Radiological Physics Center

Report to

ATC Steering Committee

Geoffrey S. Ibbott, Ph.D.
and RPC Staff

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 summarizing our findings for the radiation therapy community.

- Mandate from the Cancer Trials Evaluation Program (CTEP)

RPC's QA Activities

- Remote audits of machine output
- Treatment record reviews
- On-site dosimetry reviews
- Credentialing
  - Questionnaires, rapid reviews, benchmarks, phantoms
- Independent recalculation of patient dose
- Audits of Proton Therapy Centers
  - Questionnaires, TLD audits, visits, phantoms
- International Activities
  - Independent remote audits

Web-based Facility Questionnaire

All textboxes can be edited. Please verify correctness of data. Click **Sub**
data with more than one records (in frames), use the according Buttons on

1) Institution Name: 21st Century Oncology-Englewood

Address: Englewood Radiation Therapy Regional Ctr.

571 Medical Drive

City: Englewood

State: FL Country: USA

Telephone: 9414750022 Extension: Fax:

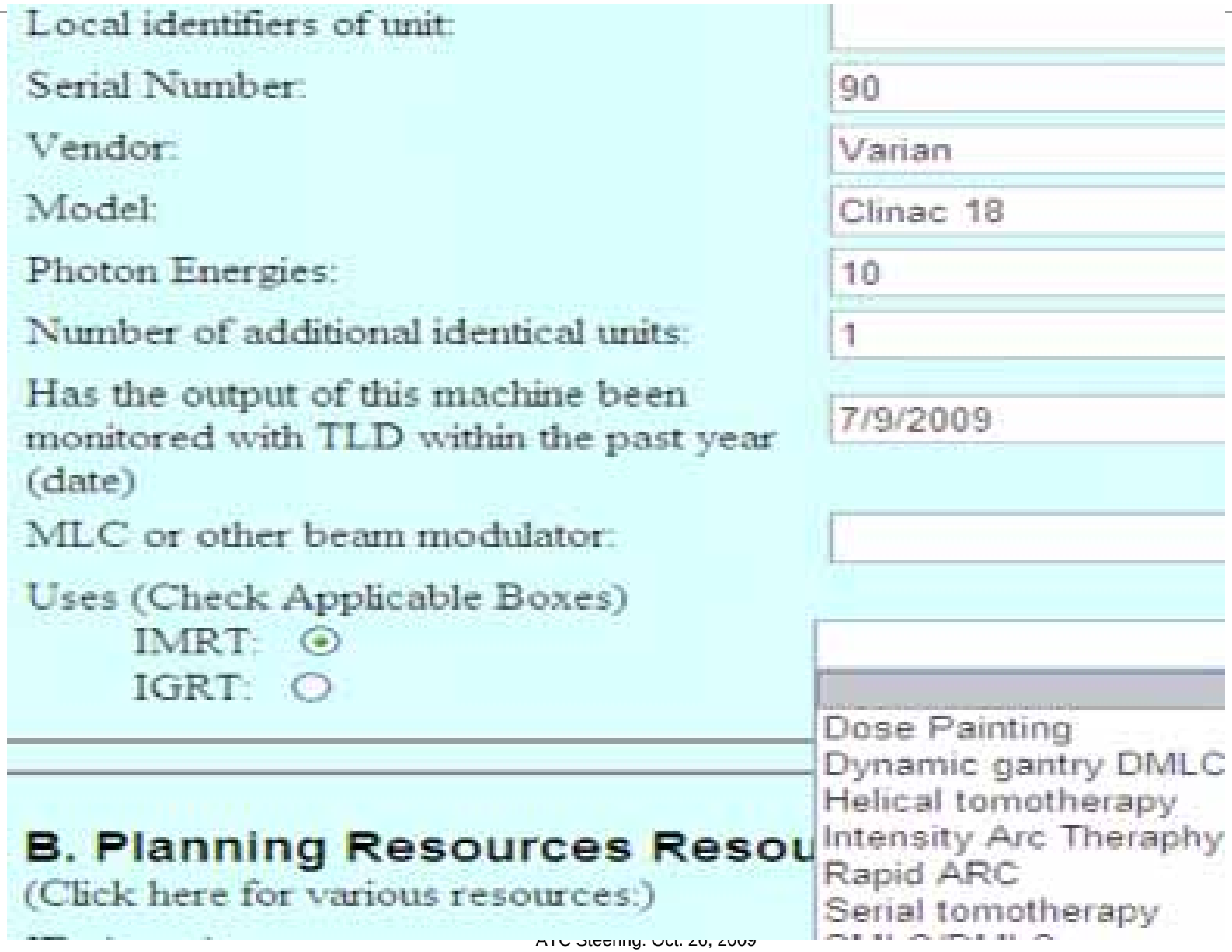
Person submitting this form:

Email: Ph

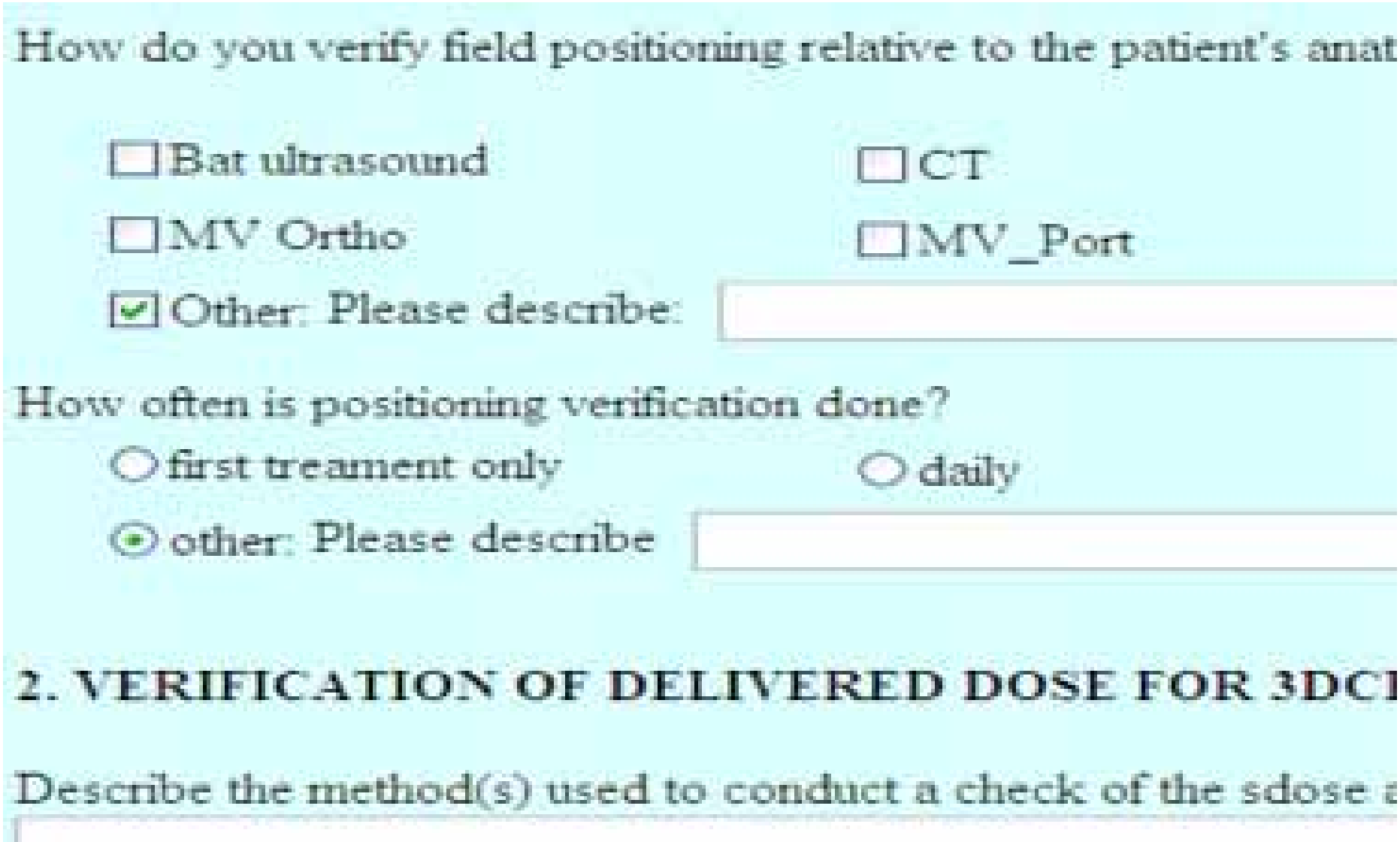
3) Date questionnaire updated: 23-Sep-2009

4) Cooperative group membership

Facility Questionnaire (cont'd)



Facility Questionnaire (cont'd)


How do you verify field positioning relative to the patient's anat

- ☐ Bat ultrasound
- ☐ CT
- ☐ MV Ortho
- ☐ MV_Port
- ☑ Other: Please describe:

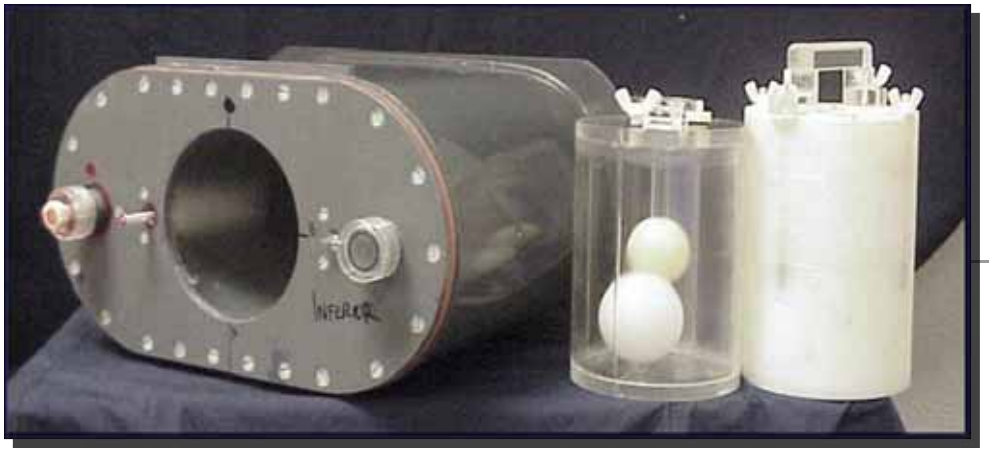
How often is positioning verification done?

