



The Radiological Physics Center's Anthropomorphic Quality Assurance Phantom Family: New Developments

David Followill, Ph.D.

Geoffrey Ibbott, Ph.D.

THE UNIVERSITY OF TEXAS
MD ANDERSON
CANCER CENTER

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:

1. assessing the institution's radiotherapy programs,
2. helping the institutions implement remedial actions,
3. assisting the study groups in developing protocols and QA procedures, and
4. informing the community of our findings.

RPC Activities

- Remote Reviews
 - TLD program
 - **Phantom program**
 - **Credentialing**
- Patient Record Dosimetry
- On-site Dosimetry Reviews
- Support of Study Groups
- Research
- Outreach Activities

Purpose of Credentialing

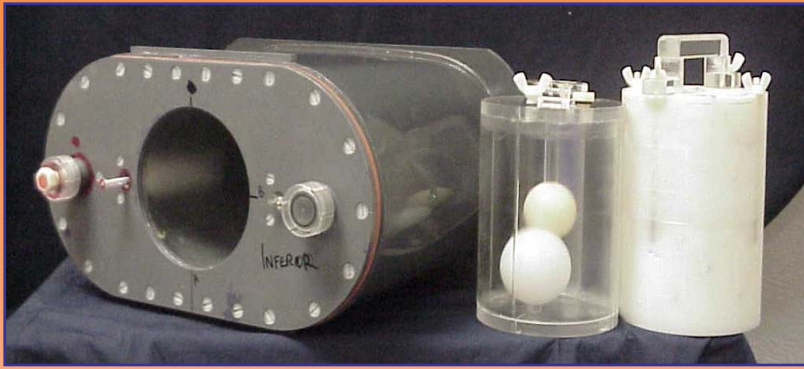
- Education
- Evaluate ability to deliver dose
- Improve understanding of protocol

Reduce deviation rate

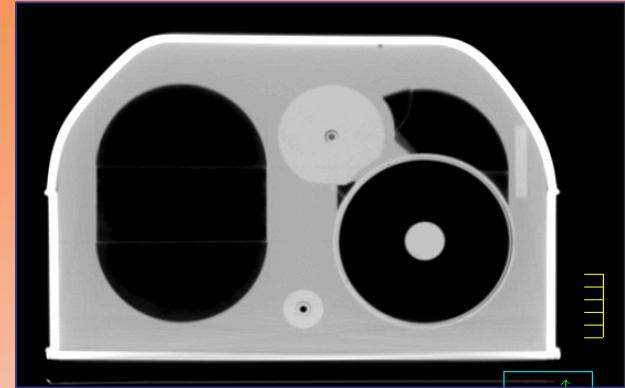
General Credentialing Process

- Previous patients treated with technique
- Facility Questionnaire
- Knowledge Assessment Questionnaire
- **Phantoms** or benchmark case
- Electronic data submission
- RPC QA & dosimetry review
- Clinical review by radiation oncologist

RPC Phantoms



prostate RTOG 0126 (IMRT)



thorax RTOG 0236 (SBRT)



