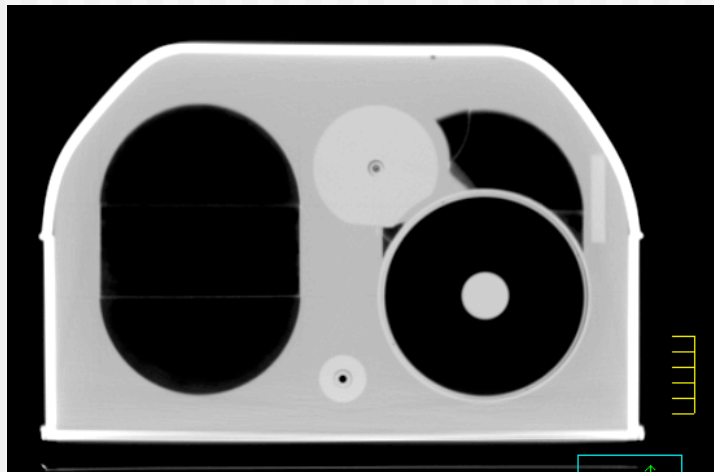
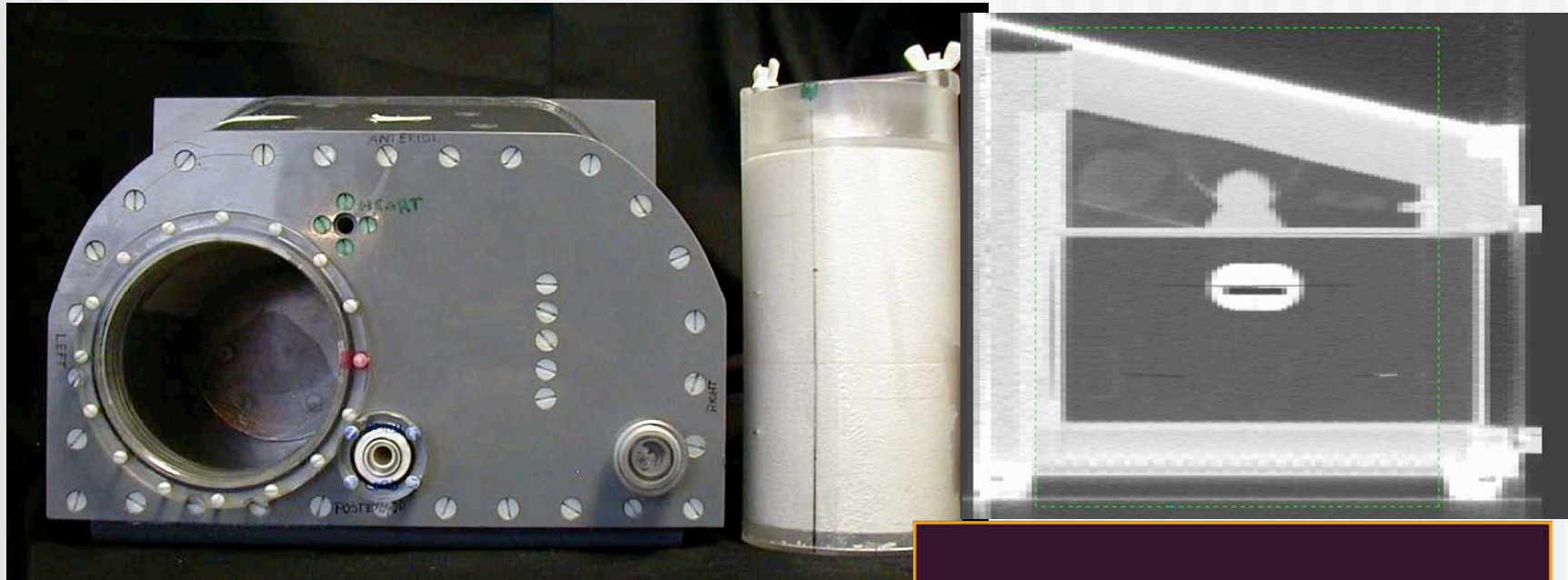
Explanation	Minimum # of occurrences
incorrect output factors in TPS	1
incorrect PDD in TPS	1
<b>Software error</b>	<b>1</b>
inadequacies in beam modeling at leaf ends (Cadman, et al; PMB 2002)	14
not adjusting MU to account for dose differences measured with ion chamber	3
<b>errors in couch indexing with Peacock system</b>	<b>3</b>
2 mm tolerance on MLC leaf position	1
setup errors	7
target malfunction	1