- ○ first treament only
- ○ daily
- ◉ other: Please describe

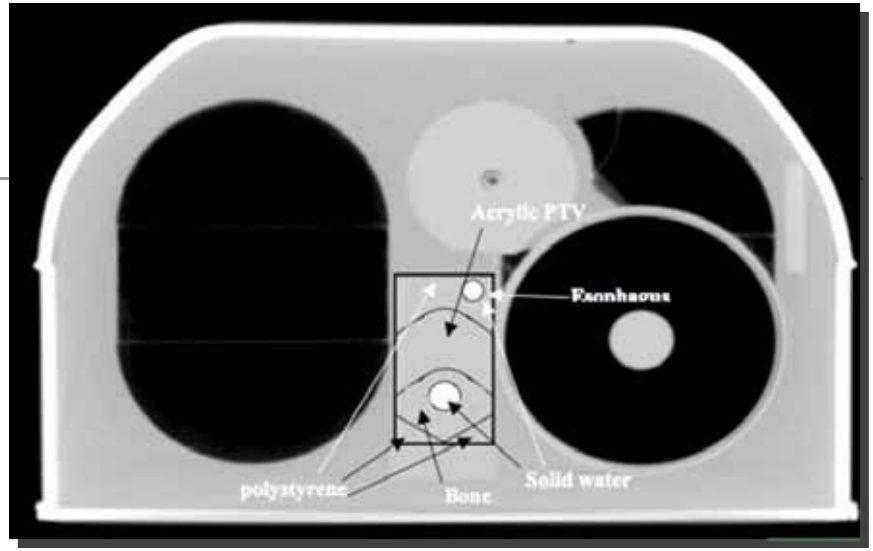
2. VERIFICATION OF DELIVERED DOSE FOR 3DC

Describe the method(s) used to conduct a check of the sdose

RPC Phantoms



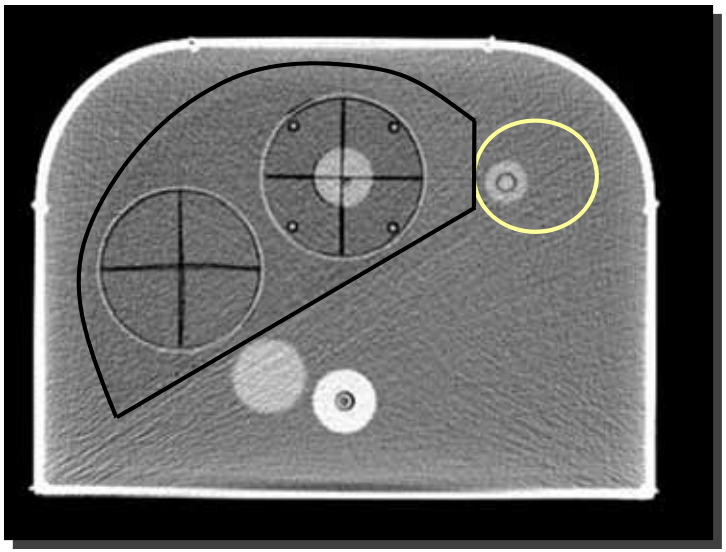
Pelvis (10)



Thorax (13)

H&N (31)

SRS Head (4)

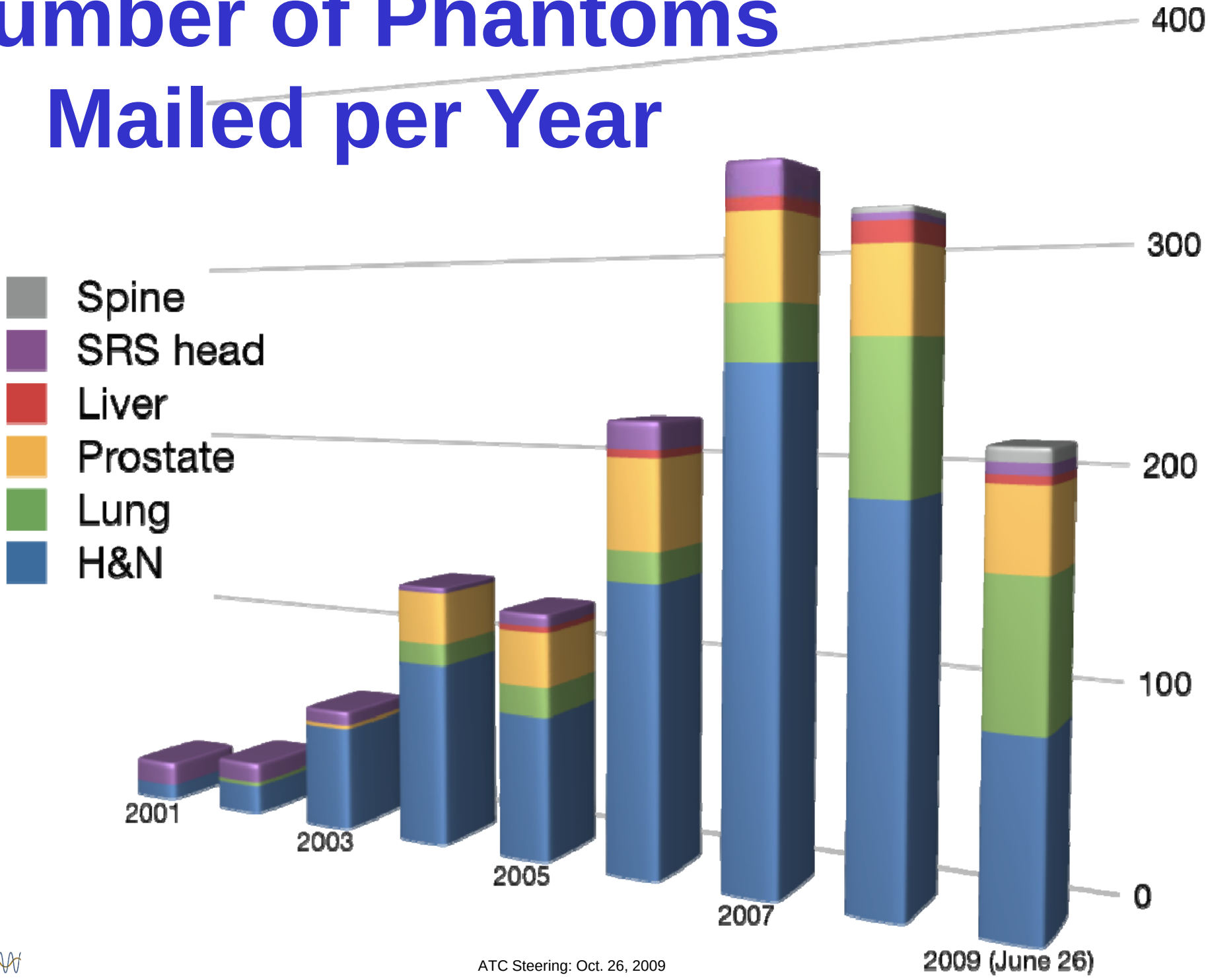


Liver (2)

