

AN ABSTRACT OF THE THESIS OF

Lindsey S. Webb for the degree of Master of Science in Radiation Health Physics
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Title: Dosimetric Verification of Respiratory Gated Radiation Therapy for Tumors
Involving the Lung

Abstract approved:

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As the field of radiation therapy evolves new treatment techniques will be established. An example of an evolving treatment technique is respiratory gated radiation therapy (RGRT). Research and studies have shown that RGRT can be used to account for tumor motion as a result of respiratory motion. With evolving technology and advanced treatment techniques comes complexity, as is the case with RGRT.

One step used to prove the validity of RGRT as a treatment technique is dosimetric verification. This study is performed on a Varian Trilogy linear accelerator coupled with Varian's Real-time Position Management[™] (RPM) system. The dosimetric verification is based on the measurements taken using a dynamic respiratory motion phantom with an ionization chamber and MapCHECK[™]. The ionization chamber and MapCHECK[™] measurements are then compared to predicted values of the treatment planning system (TPS) and RadCalc[®] (independent monitor unit calculation).

After the dosimetric verification was completed on a dynamic respiratory motion phantom, the dosimetry of several RGRT patient treatments plans was also evaluated and verified.

The dosimetric verification in the study confirmed our ability to accurately measure the predicted or calculated dose from the TPS, validated the dose calculation algorithm used in the TPS and validated RadCalc[®]. The agreement between measured and predicted central axis point doses fell within the distance to agreement (DTA) acceptance criteria of 3% and 3 mm or 1 cGy. The agreement between measured and predicted planar doses also fell within the DTA acceptance criteria with a minimum of 94% of the points passing with an exception of one beam with 91.2% of the points passing.

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Dosimetric Verification of Respiratory Gated Radiation Therapy for Tumors Involving
the Lung

by
Lindsey S. Webb

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Lindsey S. Webb, Author

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Dosimetric Verification of Respiratory Gated Radiation Therapy for Tumors Involving the Lung

1 Introduction

The purpose of this study was to perform and evaluate dosimetric verification for respiratory gated radiation therapy (RGRT). The study was completed at a facility that treats an average of 70 patients per day. The treatment techniques at the facility include external beam therapy and electronic brachytherapy. More specifically, within the external beam therapy program the treatment techniques include 2-dimensional radiation therapy (2DRT), 3-dimensional conformal radiation therapy (3DCRT) intensity modulated radiation therapy (IMRT), and image guided radiation therapy (IGRT) techniques. The physicians at the facility showed interest broadening their current external beam radiation therapy program to include RGRT due to the many benefits it offers. These include higher target dose, lower healthy tissue dose, higher chances for local control, lower chances for complications, etc. Though dosimetric verification is a very important aspect of the implementation of RGRT, it should be noted that it is only one very important aspect of the implementation of RGRT. The implementation process as a whole is very complex, and each aspect should be evaluated and verified individually for completeness. However, that is beyond the scope of the following study.

In the following study a dynamic respiratory motion phantom was used to simulate a real patient. Several variations of motion were used when acquiring the 4-dimensional computed tomography (4DCT) of the dynamic respiratory motion

phantom. These variations are similar to what a real patient's tumor motion and respiratory cycle would exhibit. Following the 4DCT, IMRT treatment plans were generated for each 4DCT data set, and various verification plans was calculated. The Quasar[™] respiratory motion phantom and MapCHECK[™] were used in the dosimetric verification of the calculated treatment verification plans. Should the dosimetric verifications prove the efficacy of RGRT, the facility will continue with the implementation of RGRT into the current external beam radiation therapy program.

2 Background

2.1 History of Linear Accelerator in External Beam Radiation Therapy

Radiation has been used as a form of therapy for well over 100 years with the help of William Roentgen's discovery of the X-ray in 1895. The first clinical linear accelerator in the Western hemisphere dates back to 1956 and has evolved to become what it is today (1). A Trilogy, a linear accelerator manufactured by Varian Medical Systems, can be seen in Figure 1.



Figure 1 Varian Trilogy.

The linear accelerator through the years has become a very important tool in the field of radiation therapy. Not only has the linear accelerator been used to kill cancer cells, but it has also been used to repress the rejection of an organ transplant,

suppress the immune systems of patients undergoing blood and marrow transplants, correct certain neurological and cardiovascular disorders, relieve pain, etc (2).

2.3 External Beam Radiation Therapy

2.3.1 Volume Definition

The gross tumor volume (GTV) is defined as the known tumor volume either palpable or visible on an imaging study (3). The clinical target volume (CTV), which includes the GTV plus a margin, accounts for microscopic spread. The internal target volume (ITV) includes the CTV plus an internal margin, which accounts for variations of the CTV during the course of treatment. The planning target volume (PTV) is defined as the CTV plus an internal motion margin and a margin for daily setup error. An example of a GTV, CTV, and PTV can be seen in Figure 2.

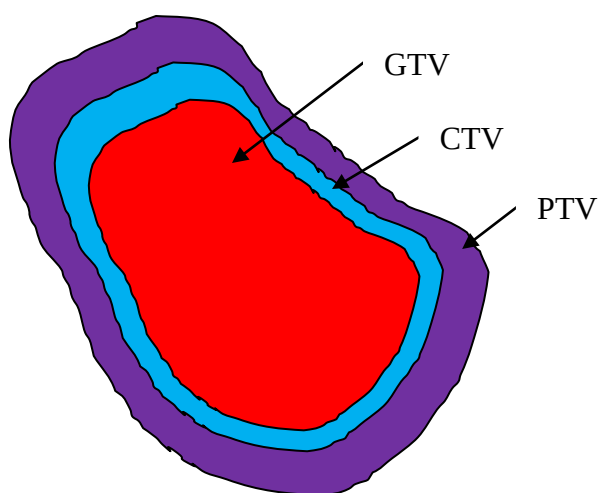


Figure 2 GTV, CTV and PTV.

After defining these volumes, the physician works with the physicist and dosimetrist on designing a treatment plan that maximizes the amount of dose received

by the treatment volume and minimize the amount the dose received by the surrounding healthy tissue and critical structures.

2.3.2 2-Dimensional and 3-Dimensional Conformal Radiation Therapy

A 2-dimensional (2-D) radiation therapy (2DRT) planning approach uses a conventional X-ray simulator to obtain a 2-D image of the area of interest on the patient. The 2-D image is then used to design treatment fields based on standardized beam arrangement techniques and bony landmarks visualized on the 2-D image, which is considered a planar approach (3).