H&N IMRT

RTOG 0022, 0225 0126; COG
ACNS0331, 7 Swiss

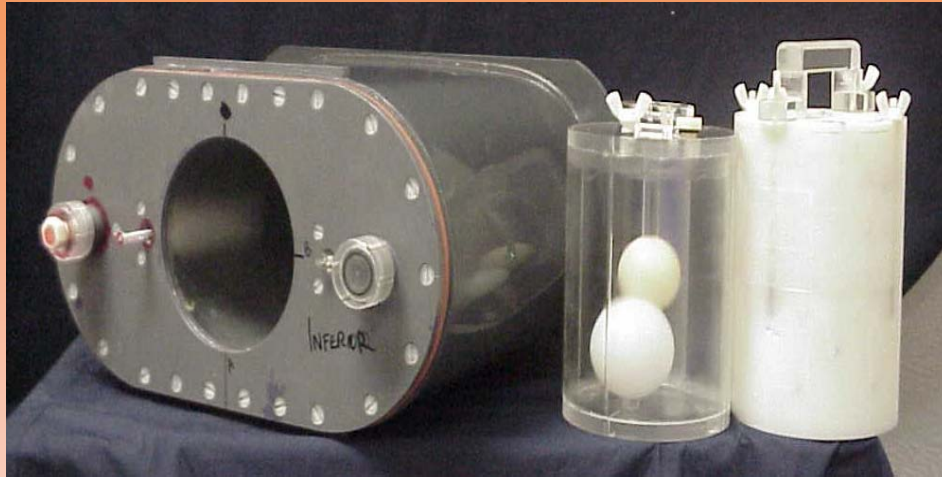


SRS encouraged for
RTOG & ACOSOG

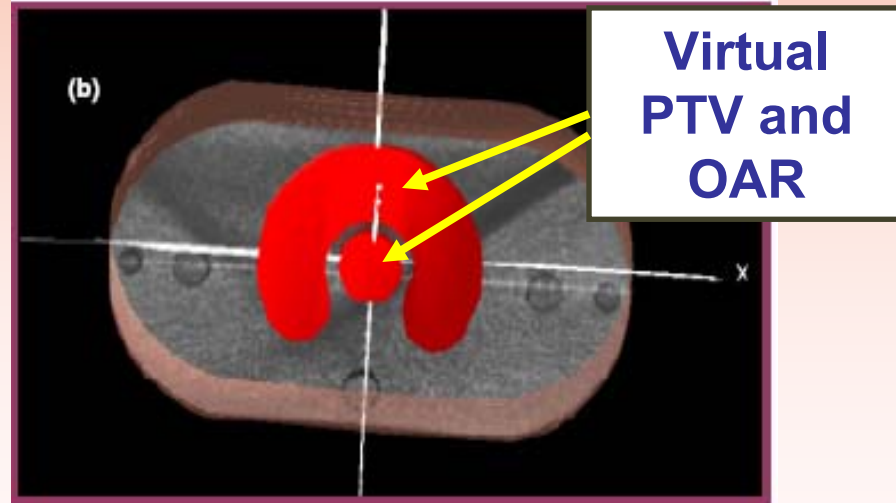
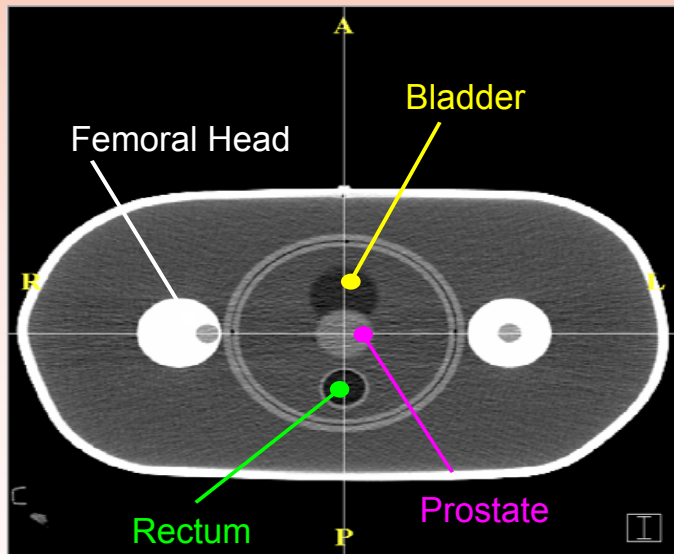
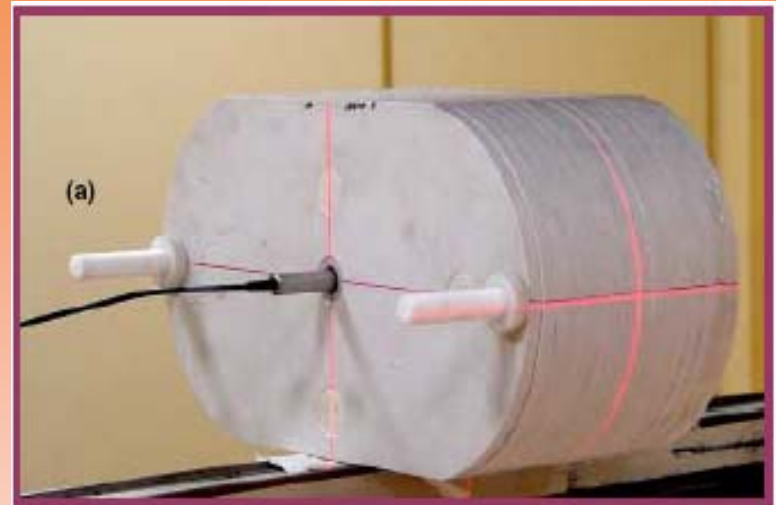
General Phantom Design