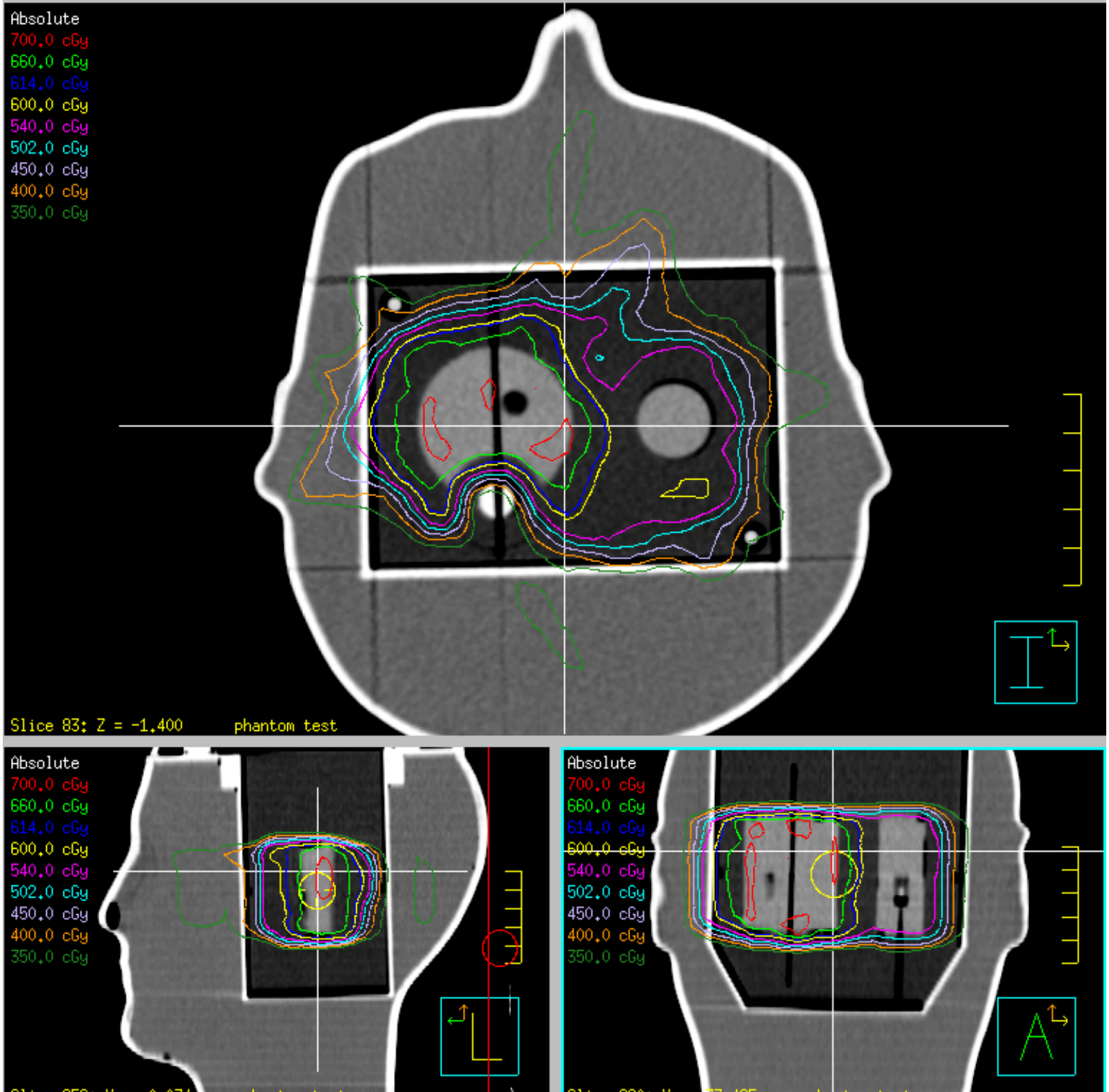
Lung Phantom and Moving Platform

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

Number of Phantoms Mailed per Year

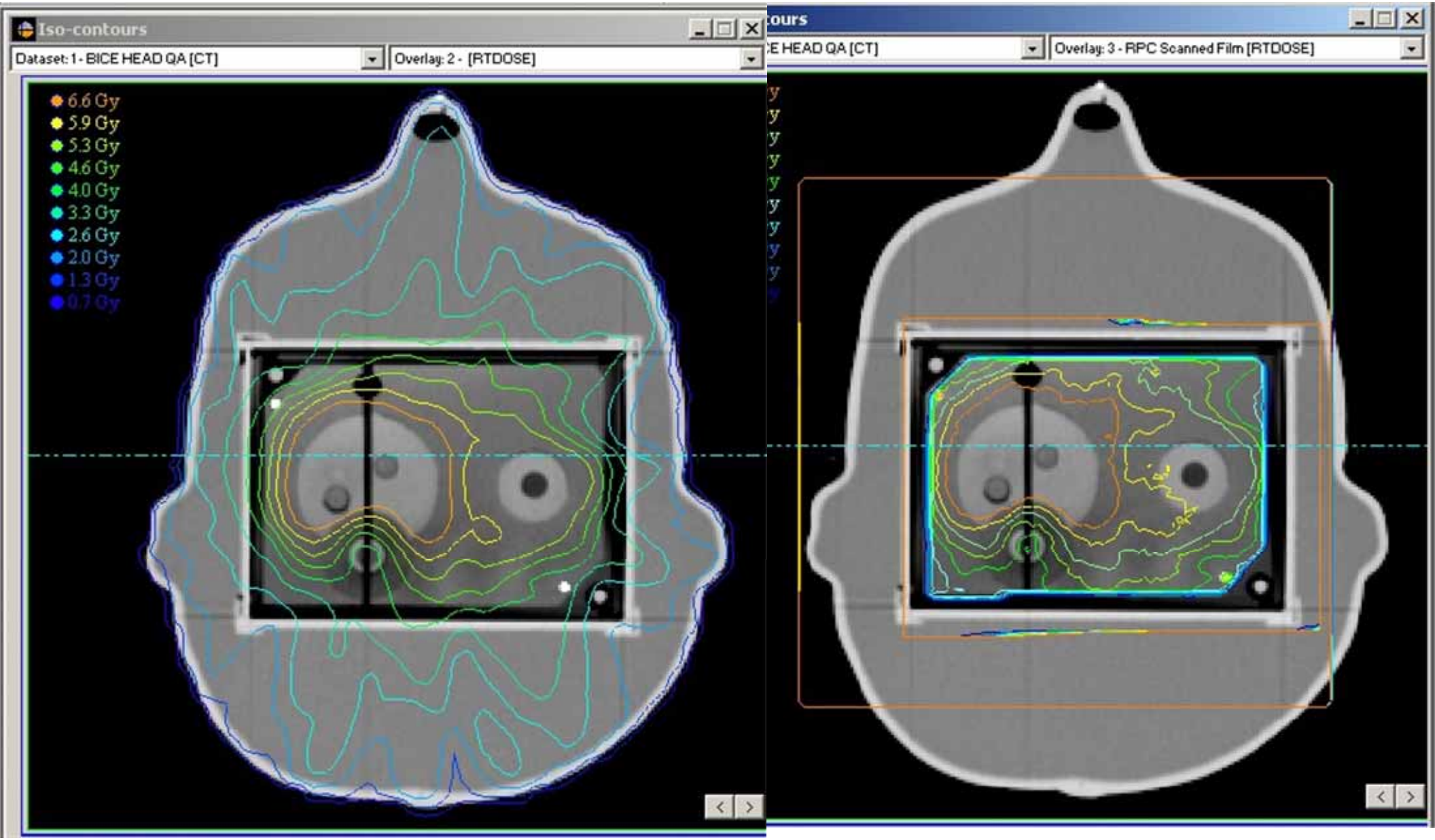


Treat phantom as if it were a patient


Absolute
700.0 cGy
660.0 cGy
614.0 cGy
600.0 cGy
540.0 cGy
502.0 cGy
450.0 cGy
400.0 cGy
350.0 cGy
Slice 83: Z = -1.400
phantom test
Absolute
700.0 cGy
660.0 cGy
614.0 cGy
600.0 cGy
540.0 cGy
502.0 cGy
450.0 cGy
400.0 cGy
350.0 cGy
Absolute
700.0 cGy
660.0 cGy
614.0 cGy
600.0 cGy
540.0 cGy
502.0 cGy
450.0 cGy
400.0 cGy
350.0 cGy

Deliver treatment

RPC Compares Treated Distribution with Plan

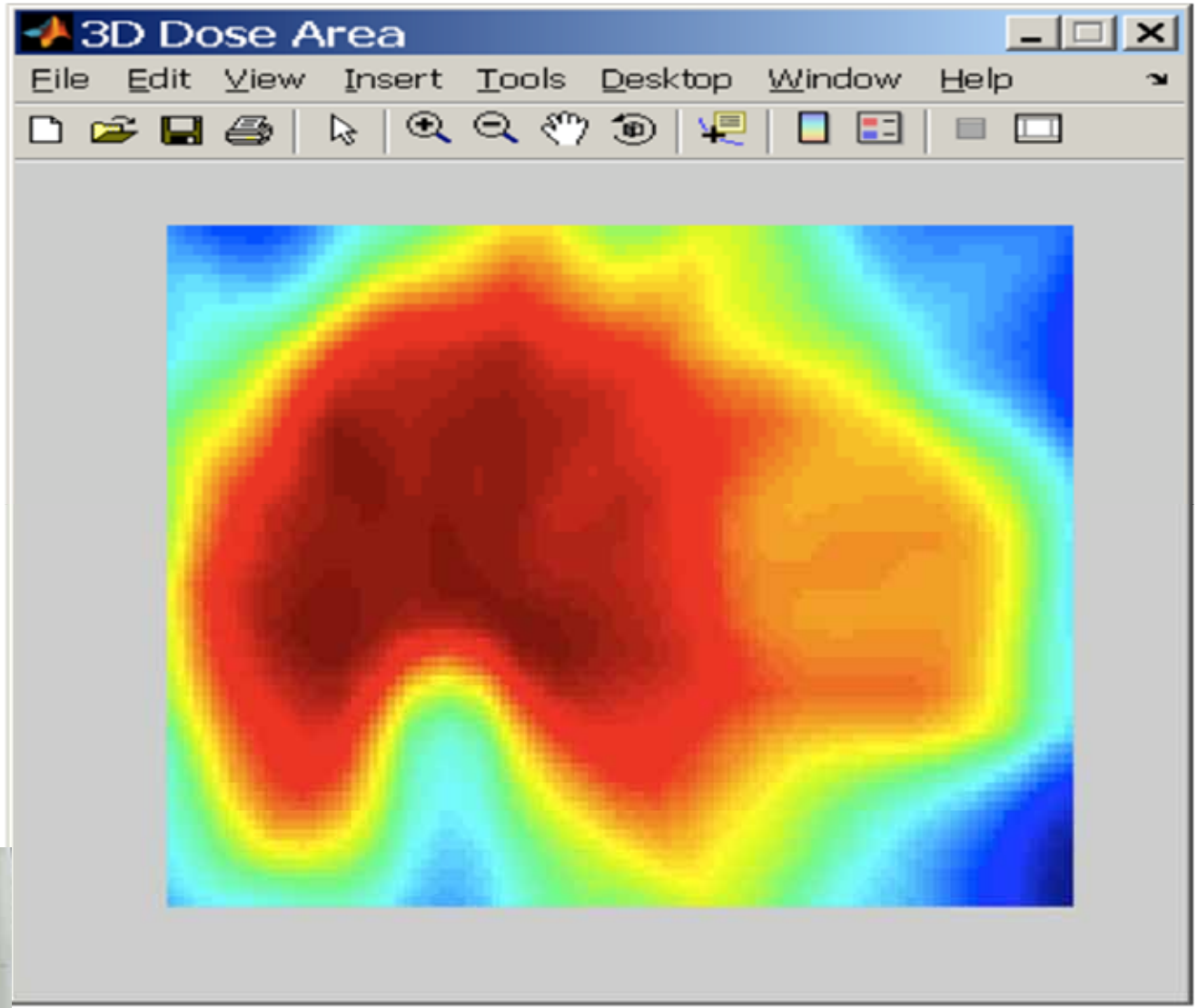


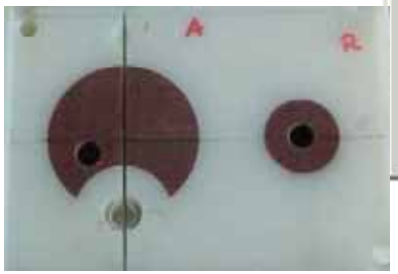
Phantom Results

Comparison between institution's plan and delivered dose.
Criteria for agreement: 7% or 4 mm DTA (5%/5mm for lung)