Three-dimensional (3-D) conformal radiation therapy (3DCRT) uses a planning approach that begins with a computed tomography (CT) scan of the patient. The tumor and critical structures will be defined in three dimensions using a treatment planning system (TPS), which is considered a volumetric approach. Tumor definition in 3-D allows for the physician to design a more conformal treatment that is consistent in intensity. A more conformal treatment allows the physician to prescribe a higher dose to the tumor while sparing surrounding healthy tissue. Stevens *et al.* (4) listed the three main goals of 3DCRT to be the following: to define the tumor in three dimensions (to ensure that the entire PTV is within the high-dose region), to shrink the margins where possible (because of better tumor localization and immobilization), and to better quantify the radiation dose to normal tissue.

A multileaf collimator (MLC) can be used in place of standard blocking. A MLC consists of 20 to 60 pairs of tungsten leaves that have a typical width of 10 mm or less (5). Unlike standard blocks, the MLC is inside the head of the treatment unit.

The leaves of the MLC are controlled by individual motors and therefore, can act independent of each other. The MLC shape can be achieved by the aid of either a program called Shaper or with the TPS. A Varian 120 leaf MLC with the leaves extended can be seen in Figure 3.



Figure 3 Varian 120 leaf MLC with leaves extended.

Shaper[™] is computer software that allows for a dosimetrist, physicist, or physician to develop contours using the software. The contours can then be converted to a MLC shape. An MLC file is created and is used for treatment. The TPS works similarly to Shaper[™], but instead the planning software uses a CT dataset to aid in the contouring of the treatment volume.

2.3.3 Intensity Modulated Radiation Therapy

Intensity modulated radiation therapy (IMRT) takes 3-D conformal radiation therapy to the next level. IMRT, with the help of the MLC and very robust computer software, modulates the intensity of the beam across the 3-D target volume. In other words, the intensity is no longer consistent across the treatment field. This means that certain parts of the treatment area can receive higher doses of radiation while surrounding healthy tissue and critical structures are spared.

IMRT requires inverse treatment planning (ITP). Inverse treatment planning uses an optimization algorithm inside the TPS to design a treatment plan. Treatment volumes and critical structures are contoured by the dosimetrist and physician. Objectives are then set for the volumes and structures. The objectives consist of minimum and maximum doses for the treatments volumes and maximum doses for the critical structures. The TPS then uses the optimization algorithm to optimize a treatment plan to the specific objectives that were initially defined.

With IMRT the probability of tumor control is increased and treatment morbidity is decreased (5). Along with all of the benefits, IMRT brings along complexity. These complexities include the following: equipment used for dose delivery, the treatment planning process, and the issues of quality assurance (QA) of the dose distribution calculation and dose delivery (5). The MLC must be commissioned before initial use and should be tested on a routine basis to monitor any mechanical issues that might arise. IMRT QA is standard practice and is discussed in AAPM (American Association of Physicists in Medicine) report number 46 (6).

IMRT QA should be completed to verify the dose distribution that was calculated by the algorithm inside the TPS as well as verify the dose delivery of the treatment machine. The IMRT QA process will be discussed in detail later in this report.

2.3.4 Image Guided Radiation Therapy

Along with developments in target localization, the effectiveness of treatment delivery has been improved with the modern introduction of IMRT (5). The precision of dose delivery with IMRT has been limited by uncertainty in target localization at the time of treatment (5). Interfraction target movement (movement between treatment fractions) as well as intrafraction target movement (movement during a fraction of treatment) relative to reference landmarks joined with set-up errors and other inaccuracies add to this uncertainty (5).

Imaged guided radiation therapy (IGRT) is a type of therapy that uses image guidance before, during, and after treatment delivery. Image guidance simply means that the treatment will be guided according to different imaging techniques that will verify the regions of interest (normal tissues, critical structures, and treatment targets) on a daily basis. Various imaging techniques are used for image guidance. Some common techniques include an on-board kV imager capable of radiographic imaging and fluoroscopy, MV electronic portal imaging device (EPID), and ultrasound.

Imaged guided radiation therapy increases confidence in target localization, and therefore, the treatment volume expansions become smaller. As the treatment volume expansions become smaller, the normal or healthy tissue irradiated also becomes smaller. This is very attractive to physicians as the healthy tissue is spared.

2.4 Problems with Respiratory Motion during Radiation Therapy

Problems with motion during radiation therapy arise when the tumor volume and position are influenced by the breathing motion of the patient. Respiration during treatment delivery can lead to dosimetric errors of up to 4%, volumetric errors in dose volume histograms (DVH) of up to 46%, and positional errors that can lead to geometric misses of the target volume (7). A DVH is a graphical representation of the amount of dose that each contoured volume is receiving and can be used in the evaluation of a treatment plan. Specifically, the DVH is a tool used to evaluate the dose delivered to the target volumes and critical structures. The x-axis is labeled as dose in cGy, and the y-axis is labeled as either percent volume or absolute volume.

Common sites that are influenced by the breathing motion of the patient include lung, liver, pancreas, esophagus, breast, kidney, and prostate (8). The focus of this study is respiratory gated radiation therapy to tumor sites involving the lung, as this is the site where tumor volumes are most influenced by respiratory motion. Aside from the influence of respiratory motion, the lung is very sensitive to radiation, and therefore, it is very important to minimize irradiating healthy tissue when possible to reduce toxicity and unwanted side effects to healthy tissue.

Stephens *et al.* (4) found that out of 22 lung tumor patients, the mean tumor motion was 4.5 mm plus or minus 5.0 mm (overall range 0-22 mm). Stephens *et al.* (4) also found that out of the 22 patients 10 subjects showed no tumor motion in the superior inferior (SI) direction, and of the remaining 12 patients, the average SI displacement varied from 3 to 22 mm. Ultimately, Stephens *et al.* (4) concluded that

tumor size, tumor location and pulmonary function tests cannot predict superior and inferior motion. Similarly, Gierga *et al.* (9) stated that the magnitude of respiratory-induced target motion can be as large as 2 to 3 cm, peak-to-peak. Murphy *et al.* (10) observed maximum tumor displacements of 2 mm, 4 mm, 6 mm and 15 mm during free breathing in their fluoroscopic studies of four lung patients and stated the main motion or displacement occurs in the superior and inferior directions.