- Anthropomorphic in design
- Plastic outer shell
- Required filling with water
- Imageable Targets and Organs at Risk (correct densities)
- TLD and radiochromic film

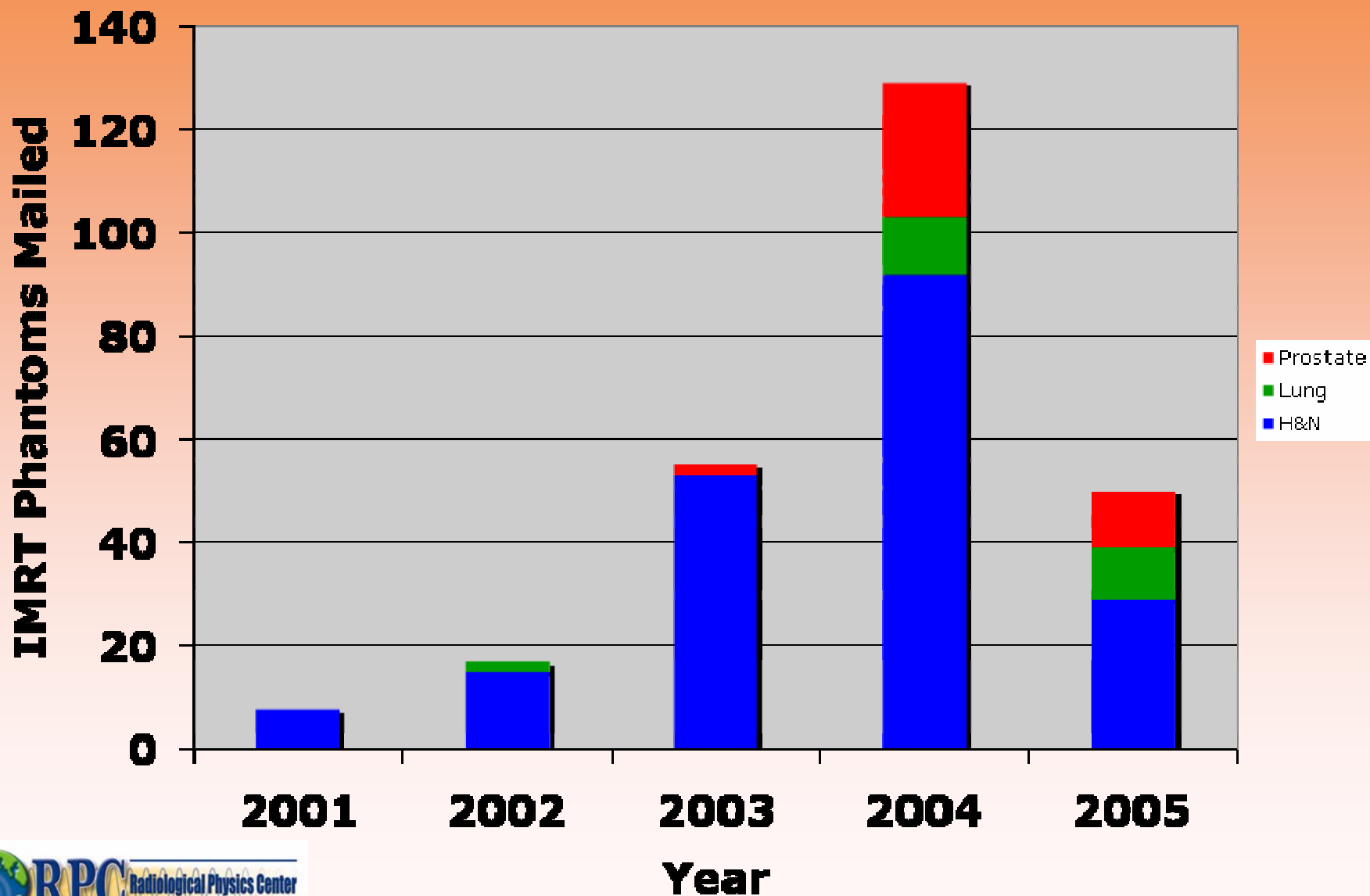
RPC Pelvic Phantom



European IMRT Phantom



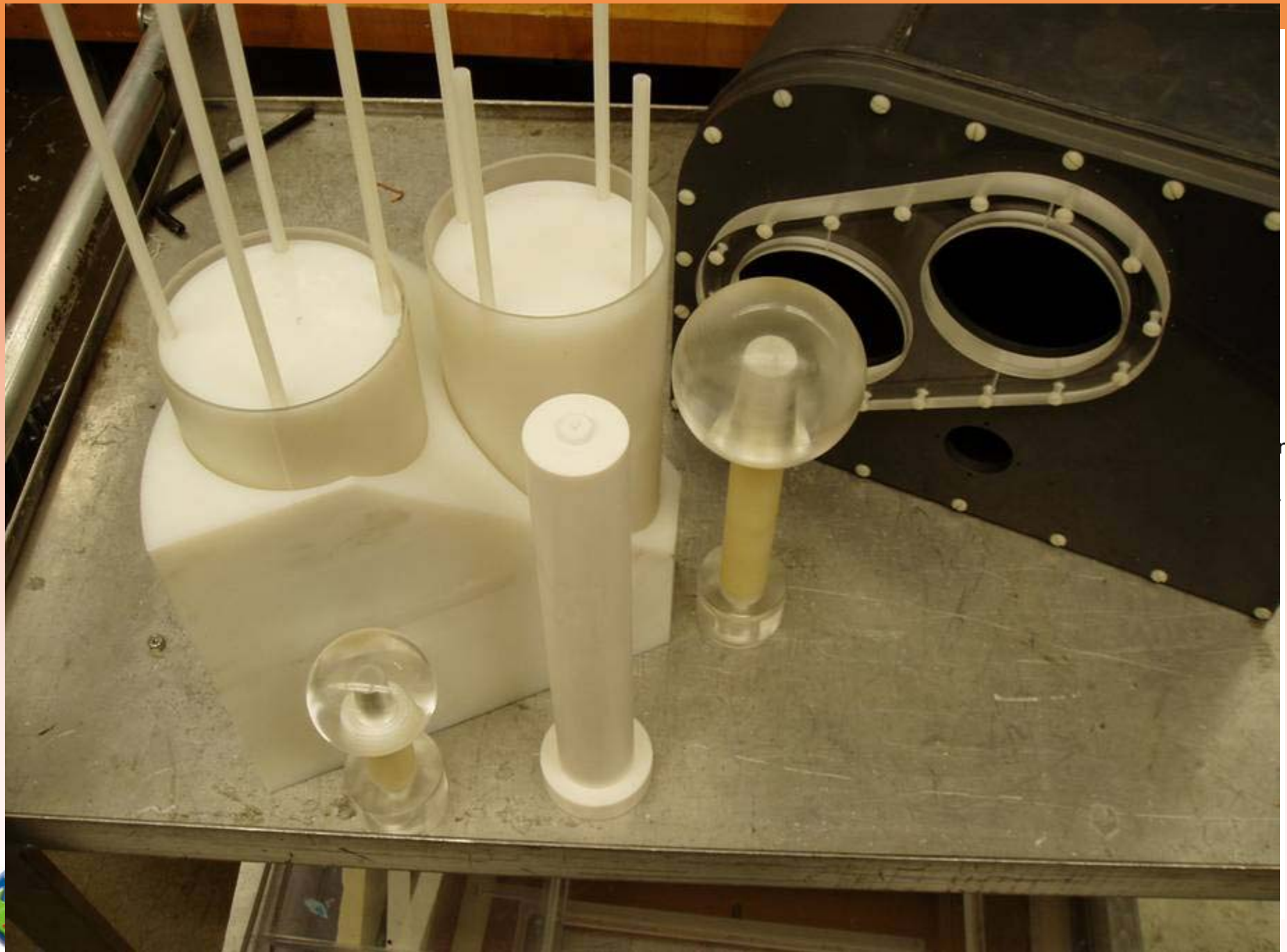
Number of H&N Phantom Mailings



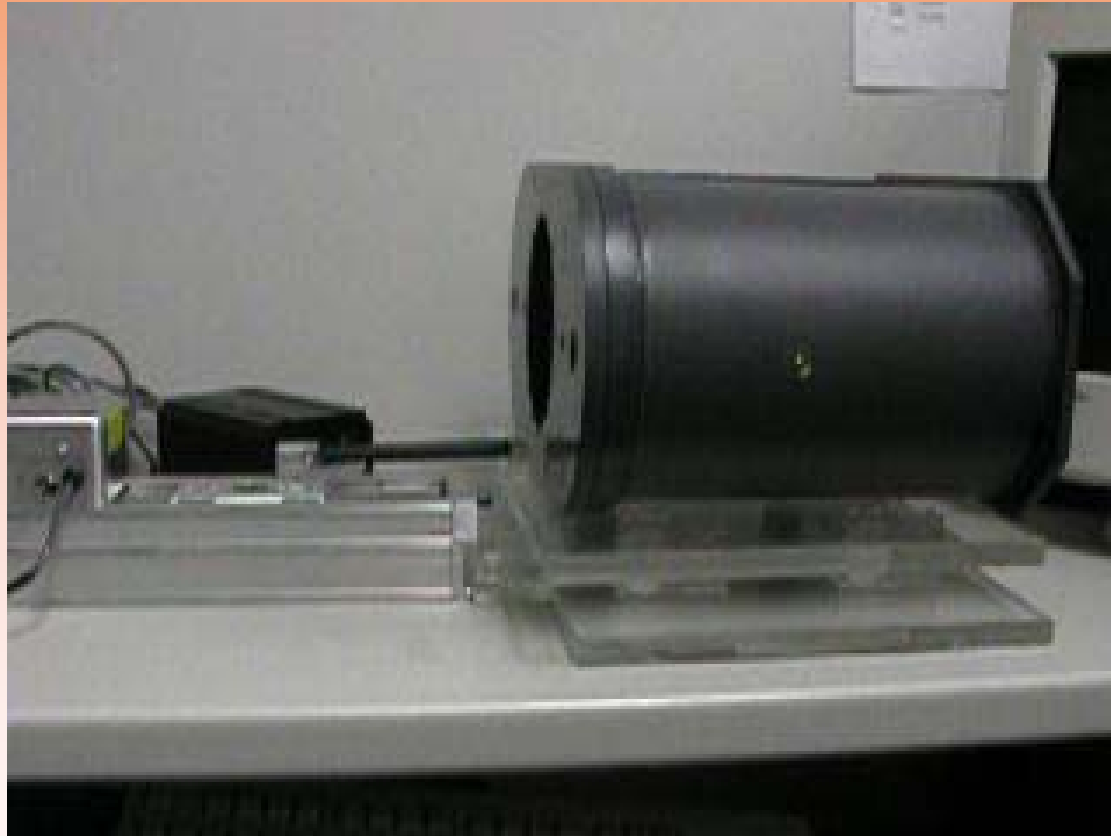
Phantom Development

- Design of “liver” phantom, with simulated respiratory motion, for RTOG 0438
- STTR proposed: Dynamic phantom for gated & adaptive therapy