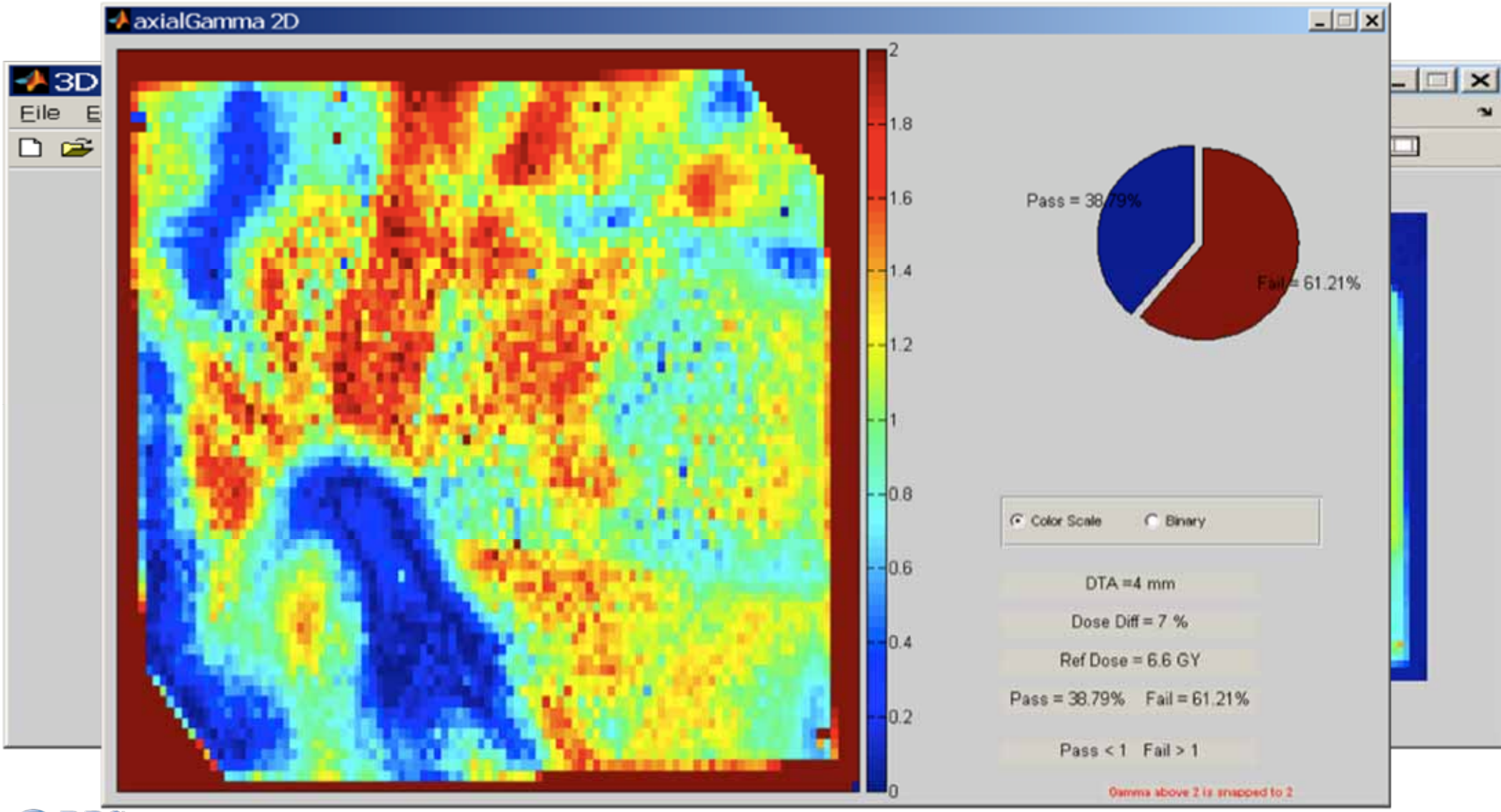
Site	Irradiations	Pass
H&N	718	78%
Pelvis	130	82%
Lung	167*	71%
Liver	18	50%

*Irradiated without motion. If "good" algorithm, 77% pass. If consider only 3D-CRT, 85% pass.


3D Dose Area
File Edit View Insert Tools Desktop Window Help

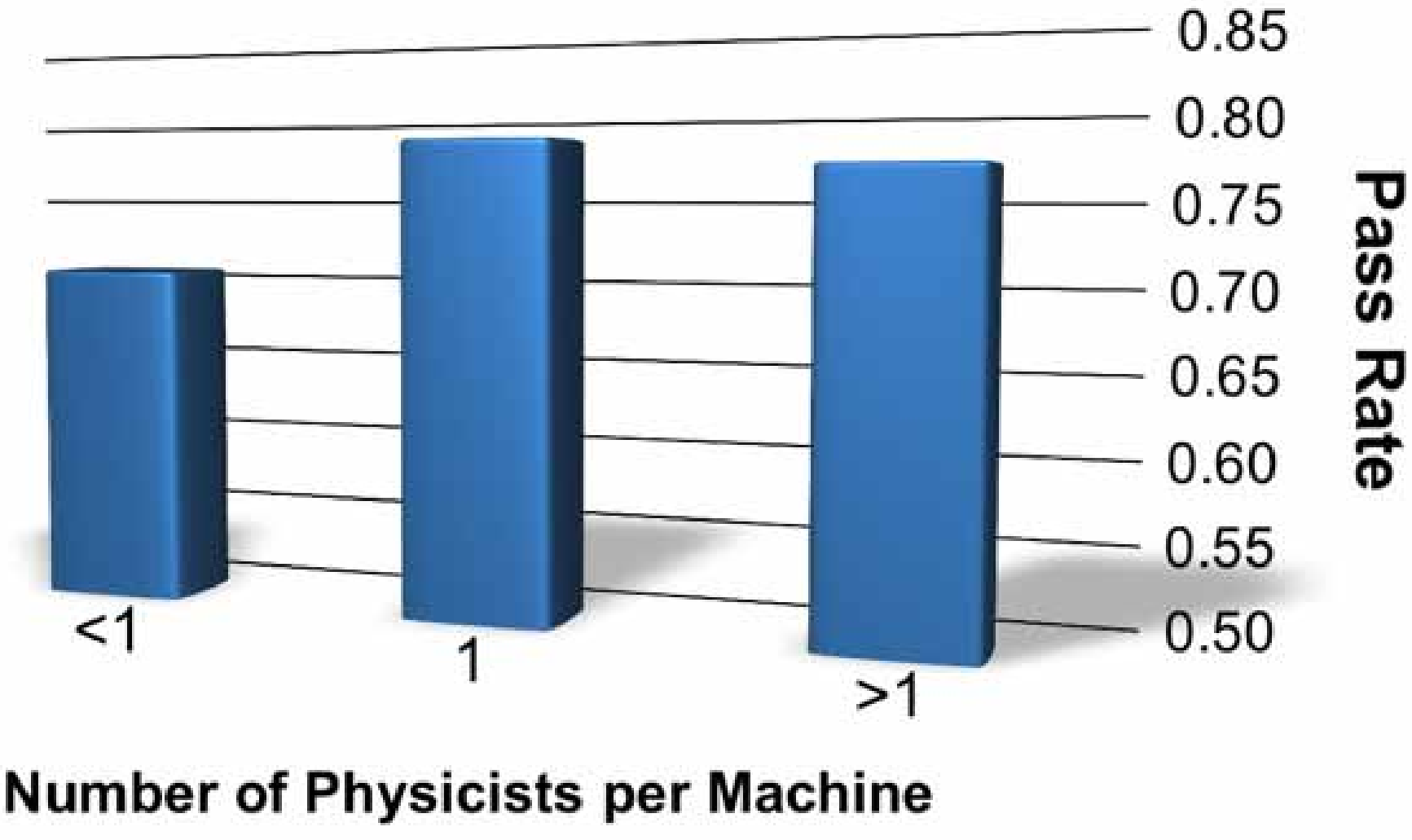


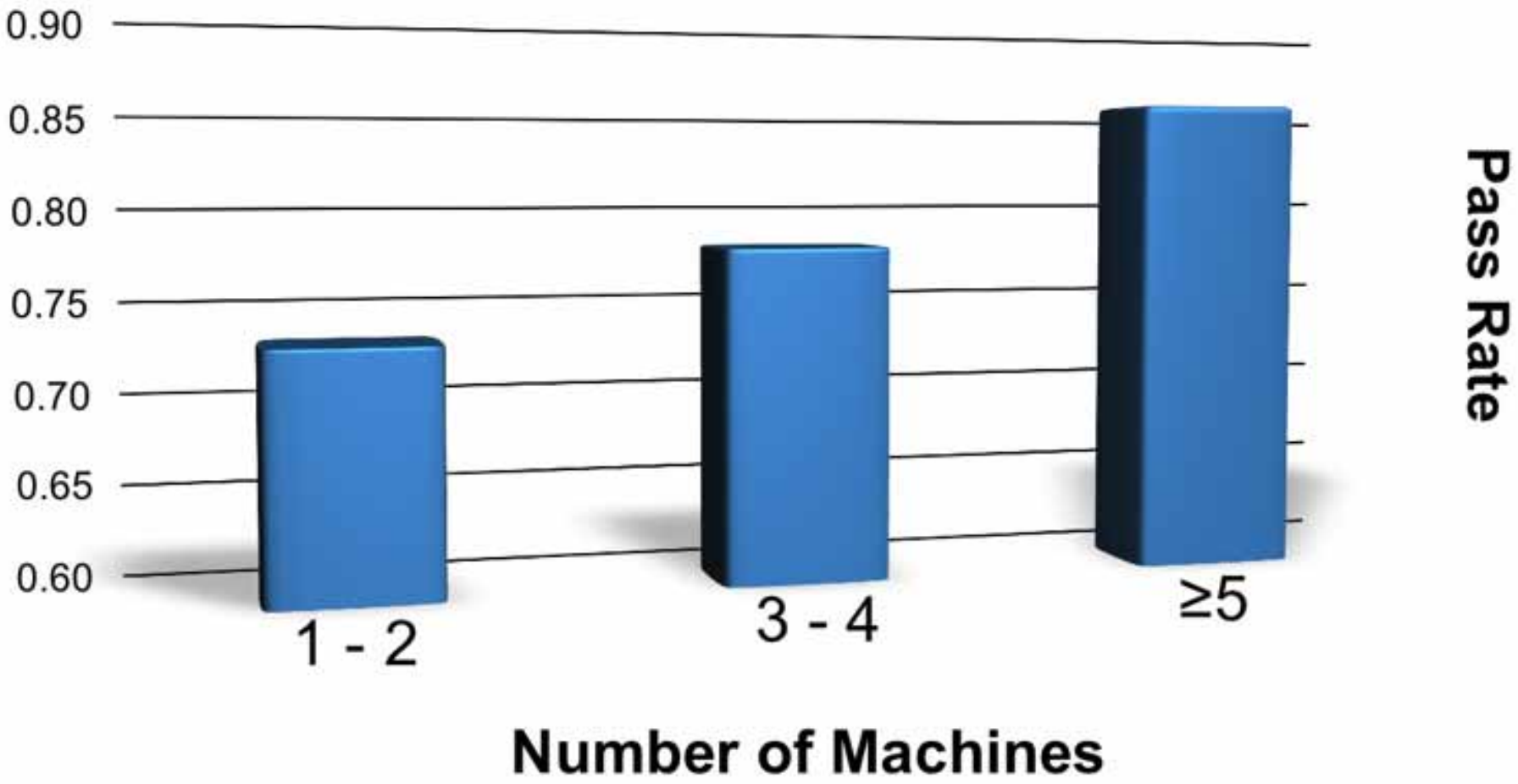
Comparison: Planned vs. Delivered Distribution



HN results grouped by TPS

Treatment planning system	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Corvus	75	32	7	0	1
Eclipse	85	114	10	4	3
Pinnacle	73	168	33	4	8
TomoTherapy	73	22	5	1	0
XiO	73	59	7	4	5
Other	79	24	3	0	2
Total		419	65	13	19


0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
Pass Rate
<1
1
>1
Number of Physicists per Machine