Tumor motion during treatment, if unaccounted for, can cause under-dosing to the target volume. As a patient breathes, as mentioned above, tumor displacement is likely to occur. The TPS does not account for tumor motion, but instead the treatment target is seen as a static volume. The simplest way to account for the motion of lung tumors is to create a PTV with margins large enough so that if the tumor is in motion it will be completely encompassed by the PTV. Though this is the simplest method to account for tumor motion, it is not a good method in terms of sparing surrounding healthy tissue. The additional PTV margin defined will overlap the surrounding healthy tissue, and as mentioned before, the lung is very radiosensitive.

2.5 Techniques to Account for Respiratory Motion during Radiation Therapy

Several techniques, which are discussed below, have been used to account for respiratory motion during radiation therapy. Each of the techniques has advantages and disadvantages. When reviewing the techniques it should be noticed that some methods try to control tumor motion while other methods try to track tumor motion.

2.5.1 Breath-hold Techniques

Breath-hold techniques, which try to control tumor motion, involve instructing the patient when to inhale and exhale. Breath-hold treatment techniques are beneficial in some clinical applications, where dose-limiting organs can be moved away from the treatment volume (11). One breath-hold technique is deep inspiration breath hold (DIBH) and requires the patient to voluntarily hold his or her breath during treatment. This type of therapy is often times unrealistic for patients. Frequently, the patients have decreased pulmonary function due to their disease. This decreased pulmonary function will limit the patient's ability to hold their breath for an extended period of time. Another breath-hold technique is active breathing control (ABC). This technique uses an air-flow measuring/controlling device to determine when patients exhale to approximately 60% of their vital capacity and then blocks further air flow for about 20 s (4). The ABC technique is also often unrealistic due to decreased pulmonary function.

2.5.2 Forced Shallow Breathing with Abdominal Compression

Forced shallow breathing (FSB) uses a plate for abdominal compression. The abdomen of the patient is compressed, which restricts the movement of the diaphragm, and therefore, the amplitude of the respiratory cycle is restricted as well. Consequently, FSB with abdominal compression can reduce lung tumor motion in some patients.

2.5.3 Respiratory Gating

This method, which is the focus of this study, is discussed in detail in section 2.6.

2.5.4 Real-time Tumor Tracking

Real-time tumor tracking is a technique in which the radiation beam adapts or moves with the tumor. No longer is the motion of the tumor trying to be controlled. This technique is ideal for patients and therapists as the duty cycle (the time that the radiation beam is turned on with respect to the total treatment time) is 100% due to the radiation beam adapting to the tumor motion.

Currently under development or used clinically, real-time tumor tracking is achieved by one of the following ways: imaging of the tumor itself via fluoroscopy; imaging of fiducial markers implanted in the tumor, inference of the tumor position from surrogate breathing motion signals, and non-radiographic tracking of an active or passive signaling device implanted in the tumor (12).

2.6 Respiratory Gated Radiation Therapy

IGRT can be taken a step farther in terms of accuracy and the ability to spare healthy tissue with the help of respiratory gated radiation therapy (RGRT), the main focus of this study. During radiation therapy treatments respiratory motion can be of great concern and importance as described above. A way to minimize the effects of motion during radiation therapy would be to find an approach to monitor tumor motion during a treatment and only turn the beam on when the tumor is in a specific

location. Consequently, the amount of healthy tissue irradiated would be decreased. Bulter *et al.* (13) found that a reduction in the mass of normal tissue irradiated when treatment portals based on the respiratory gated PTV were used.

The purpose of RGRT is to achieve the same target position during and between fields through a single treatment fraction and between treatment fractions (11). The following requirements must be met in order for the successful implementation of RGRT: the respiratory cycle must be periodic and maintained during treatment, the movement of the target must be related to the respiratory cycle, and the gating window (the window of the time in which the radiation beam is turned on) can be set sufficiently large to minimize the overall treatment time or increase the duty cycle and yet small enough to be within the gate (14).

During RGRT the treatment machine is “gated” according to the location of the tumor. This means that the radiation beam is turned on when the treatment target is in the location for which the treatment was planned. The radiation beam is turned off when the treatment target moves out of the location for which the treatment was planned. For most RGRT methods the treatment target itself is not monitored, but instead the respiratory cycle is monitored. This is why, as mentioned above, the movement of the target must be related to the respiratory cycle. Without this relationship RGRT would not be an ideal treatment technique.

The respiratory cycle of a patient can be monitored using different tracking techniques. These tracking techniques use either an internal or external marker, sometimes referred to as a surrogate, during treatment delivery. Internal markers, such

as implanted fiducial markers, can be surgically inserted. The implanted fiducial markers are used as internal motion surrogates and are composed of 2 mm diameter gold spheres (12).

However, the majority of the systems in the United States and the developing world are based on external respiratory motion markers, such as markers placed on the surface of the patient's chest or abdomen (11). This is the method of tracking used for RGRT at the current facility. The external marker indicates the internal position of the target volume. This is based on the assumption that the tumor moves consistently during the respiratory cycle. This assumption is further verified by imaging the patient before, during, and after treatment to monitor the tumor position with respect to the respiratory cycle.

When using external surrogates, two different forms of gating can be used: phased gating and amplitude gating. When using the external marker's position as the surrogate signal, it is called amplitude gating (15). The amplitude of the external marker is used to monitor the respiratory cycle. When using breathing phase derived from the surface marker motion as the surrogate signal, it is called phase gating (15). With phase gating the respiratory cycle is described by angles in degrees instead of amplitude. The gating window, defined by the user, converts the surrogate signal to one when the surrogate falls within the window and zero otherwise. The gating window converts the surrogate into a gating signal which ultimately controls the linear accelerator (15).

An example of a system that uses an external surrogate is the Varian Medical System's Real-time Position ManagementTM (RPM) system, which consists of the following: a block marker with two reflective fiducials, an infrared (IR) light source, a charge coupled device (CCD) tracking camera, a viewfinder used to visualize the relative position of the block, and a workstation that displays and records the motion data (16). The CCD tracking camera and view finder can be seen below in Figure 4.



Figure 4 CCD tracking camera, IR source and viewfinder used in real time.

The RPMTM system measures abdominal displacement relative to a baseline at the end of exhalation using the external surrogate and tracking camera (11). The tracking camera uses the two reflective fiducials on the block marker to track abdominal motion in the anterior and posterior direction, which is assumed correspond to the tumor motion. The respiratory cycle has to be consistent and reproducible for the RPMTM system to be effective.