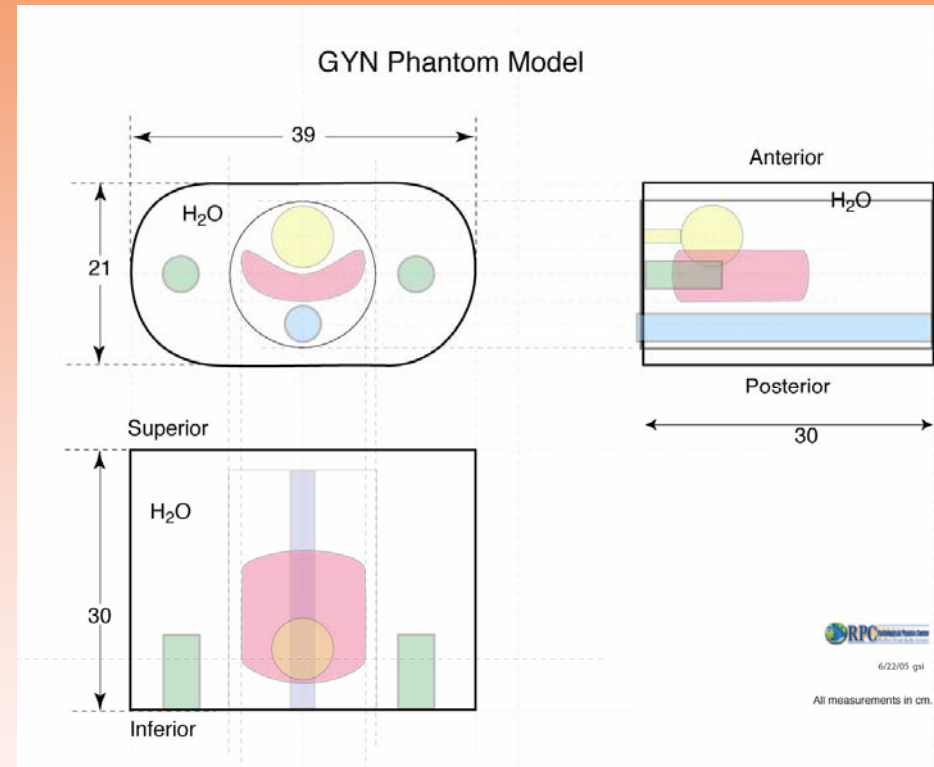
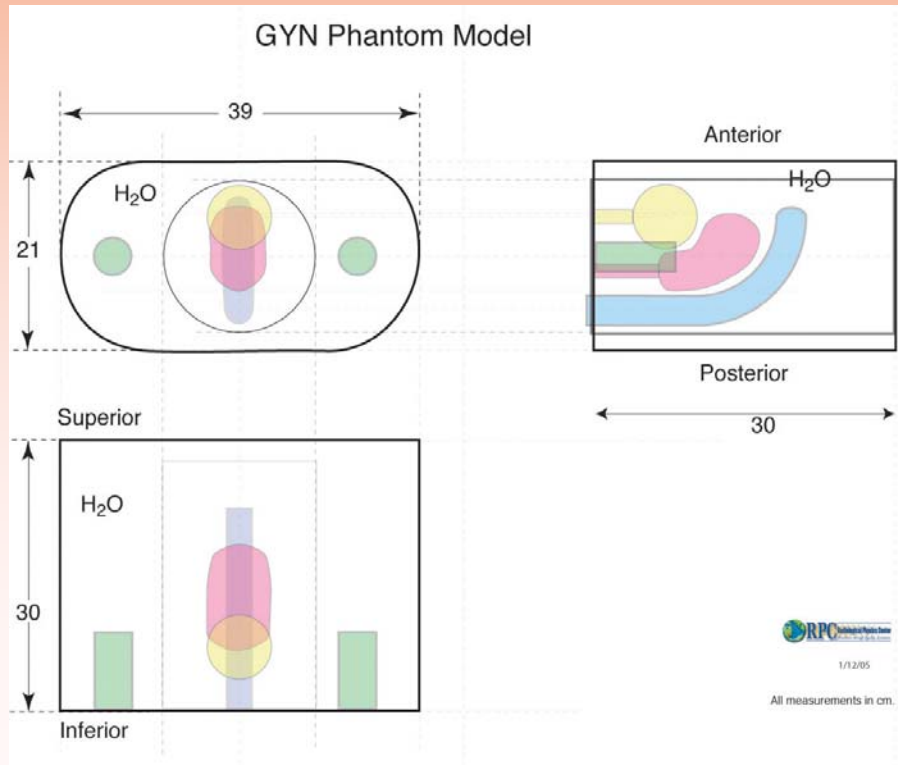