0.90
0.85
0.80
0.75
0.70
0.65
0.60
1 - 2
3 - 4
≥5
Number of Machines
Pass Rate

Explanations for Failures

Explanation	Minimum # of occurrences
incorrect output factors in TPS	1
incorrect PDD in TPS	1
IMRT Technique	3
Software error	1
inadequacies in beam modeling at leaf ends (Cadman, et al; PMB 2002)	14
QA procedures	3
errors in couch indexing with Peacock system	3
equipment performance	2
setup errors	7

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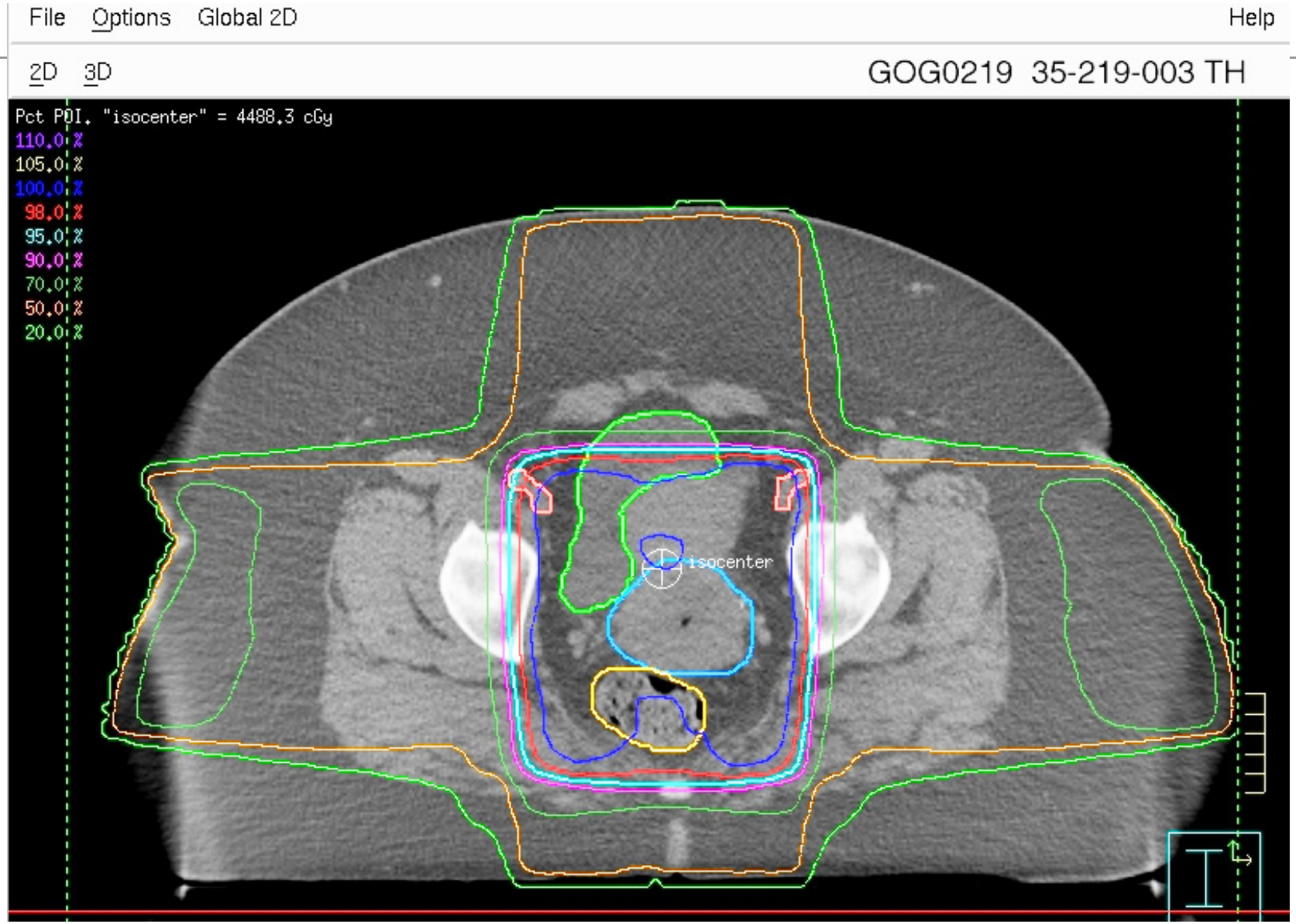
Independent Reviews of Patient Plans



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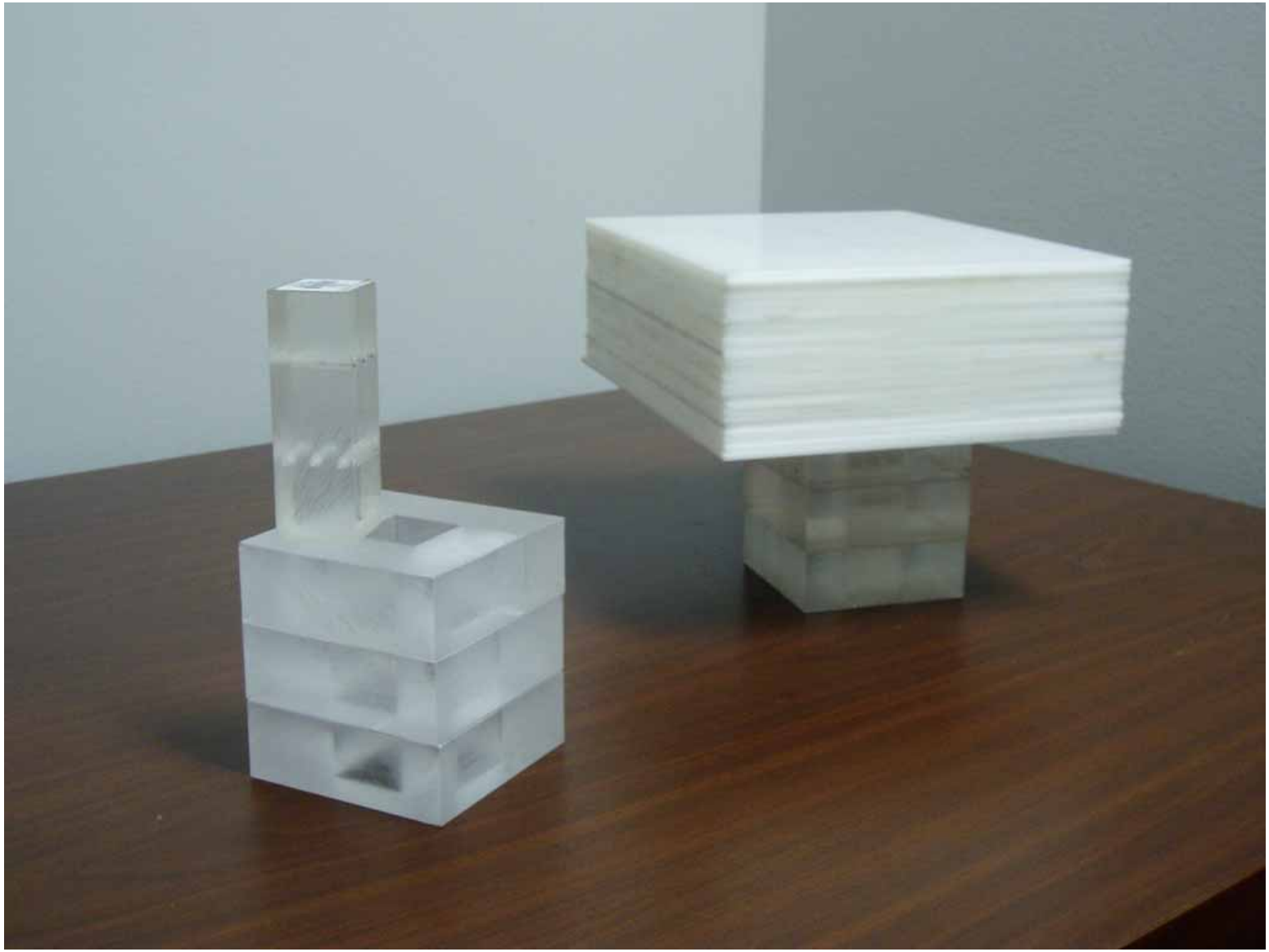
Charged particle beams

- Presently 6 clinically-active US proton therapy centers
- 1 new center expected to open this year, perhaps 5 more in next 2 years
- No heavy particle beam centers anticipated today
  - RPC anticipates that by 5th year of next grant cycle, will need to prepare to audit helium/carbon ion beam facilities