The new technology of RGRT creates unique challenges in a clinical setting to ensure the patient treatment is delivered as planned. Jiang *et al.* (17) listed five QA steps that should be taken to ensure an accurate externally gated treatment:

1. During treatment simulation, the reference home position should be accurately measured, using techniques such as 4DCT (a 3DCT scan taken with respect to respiratory cycle).
2. During treatment planning, the patient and tumor geometry corresponding to the gating window should be used.
3. During patient setup, the tumor home position at this fraction should be matched to the reference home position.
4. During the treatment delivery, measures should be taken to maintain a constant tumor home position, i.e., the tumor should always be at the same position when the beam is turned on.
5. During the treatment delivery, tumor positions corresponding to the gating window should be measured and compared with the reference tumor home position, either on- or offline.

2.6.1 Patient Immobilization for Respiratory Gated Radiation Therapy

Patient immobilization is a very important aspect of RGRT. It is important that the patient's position during the CT scan be reproduced for each fraction of treatment. To increase patient position reproducibility, various immobilization devices can be used during the initial setup of the patient on the table of the CT. Common devices used during RGRT include wing boards in combination with

vacuum bags, alpha cradles, etc. A wing board provides support for a patient's arms while they are raised above their head. It is ideal for a patient's arms to be out of the treatment fields. A vacuum bag is a bean bag type device on which the patient lays. A vacuum is then used to withdraw the air from the bag which results in a very rigid bag that has conformed to the patient's body. This vacuum bag is then used to reproduce the patient's position that was achieved during the CT scan. An alpha cradle is similar in that it conforms to the patient's body as well. The alpha cradle becomes rigid and provides another option for patient immobilization.

2.6.2 Data Acquisition for Respiratory Gated Radiation Therapy

To begin the treatment planning process using RGRT a 4DCT data set must be acquired. The 4th dimension, which is what is needed for RGRT, is time. In other words, a 4DCT scan is taken with respect to the respiratory cycle. A 4DCT reduces the number of artifacts induced by breathing motion by accounting for the respiratory motion of the patient. This is demonstrated in Figure 5.

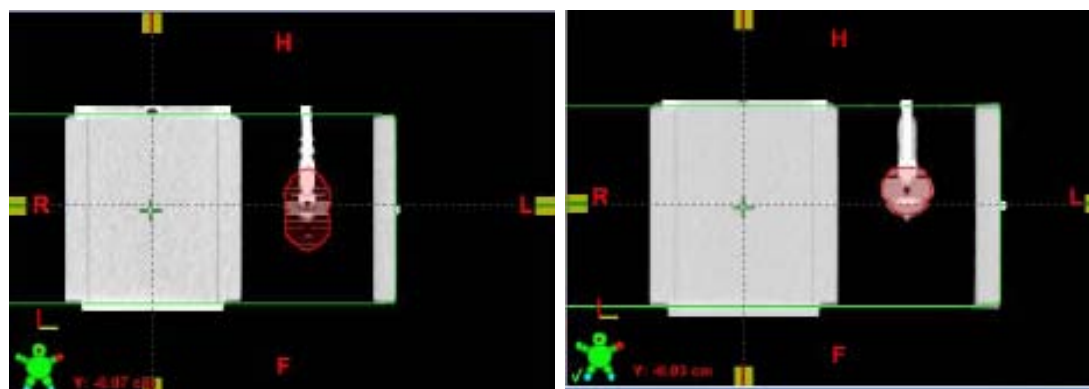


Figure 5 (Left) A free breathing CT scan of respiratory motion phantom and (Right) a 4DCT scan using the Varian RPM system.

The 4DCT data can be one of two types, prospective or retrospective. In prospective scanning the 4DCT scanner collects image data at only one phase of the respiratory cycle, which creates one image data set. The phase in which the image data is collected is the phase in which the target volume will be contoured. In retrospective scanning the 4DCT scanner will collect image data during the whole respiratory cycle. The image data can then be reconstructed according to the phase of the respiratory cycle, creating multiple data sets.

During data acquisition the patient's respiratory cycle should be evaluated by the physician. The physician must determine if the patient is a good candidate for RGRT. The respiratory cycle should be periodic and maintainable as the largest source of error for 4DCT is irregular patient respiration, which causes artifacts in image reconstruction and re-binning (11). Keall *et al.* (18) summarized three clinical decisions that need to be made during the patient selection process:

1. Is there sufficient motion to warrant respiratory gating? A 5 mm threshold is used which is based on the Task Group 76 report (12).
2. Can clinical goals be fully achieved without respiratory gating?
3. Is the respiratory pattern sufficiently reproducible to make the use of gating worthwhile?

2.6.3 Treatment Planning for RGRT

Once the 4DCT scan has been completed and the physician has prescribed RGRT, the image set is transferred to the TPS, and the planning process can begin. The end-expiration image set is typically used for treatment planning purposes

because this image set represents the phase of the respiratory cycle where the anatomical movement is often the least for the longest time (14). The physician will contour the GTV and CTV and define a margin for the PTV, which is typically on the order of 2 to 8 mm. This accounts for setup error and residual tumor motion, which were not accounted for during the 4DCT.

Prior to a RGRT patient's first treatment, a pre-treatment 4DCT can be completed to verify that the relationship between the patient's respiratory cycle and tumor position is consistent with the relationship seen in the pre-planning 4DCT. A fusion of the two 4DCT data sets can be analyzed by the dosimetrist, physicist, and physician. If the relationship is found to be the same between the two data sets the patient should begin RGRT.

2.6.4 Implementation of Respiratory Gated Radiation Therapy using External Markers

The implementation of RGRT using external markers as a surrogate for tumor position is a very important process to ensure accurate patient delivery. It is recommended by Task Group 76 (12) that dynamic phantoms that simulate respiration are used, in order to test in vivo dosimetry and target localization. Task Group 76 (12) also lists in their report several important factors to acknowledge during implementation of RGRT which include the following:

1. The phantom should produce cyclical motion similar to human respiration.
2. The gating feedback mechanism must detect phantom motion in a manner similar to the clinical process.

3. The device should allow attachment of dose measuring detectors.
4. The phantom should be reliable and have a reasonable cost.

The QuasarTM (Quality Assurance System for Advanced Radiotherapy) programmable respiratory motion phantom, as seen in Figure 6, is used in the dosimetric verification this study. The assembly consists of a programmable drive unit, chest wall platform, and a body shaped phantom with cylindrical inserts, which include the following: an acrylic insert with chamber cutout, cedar insert with a solid tumor volume and chamber cutout, and cedar insert with chamber cutout. The cedar inserts are equivalent in density compared to the lung at inhalation (0.33 g/cm^3) (19). The inserts are capable of moving in the superior and inferior directions with varying amplitudes and speeds. A moving platform that is designed to mimic the chest wall motion holds a tracking device or external marker and is synchronized with the cylinder motion.