# Credentialing for Lung Protocols

- ★ Measurement of dose delivery
- ★ Evaluation of heterogeneity corrections
- ★ Simulation of respiratory motion
- ★ Fiducials used to evaluate IGRT
- ★ (First attempts)

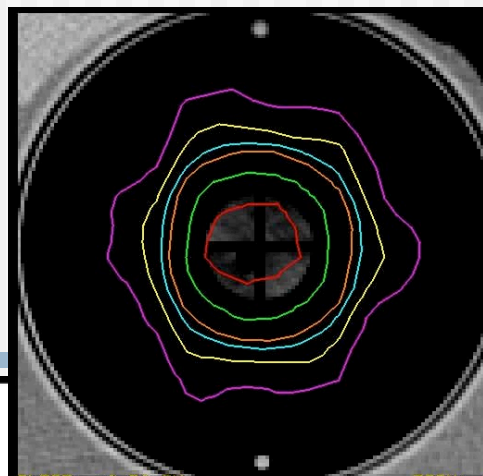


# RPC Lung Phantom



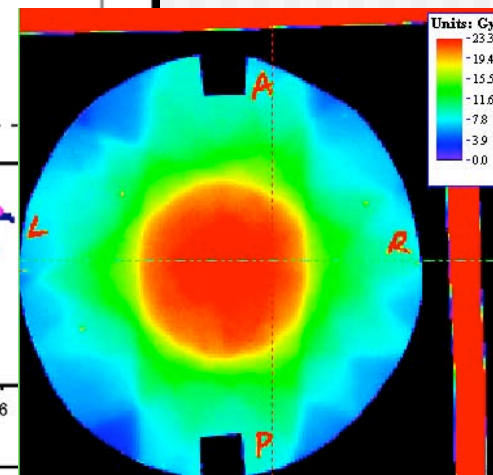
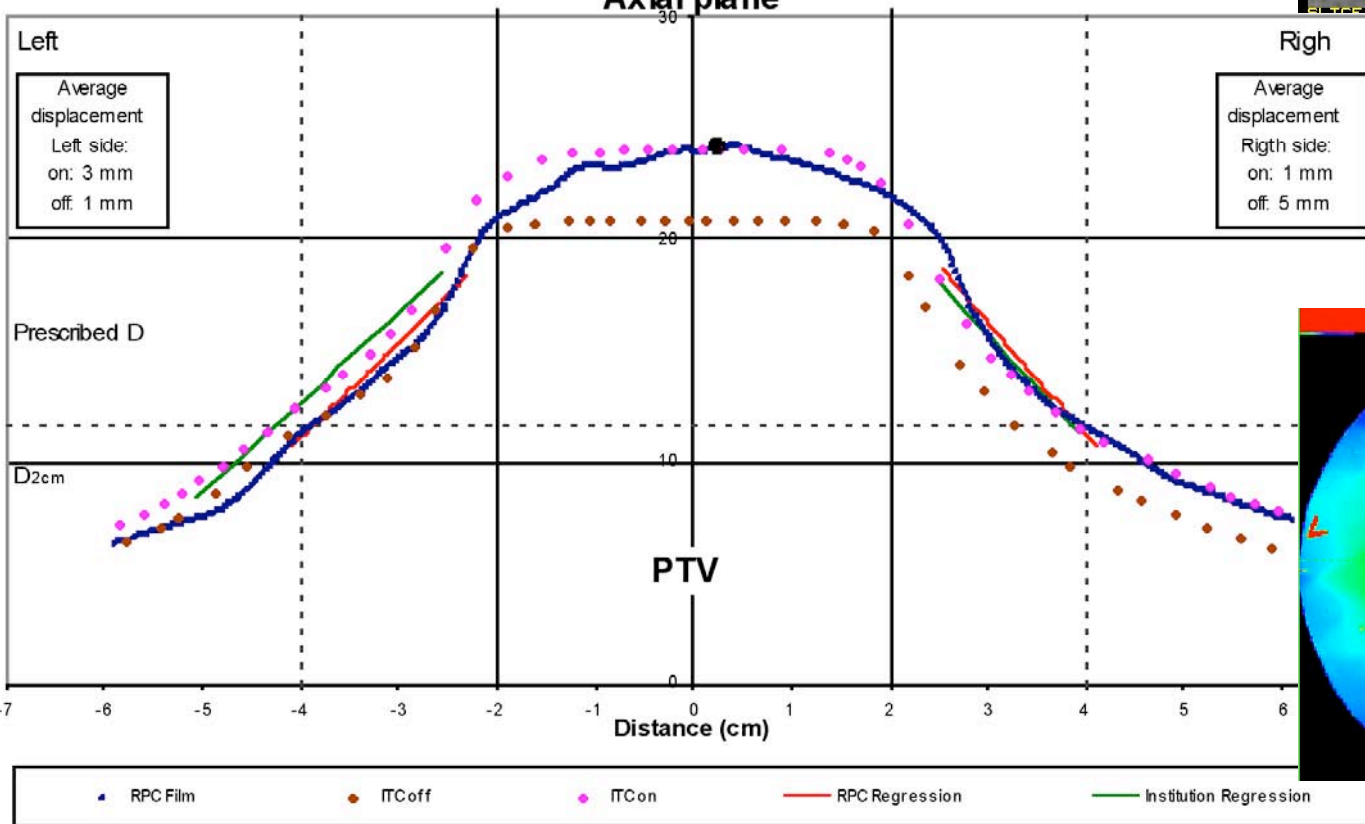