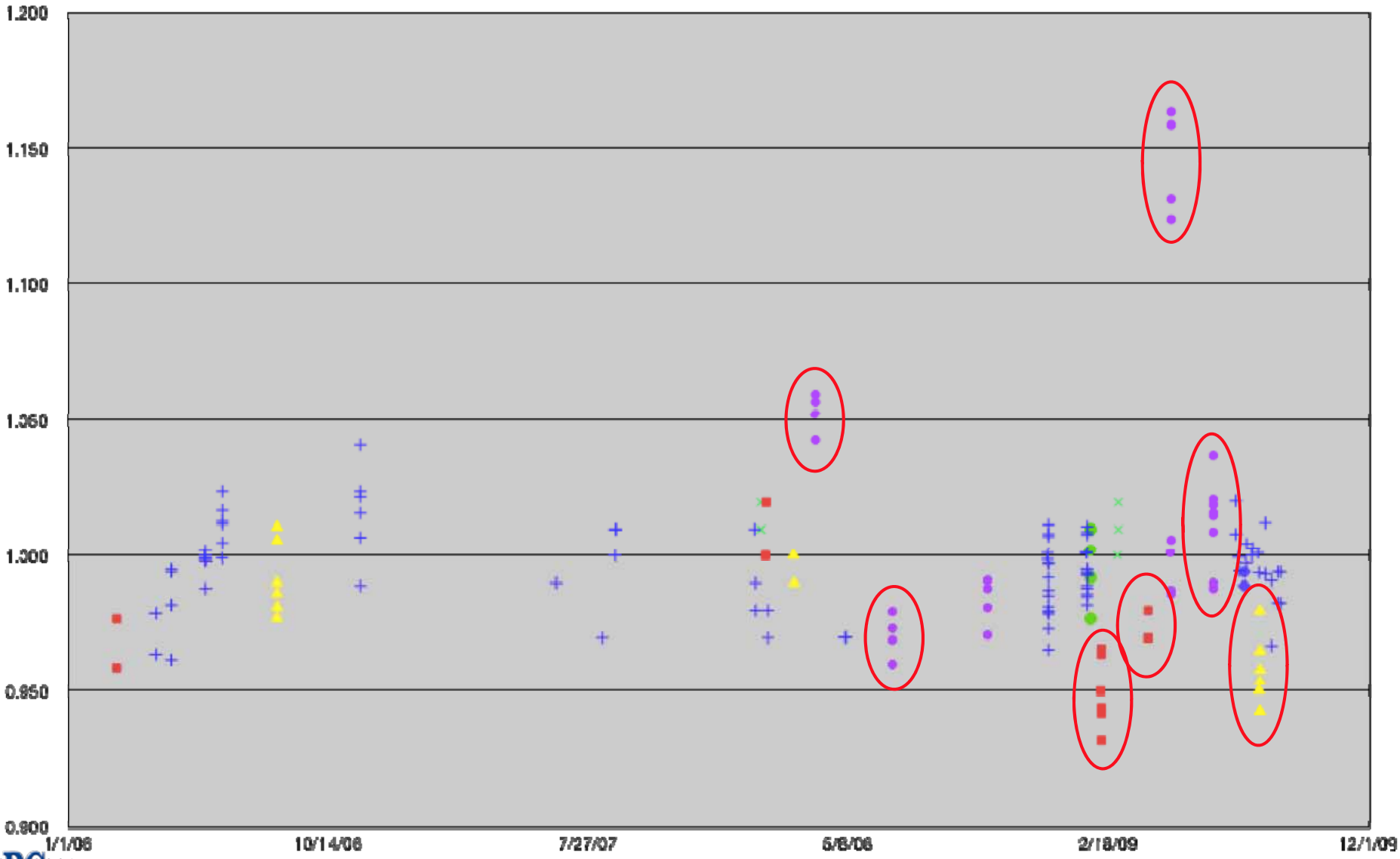
Proton Facility Credentialing

- NCI Guidelines mandate –
  - Questionnaire - sent to facilities by QARC
    - Completed by 4 of 5 centers
  - TLD monitoring
    - Mailed to 7 US centers + 1 Japanese center
  - On-site dosimetry review visits
    - 1 visit largely completed, 3 visits under way
  - Anthropomorphic phantom
    - Modified existing pelvis phantom