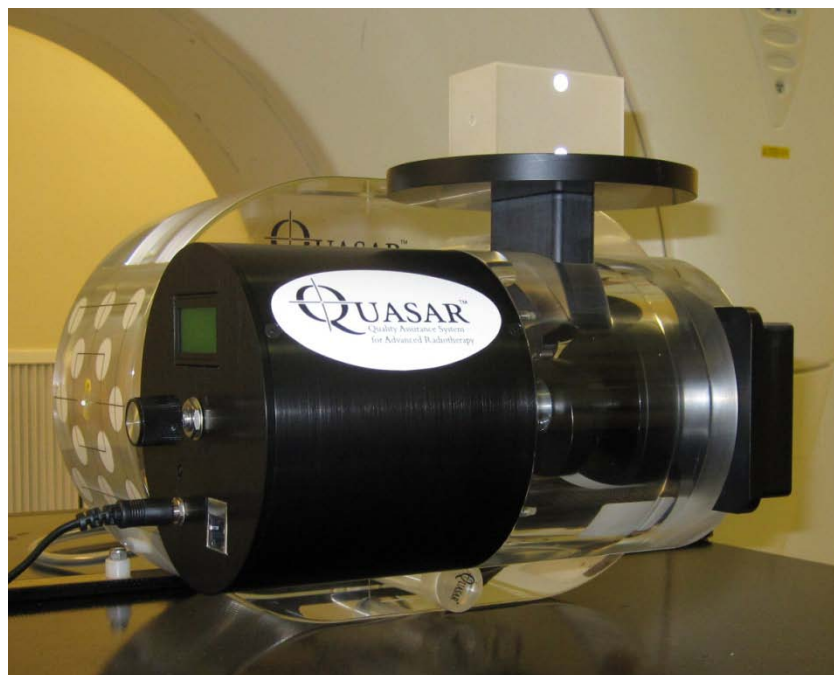


Figure 6 Quasar™ respiratory motion phantom.

Paired with Varian's RPM™ system the Quasar™ respiratory motion phantom is used in the following study of dosimetric verification of RGRT.

2.7 IMRT Quality Assurance Measurements

The IMRT QA process is relatively straight forward. The treatment fields, which are calculated based upon patient CT data, is transferred to a phantom. The phantom is commonly a 30 cm x 30 cm x 30 cm cube of solid water. The solid water is homogenous and takes out any uncertainties due to heterogeneities in the patient. Once the treatment fields have been transferred to the QA phantom, they are calculated at a specific at user defined source to surface distance (SSD). The same SSD should be used when measuring the treatment fields with the QA device on the linear accelerator. It should be noted that the treatment plan is not re-optimized once

it is transferred to the QA phantom but instead only re-calculated. Re-optimization of the treatment plan would indeed create a new treatment plan. The objective is not to create a new treatment plan but to test the treatment plan that was calculated based off of the patient CT data.

After the treatment fields have been re-calculated based upon the QA phantom, they are delivered and measured on the treatment machine, in this case the linear accelerator. The treatment fields can be measured using various devices. For instance, an ionization chamber and electrometer, film, electronic portal imaging dosimetry, or MapCHECK (a Sun Nuclear device) are all common ways measuring IMRT QA. An overview of each of these methods can be found below. After the IMRT QA measurements have been completed they are compared to the calculated values of the TPS, which are either point doses or planar doses.

2.7.1 Ionization Chamber

A cylindrical ionization chamber, paired with an electrometer, is often used to collect point dose measurements of treatment fields. A cylindrical ionization chamber works in current mode. It consists of a cylindrical shaped volume with insulated walls and a central wire electrode running through the center of the volume. A voltage is applied between the wall of the chamber and the central electrode. Photons enter the chamber and interact with the fill gas, commonly air, and ion pairs are created. The electrons are then swept towards the central electrode because of the applied voltage. The current in the central wire is recorded, which is related to the amount of radiation introduced into the chamber. A Wellhofer CC04 ionization chamber, which is used in

the following study to measure point doses, is shown below in Figure 7. The nominal volume is 0.04 cm^3 , the wall thickness is 0.4 mm and the active length is 3.6 mm (20).



Figure 7 Wellhofer CC04 ionization chamber.

The ionization chamber is placed at a known depth in a tissue equivalent medium, usually water, solid water, or acrylic, and the charge collected is recorded for each treatment field. The charge collected is then converted to absorbed dose. This is done by first recording the charge collected using a known dose calibration geometry. This may be at depth of maximum dose (d_{max}), which is where the percentage depth dose (PDD) of the beam is equal to 100%. An example of a 6 MV PDD for a 10 cm x 10 cm field size is seen in Figure 8.