# Convolution R-L Profile

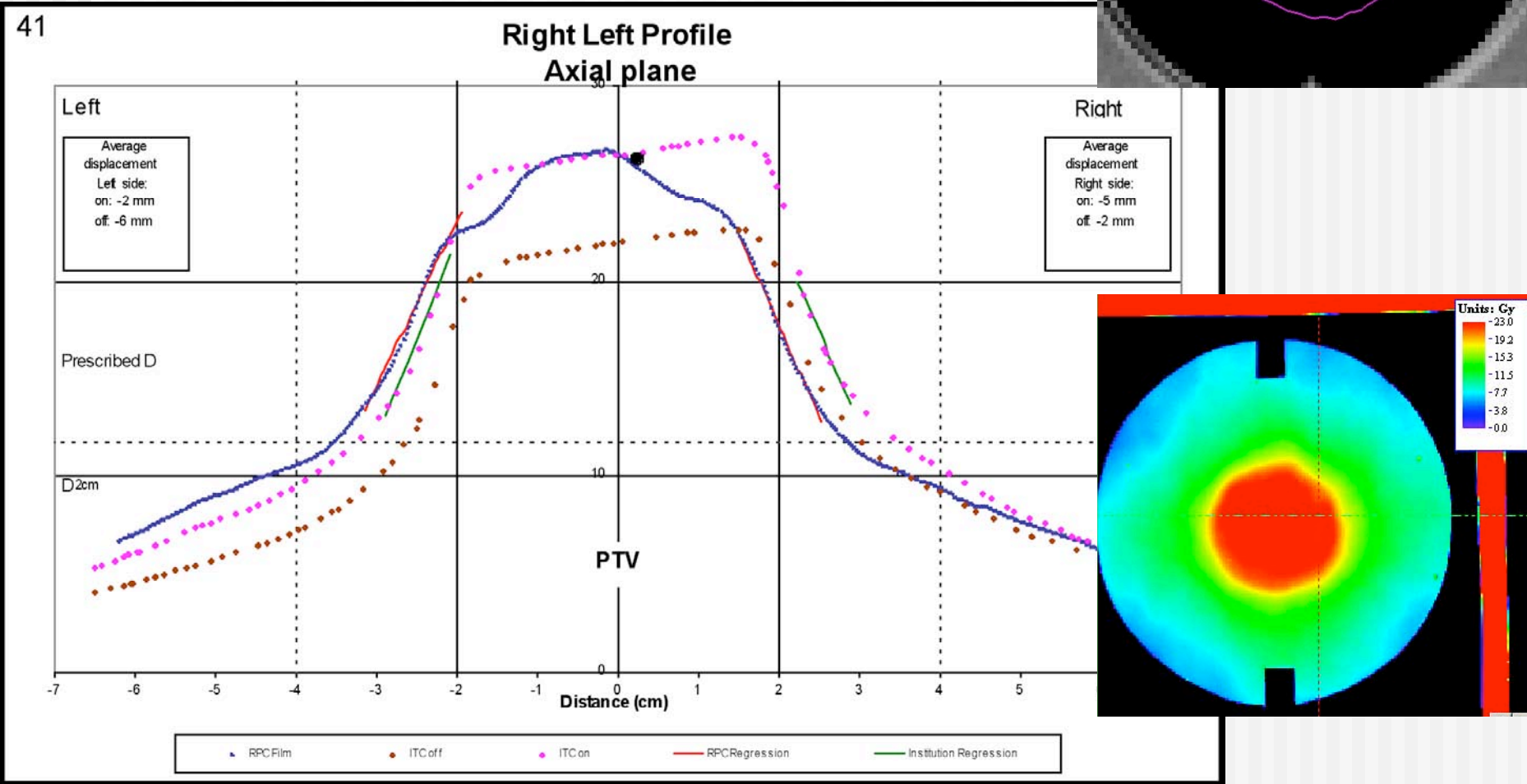
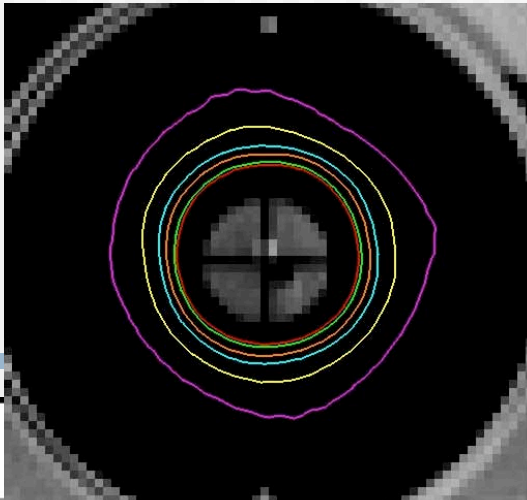