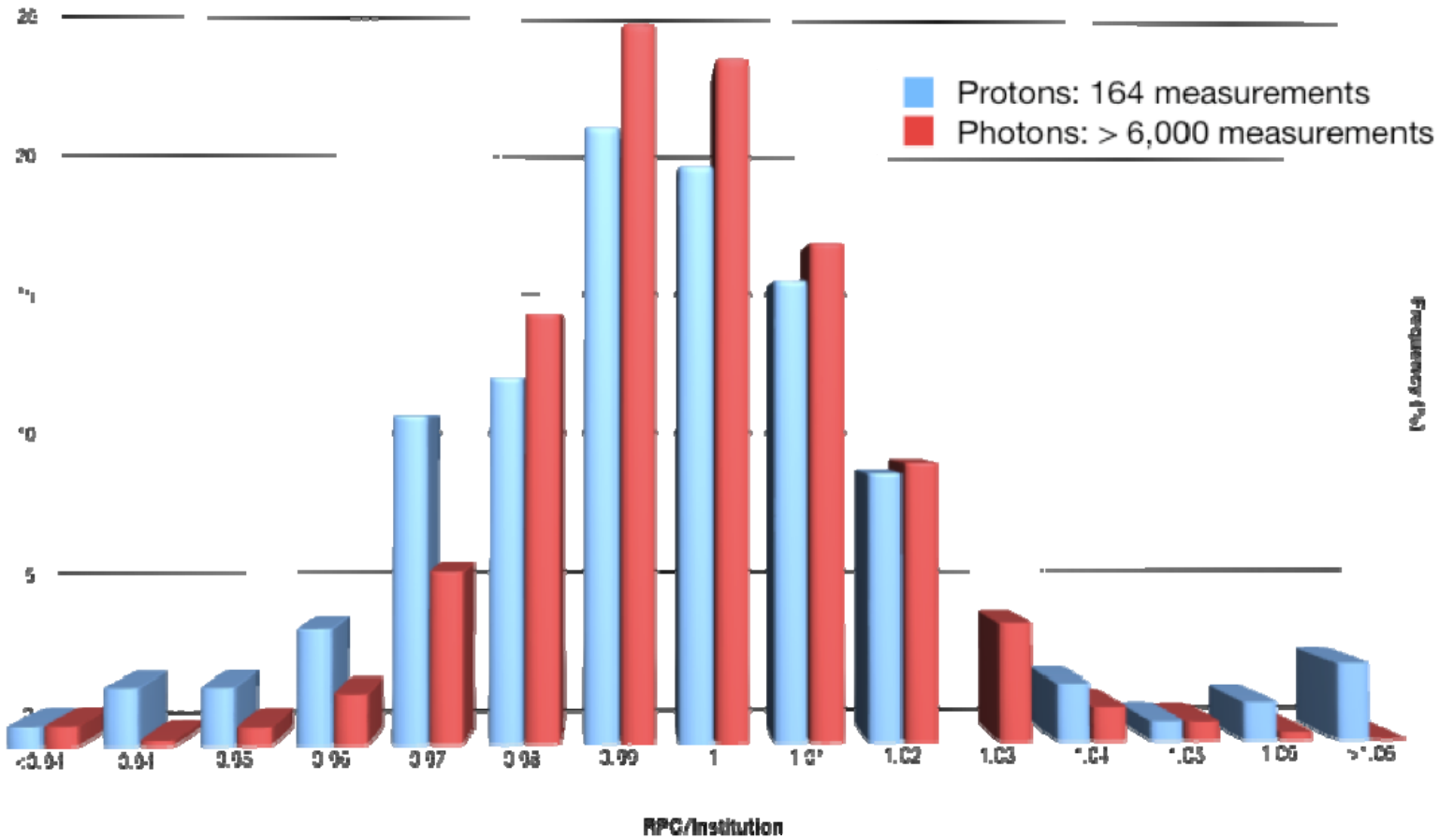
RPC TLD System



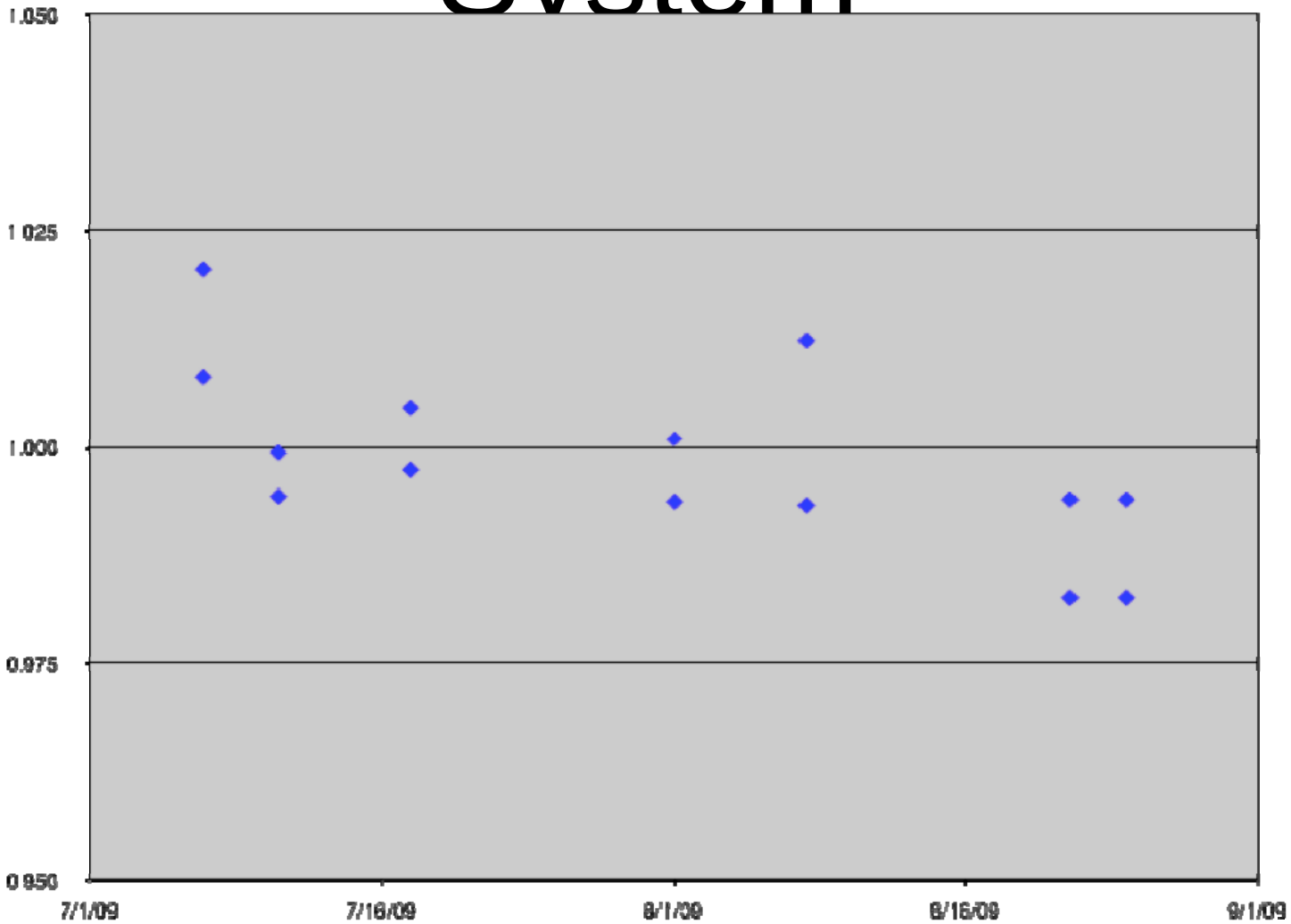
Proton Beam Monitoring



Distribution of Photon Beam TLD Measurements

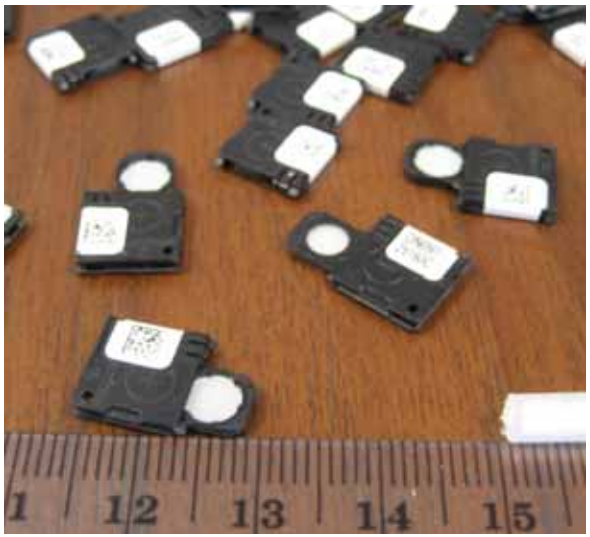


Re-validation of TLD System

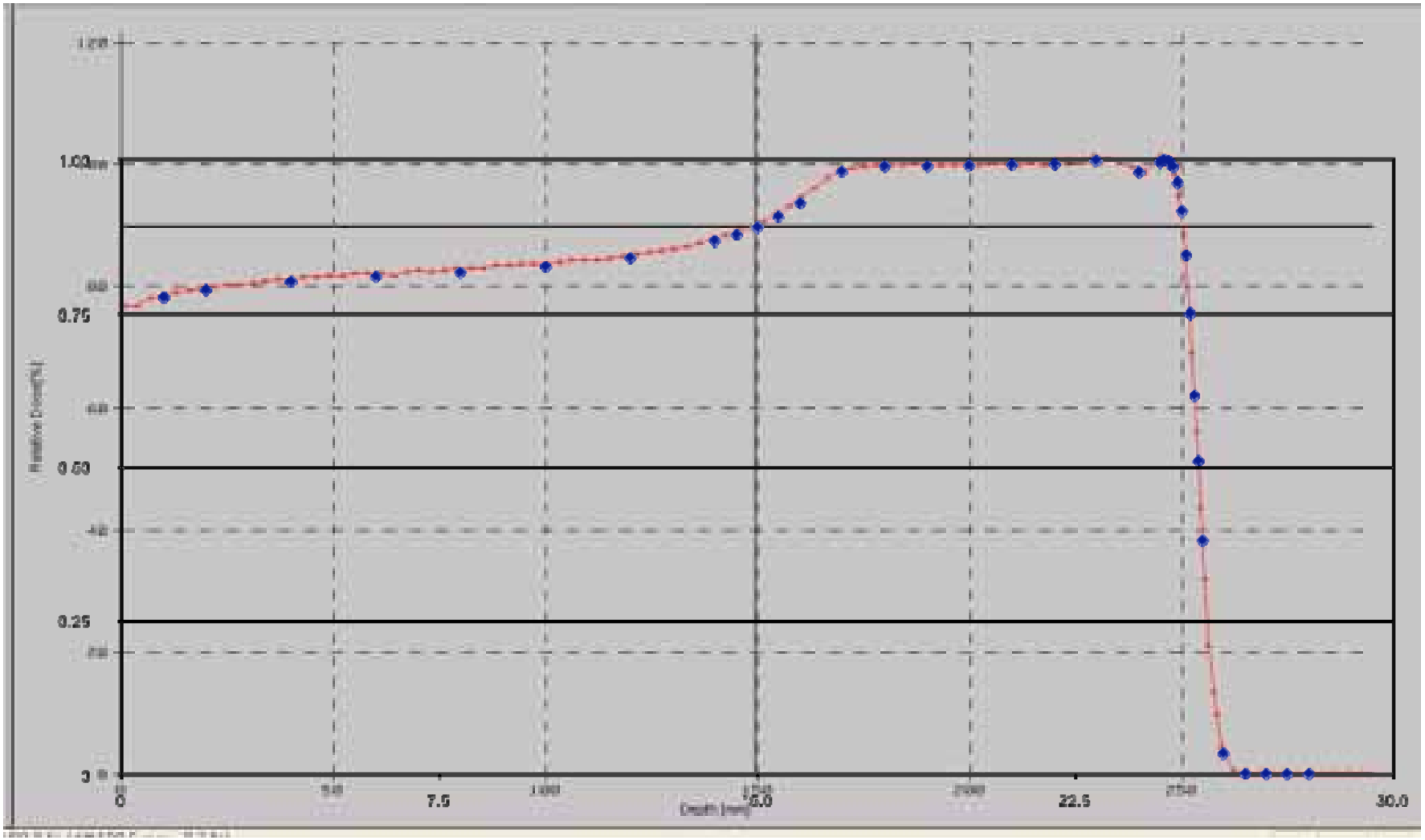


Audits

- Evaluation of OSL for audits of proton beams will begin this summer
- Program of evaluation likely to extend into next grant cycle



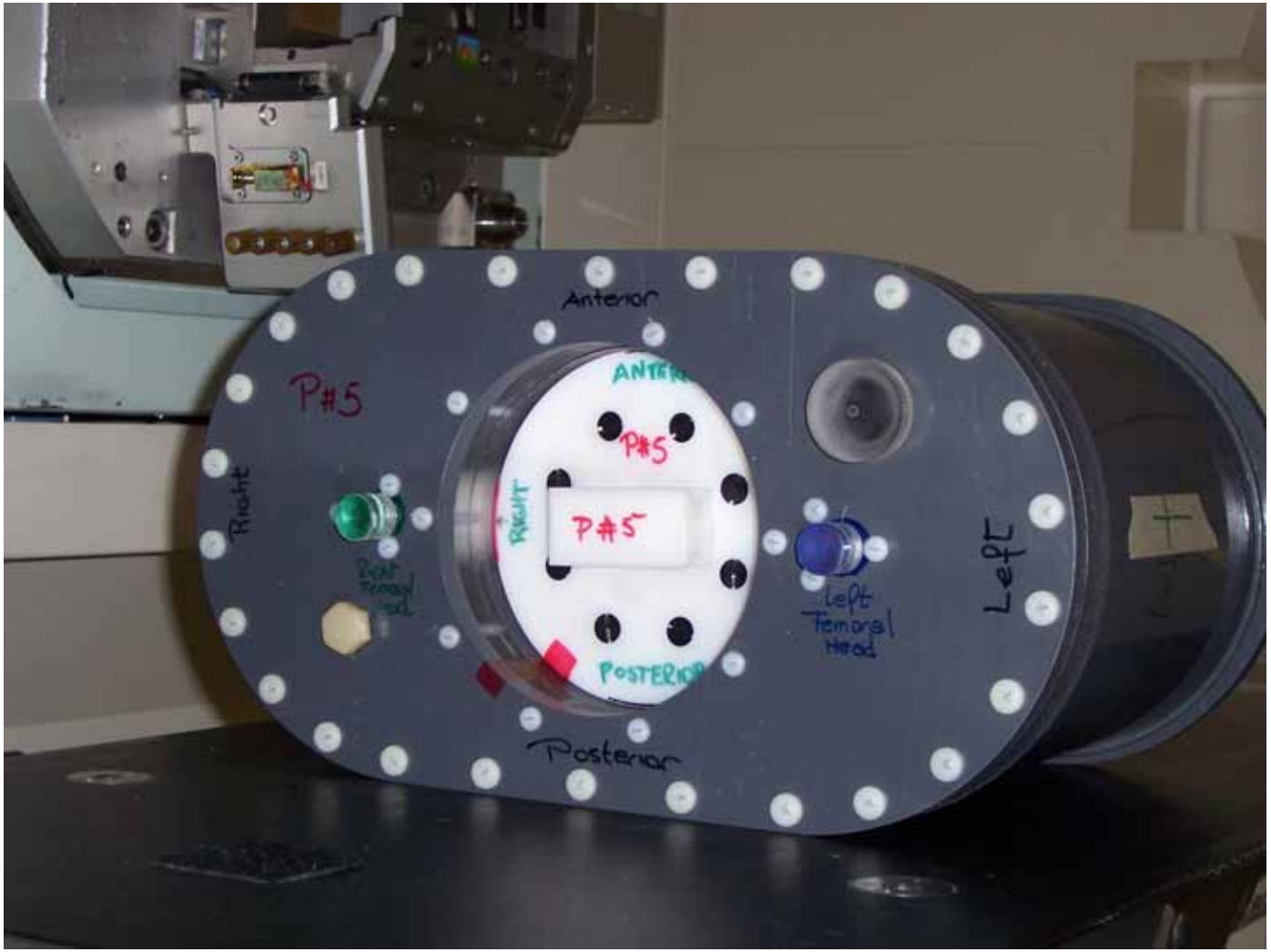
Visits:
Depth Dose Measurements



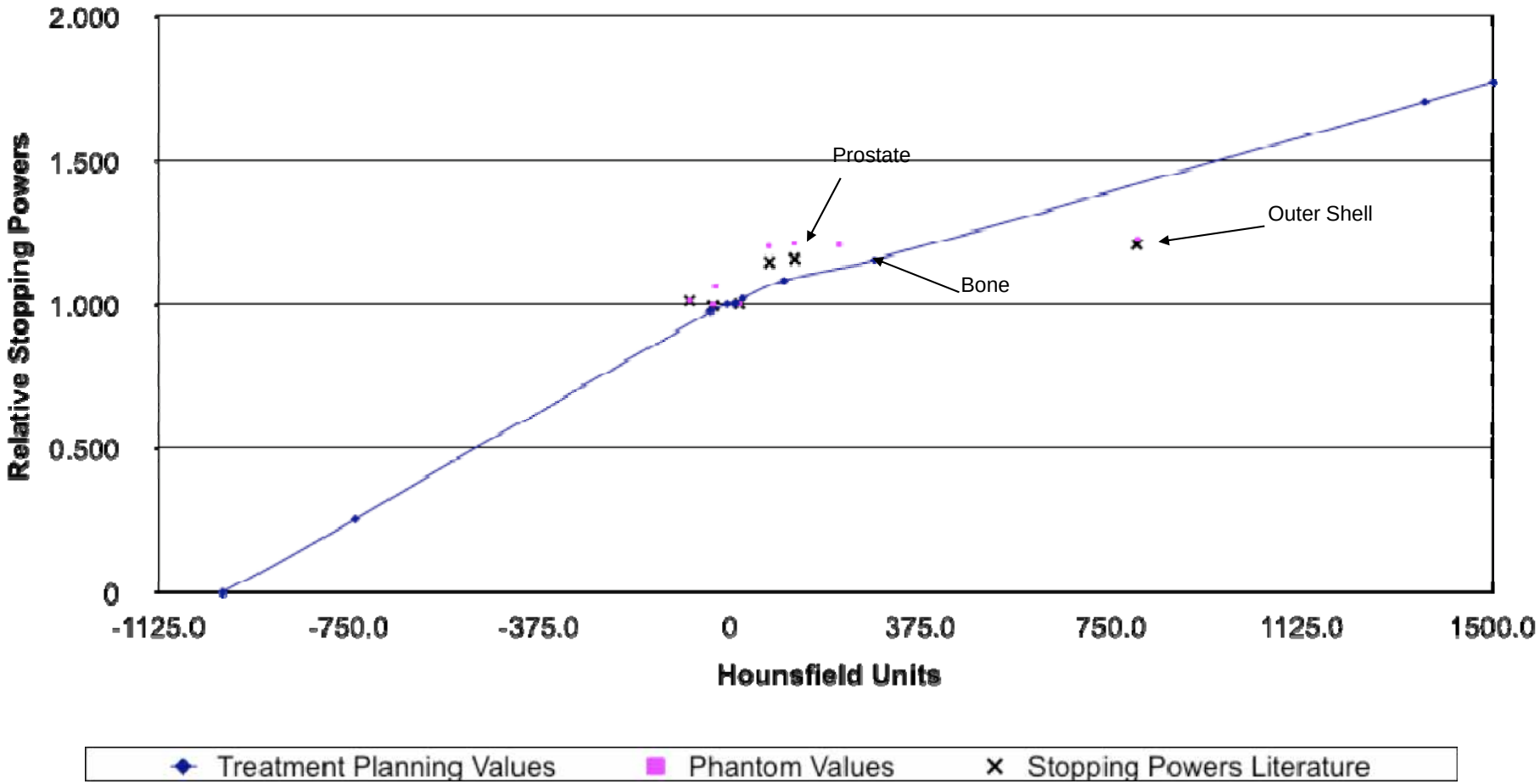
Phantoms

- Pelvis phantom has been developed
  - Evaluation is under way, will be completed this fall
- Lung phantom evaluation will begin this fall
  - Evaluation of materials will be considerably more complex
  - Likely to extend into next grant cycle