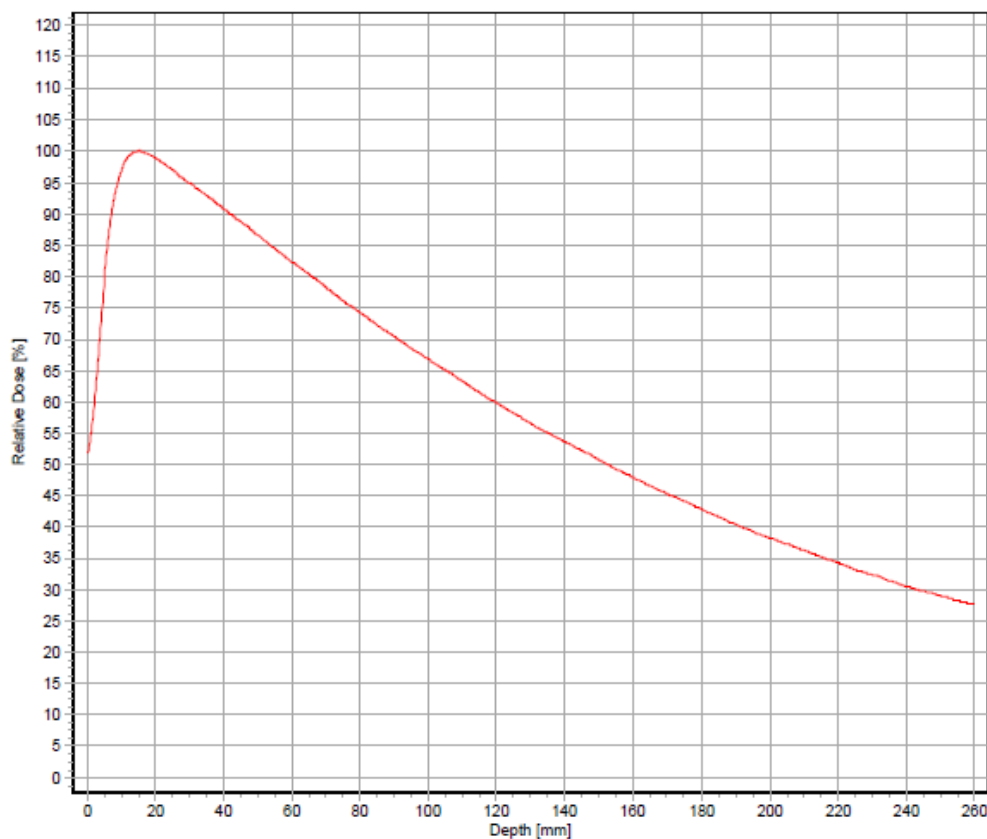


Figure 8 6 MV PDD for 10 cm x 10 cm field size.

A relationship (cGy/reading in nC) is derived between the charge collected and dose delivered to the chamber. From this relationship the dose delivered per treatment field can be calculated. The point dose measurements are compared to calculated point doses from the TPS or an independent monitor unit (MU) calculation, such as RadCalc[®].

2.7.2 Film

Film, in conjunction with point dose measurements collected with an ionization chamber, is sometimes used when evaluating IMRT QA. Film, which has high 2-D spatial resolution, can provide a point dose and planar dose measurements.

X-ray film consists of a base of thin plastic with a radiation sensitive emulsion, usually silver bromide grains with gelatin acting as a matrix to keep the grains from clumping, coated uniformly on one or both sides of the base (5). As the film is irradiated the silver bromide is ionized, and an underlying image is formed on the film, which will show up after the film has been processed (5). Light transmission, a function of the film opacity, can be measured in terms of optical density, which is a function of dose (5). Equation 1 defines optical density (OD) where I is measured intensity, and I_0 is the initial intensity of reference.

$$OD = \log_{10}(I_0 / I). \quad (1)$$

To perform QA using film dosimetry a piece of film is placed at a known depth in a stackable phantom, composed usually of acrylic or solid water. A separate film can be exposed for each treatment field or a single piece of film can be used, which would create a composite of all of the treatment fields. Once the film has been exposed it is taken to a processor. After the film is processed, it is run through a film scanner, which acts as a densitometer. Computer software is then used to evaluate agreement between the film and the point dose or planar dose that was exported from the TPS. Film dosimetry is not as common anymore due to uncertainties (film processing methodology, quality of dark room, artifact corrections related to the film scanner, etc.) that come along with it as well as evolving technology such as MapCHECKTM and electronic portal imaging devices, which are discussed below.

2.7.3 Electronic Portal Imaging Devices

Electronic portal imaging devices (EPIDs) have become another tool used to perform IMRT QA. An EPID can be seen below in Figure 9. EPIDs, high resolution devices, measure the dose response of the imaging device instead of measuring to a tissue equivalent phantom (21).

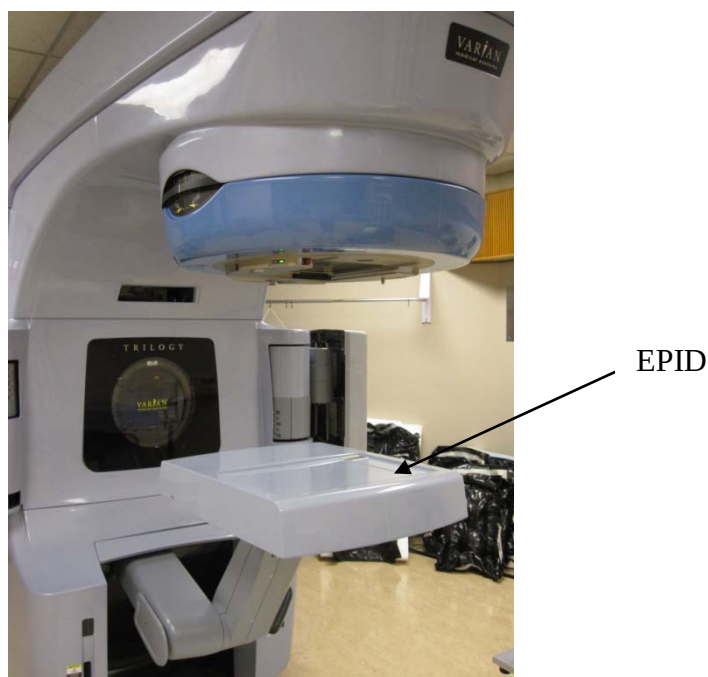


Figure 9 Varian Trilogy with EPID.

2.7.4 MapCHECK™

MapCHECK™, a product of Sun Nuclear, provides an easy and effective way performing IMRT QA and was used in this study for point dose and planar dose measurements¹. Letourneau *et al.* (22) found that MapCHECK™ offers the dosimetric characteristics needed to perform relative and absolute dose measurements for IMRT QA. MapCHECK™ is a 2-D detector array composed of 445 small diodes with an

¹ Sun Nuclear Corporation, 425 Pineda Court Melbourne, FL 32940, (321) 259-6862

area of 0.8 mm x 0.8 mm and a sensitivity of 32.0 nC/Gy (23). The active array field size is 22 cm x 22 cm the transverse (x) and radial (y) directions and is capable of measuring absolute and relative (normalized) dose distributions.

The array consists of a central 10 cm x 10 cm area in which 221 diodes are located with a spacing of 7.07 mm (23). This high density of diodes in the central 10 cm x 10 cm of the array is very important when performing IMRT QA. Many field sizes are smaller than a 10 cm x 10 cm, and therefore, they are completely encompassed by MapCHECK's[™] high density area of diodes. More data is collected where it matters the most. The outer 12 cm x 12 cm area consists of the remaining 224 diodes with a spacing of 14.14 mm (23).

A diode consists of a silicon crystal that is mixed with certain impurities to make n-type silicon and p-type silicon. N-type silicon acts as an electron donor, and p-type silicon acts as an acceptor. A region called a depletion zone is created when n-type silicon and p-type silicon are put into contact. Majority carriers diffuse from one side to the other. In other words, electrons diffuse to the p region and holes diffuse to the n region. In the depletion zone an electric field is established when equilibrium between the n region and p region exists. At equilibrium the "built-in potential" created by the electric field prevents further diffusion of the majority carriers unless excess carriers were injected by external sources (24). As a diode is irradiated, electron-hole (e-h) pairs are produced in the body of the diode and within the depletion zone, and the pairs are immediately separated and swept out by the existing electric field in the depletion zone generating a current in one direction (8). The

current generated in each diode is integrated over the irradiation period (22). A linear relationship exists between the measured charge and dose. Therefore, dose can be easily calculated (5).