14

Right Left Profile  
Axial plane



# Pencil-Beam profile



# RPC's Conventional Monitoring

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## Treatment record reviews

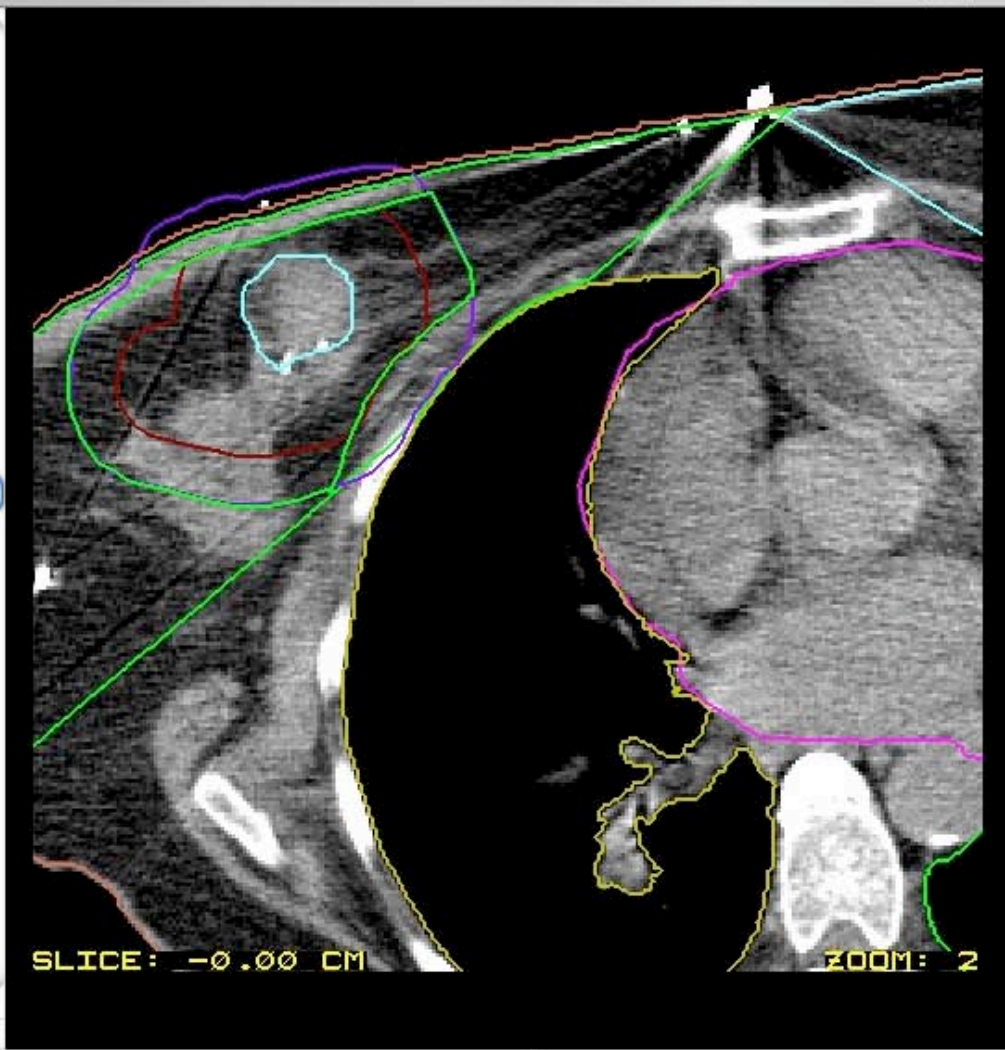
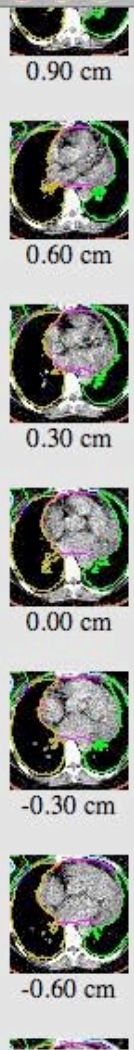
- ◆ Review for GOG, NSABP, NCCTG, RTOG (brachy)