Proton Pelvis Phantom

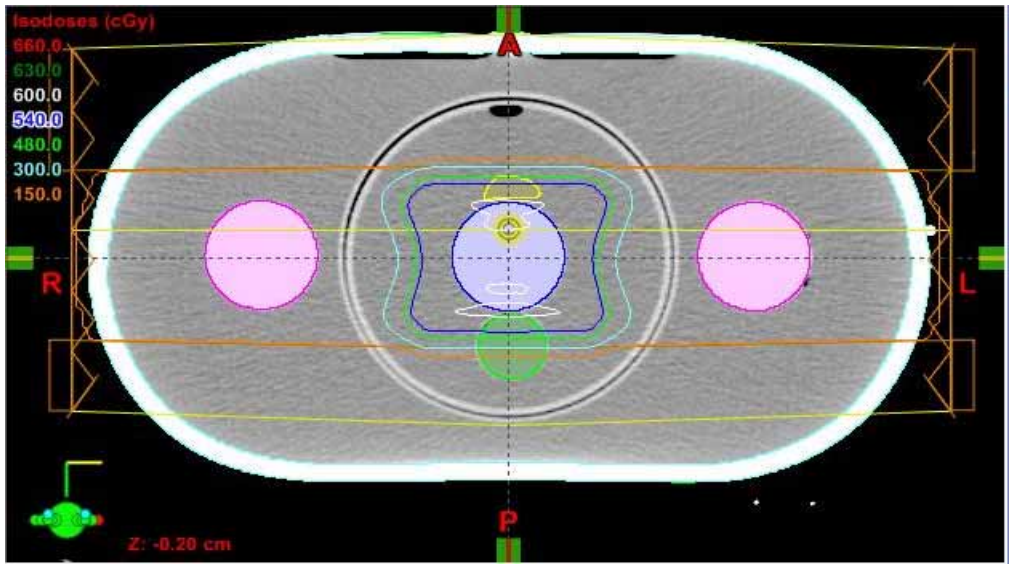


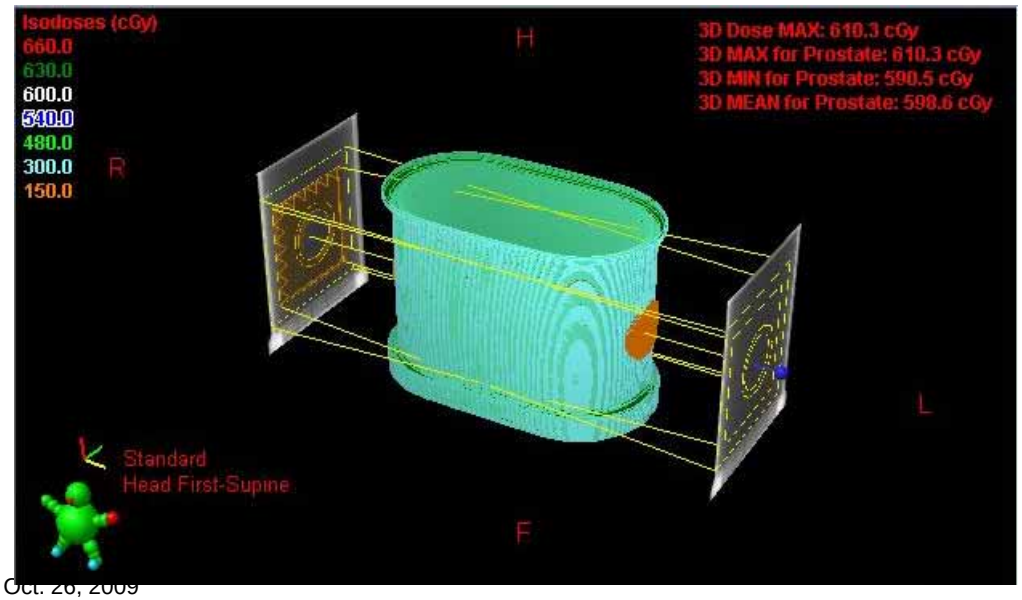
Material Stopping Powers



Phantom Treatment

- Treatment plan created with a prescription of 6 Gy to the prostate
- Plan delivered 3 times with film and TLD inserted in phantom
- Plan accounting for difference in patient and material SP to be delivered in near future





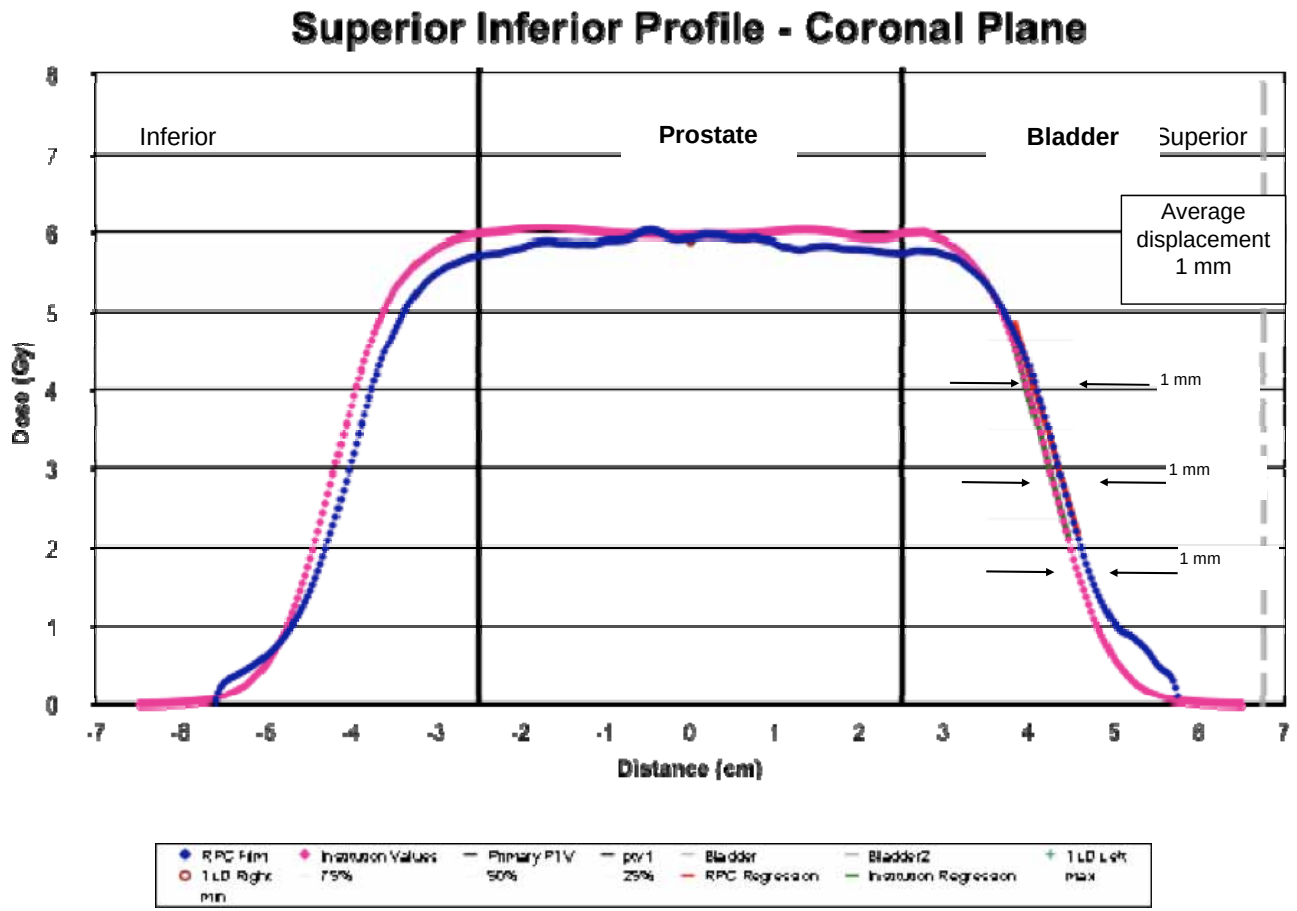
TLD results

	PTV Right	PTV Left	Femur Right	Femur Left
Institution Predicted Dose (cGy)	600.2	600.2	247.3	243.8
TLD Measured Dose (cGy)	589.8	595.1	242.1	240.4
Measured / Predicted Dose	**0.983**	**0.992**	**0.979**	**0.986**

- PTV within 1.7% of predicted value
- Femur within 2.1% of predicted value

Film Results

Feb. 19 2009 Trial 1



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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 156 non North-American institutions
  - Including 60 EORTC members

International Clinical Trials

- RTOG (and several other study groups*) are expanding trials to international participation
- Through agreements with EORTC, RPC will likely make phantoms available to international participants in NCI-sponsored clinical trials
  - Funding source yet to be determined
- Proposal for international workshops in development

- *NCCTG and GOG, among others

International Study Groups

- RPC has developed relationships with several international clinical trials QA offices, leading to reciprocal visits and collaborations:
- TROG – Trans-Tasman Radiation Oncology Group
- EORTC – European Organization for Research and Treatment of Cancer
- Japanese National Cancer Center: Outreach Radiation Oncology and Physics

Irradiation of RPC Phantoms

- Through various arrangements, 18 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


Questions?