A MapCHECK[™] array calibration is performed to correct for any differences the individual diodes may have in radiation sensitivity, which is also a function of photon energy. Within the calibration file each diode is given a correction factor that corrects the diode output variations relative to the central diode (22).

Sun Nuclear also has an accessory for MapCHECK[™] called an isocentric mounting frame (IMF) seen in Figure 10. The IMF, which slides securely into the accessory tray on the linear accelerator, allows a user to measure IMRT QA at 100 cm source axis distance (SAD). The user has the ability to rotate the gantry to various gantry angles given in the treatment plan without encountering any non-normal incidence due to a diode directional response. With the IMF, MapCHECK[™] is mounted perpendicular to the radiation beam at any given gantry angle.

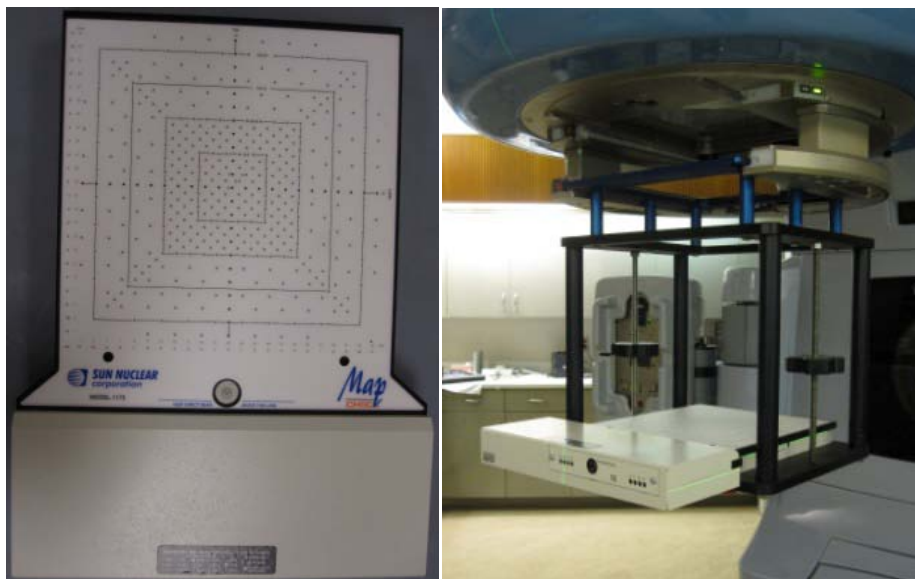


Figure 10 (Left) MapCHECK™ by Sun Nuclear and (Right) MapCHECK™ mounted with the IMF.

MapCHECK™ software provides a way of analyzing and comparing measured to calculated planes of dose from the TPS at the depth of measurement and calculation. The two planes of dose, measured and calculated, are superimposed and can be analyzed using distance to agreement (DTA) or gamma index analysis. The percentage of points passing is displayed along with the total number of points analyzed. The points of measurement that failed are shown in red (measured dose is higher than expected or calculated) or blue (measured dose is lower than expected or calculated). The user can also view profiles across the superimposed dose planes (measured and calculated) in the transverse, radial, and diagonal directions. This analysis can be completed on each individual measured treatment field, or a composite of all measured treatment fields can be evaluated at once.

As mentioned above, DTA is a method of analyzing agreement between measured and calculated data points. If a point of measurement exceeds the maximum percentage difference defined by the user, then a calculated point is searched within a defined radius (set by the user) that falls within the maximum percentage difference of dose. If a calculated point is found within the defined radius and falls within the maximum percentage difference, then the measured point is considered acceptable with respect to the user defined percentage difference of dose and search radius. The search radius can account for setup error as well as a sharp gradient in dose. It is often difficult to measure dose in a high gradient region. The DTA method allows the user to navigate around a high gradient region to find an acceptable percentage difference between measured and calculated data points.

The gamma index, a unitless index, is MapCHECK'sTM second way of analyzing agreement between measured and calculated data points. The minimum radial distance between the measurement point and the calculation point is termed the gamma index, and it provides a presentation that quantitatively indicates the calculation accuracy (25). A gamma index with a value of less than 1 or equal to 1 indicates acceptable agreement. Regions where the gamma index is greater than one or less than one corresponds to locations where the calculation does not meet the acceptance criteria (25). For example, a gamma index of 1.05 indicates that the calculation fails by 5% relative to the user defined acceptance criteria.

3 Materials and Methods

3.1 4-D CT of RGRT Phantom Patient (QuasarTM Respiratory Motion Phantom)

To begin the dosimetric verification process of RGRT, a 4DCT of the QuasarTM respiratory motion phantom coupled with Varian's RPMTM system was imaged. First, the phantom was placed on the CT table and was positioned so that the lasers in the room lined up to the cross hairs on the phantom. Fiducial markers were placed at the laser intersections, and this was defined as the scan isocenter. The scan was completed in axial mode with respiratory gating enabled. Two millimeter slice thicknesses were used in the region of interest (ROI) and 3 mm slice thicknesses everywhere else.

The cedar insert with the tumor volume was used during imaging. The phantom setup can be seen in Figure 11.



Figure 11 RGRT Phantom patient setup.

The 4DCT was repeated several times with the speed of the cedar insert varying each time. The speeds used during scanning were 10 BPM (breaths per minute), 12 BPM and 14BPM. After all scans were completed they were sent to the TPS for volume definition and planning the dose delivery geometry.

3.2 Treatment Planning of RGRT Phantom Patient

Each of the 4DCT (10 BPM, 12 BPM and 14 BPM) data sets were imported into the Varian Medical System TPS, Eclipse. These volumetric data sets will now be referred to respectively as phantom patient #1, phantom patient #2, and phantom patient #3. Once imported the GTV, PTV, lung, and body were contoured on each data set. A treatment isocenter was chosen as the center of the PTV. A nine field, 6 MV beam arrangement with a dose rate of 300 MU/min (corresponds to 300 cGy/min

at $d_{\max}$ for a 10 cm x 10 cm field size) was chosen for the IMRT treatment plan. This is the most common energy, beam arrangement, and dose rate currently used at the facility for IMRT treatment of lung tumors. Duan *et al.* (26) stated that a moderate dose rate of 300 MU/min should be used as a compromise between dose delivery accuracy and delivery efficiency for RGRT. The nine field beam arrangement, each beam in 40 degree increments, can be seen below in Figure 12. Figure 12 is a transverse view of the respiratory gating phantom resting on top of the simulation couch. The L represents the patient's left, the R represents the patient's right, the A represents the anterior aspect, and the P represents the posterior aspect. The treatment isocenter is labeled as ISO, and it can be seen that each of the 9 beams is centered at ISO.