- ◆ Including rapid reviews



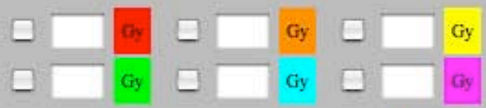
## Independent recalculation of patient dose

- ◆ Continue to find errors



Update Image Edit Contours Contour Colors

Isodose Contours Plan: fx1hetero

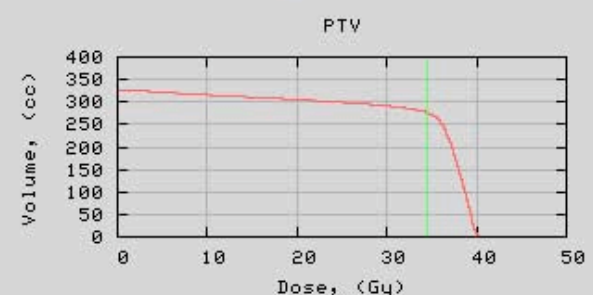


Structures (dashed when isodoses are displayed) All Off

All On

- BREAST\_CNTR
- BREAST\_IPSI
- CTV
- HEART
- LUNG\_CNTR
- LUNG\_IPSI
- PTV
- PTV\_EVAL
- SKIN
- SURG\_BED
- THYROID

DVH: ITC Re-calc DVH  
 Struct: PTV Eval DVH



Plan ID	Vol ≥ Ref	Max	Min	Mean
fx1hetero	84.50 %	40.50 Gy	0.10 Gy	35.50 Gy

Total Volume: 325.89 cc [DVH Data File](#)  
 Conformity Index = 0.675

Image Click Mode Re-Center

Window/Level Preset: Default (soft tissue)

Window: 470

# Status of RPC Preparations for Monitoring **Proton** Facilities

- RPC able to visit PTC-H during construction to learn about facility design and operation
- Visits to PTC-H and to UF/Jacksonville to measure and verify beam output, depth dose characteristics
- Irradiated TLD at 3 facilities under more than 30 combinations of energy, field size, depth and residual range
- Evaluated radiochromic film (2 types) for use in proton beams
- Presently testing BANG® gel & Presage™ dosimeters
- Agreement with Landauer to evaluate OSL dosimeters in various beams, including protons



# RPC's Vision for Support of Proton Clinical Trials

- NCI: guidelines for use of protons in cooperative group trials
- Uniform adoption of calibration protocol, traceable to NIST
- Design and implement devices for monitoring beam calibration
- Pursue evaluation of gel/Presage™ dosimeters
- Design, evaluate and implement modified anthropomorphic phantoms for evaluating proton beam delivery
- Implement proton planning on RPC's Eclipse workstation for independent review