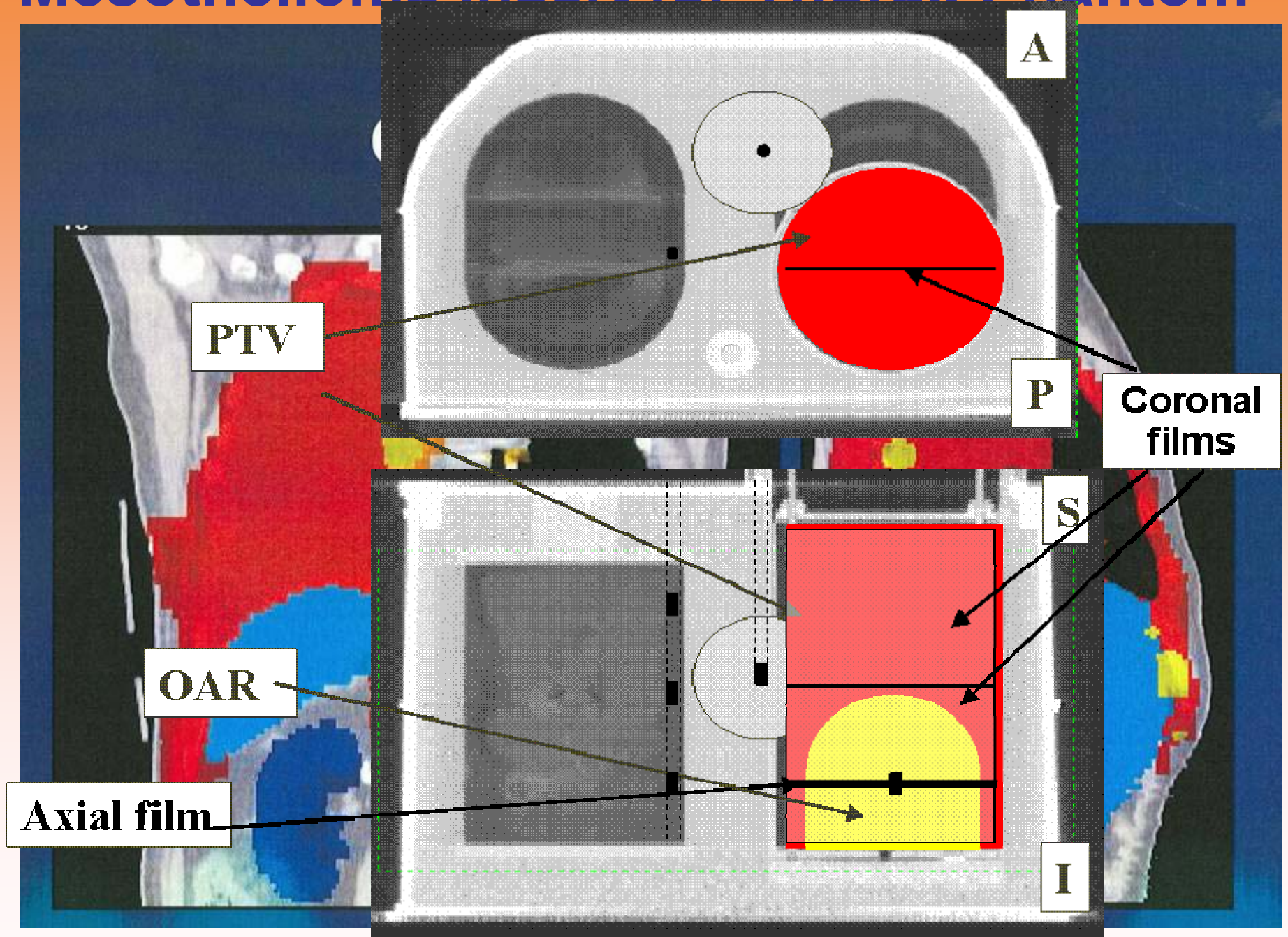
Simulation of Respiratory Motion



Gynecological Insert for Pelvic Phantom



Mesothelioma Insert for Thorax Phantom



Summary

- 1. As the cooperative group needs change, new phantoms are designed for credentialing and QA purposes.**
- 2. Phantom designs are adapting to new treatment techniques and sites.**
- 3. The family of RPC phantoms provide a mechanism to evaluate the entire treatment process from imaging to dose delivery.**

Thank You

Phantom Results

Phantom	H&N	SRS	Prostate	Thorax
Irradiations	152	72	22	11
Pass	102*	40	16	6
Fail	41	32	3	0
Under analysis or at institution	9	0	3	5
Year introduced	2001	1996	Spring 2004	Spring 2004

*** 34% of institutions failed on the first attempt**

Explanations for Failures

- incorrect output factors in TPS
- incorrect PDD in TPS
- inadequacies in beam modeling at leaf ends (Cadman, et al; PMB 2002)
- not adjusting MU to account for dose differences measured with ion chamber
- errors in couch indexing with Peacock system
- setup errors