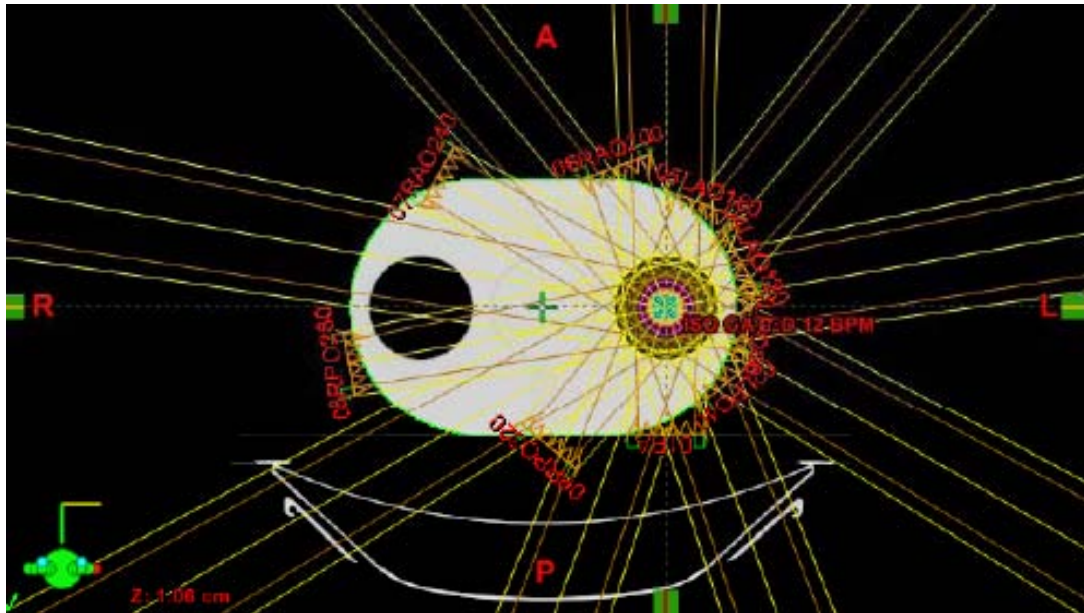


Figure 12 Beam arrangement used in IMRT plan.

Next, the optimization process began. As described earlier, objectives were set for the volumes and structures and consist of minimum and maximum doses for the

treatment volumes and maximum doses for the critical structures. The optimization algorithm optimized a treatment plan to the specific objectives that were set, and then the leaf motions of the MLC were calculated along with dose and MU.

Several treatment verification plans were then calculated using two QA phantoms. The first phantom used to verify the dose delivery in “gated mode” was the QuasarTM respiratory motion phantom. As reported by Task Group 76 (12), a dynamic phantom should be used in the dosimetric verification of RGRT. In this case the test patient is also the QuasarTM respiratory motion phantom, and therefore, the treatment plan did not have to be recalculated on the respiratory motion phantom. The QuasarTM respiratory motion phantom provides complex geometry due to the curved surface and heterogeneities as seen in Figure 12. The complex geometry is similar to what is seen in a real patient.

The second phantom used was a standard 30 cm x 30 cm x 30 cm plastic water phantom, which offers simple geometry with a flat surface and no heterogeneities. The beams were calculated at 90 cm SSD with the treatment field gantry angles all set to 180 degrees which can be seen below in Figure 13.

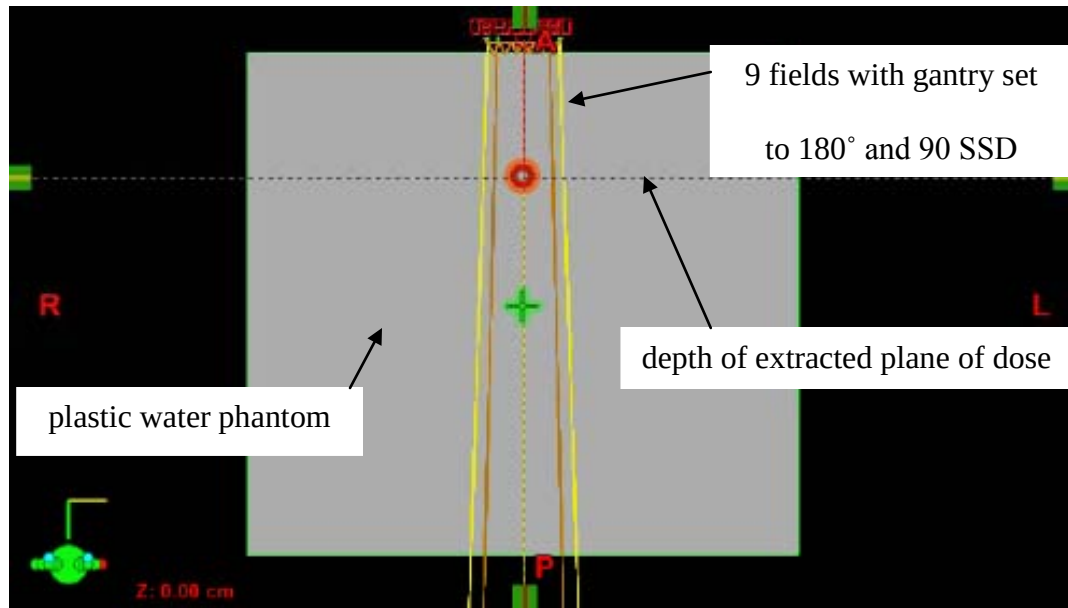


Figure 13 30 cm x 30 cm x 30 cm plastic water phantom with treatment fields at 90 cm SSD.

3.3 QA of RGRT Phantom Patient

3.3.1 Relationship between Absorbed Dose and Charge Collected

Before irradiating the respiratory motion phantom, a relationship between absorbed dose and charge collected was found. A 30 cm x 30 cm x 30 cm plastic water tank filled with water was placed on the treatment couch, as seen in Figure 14.

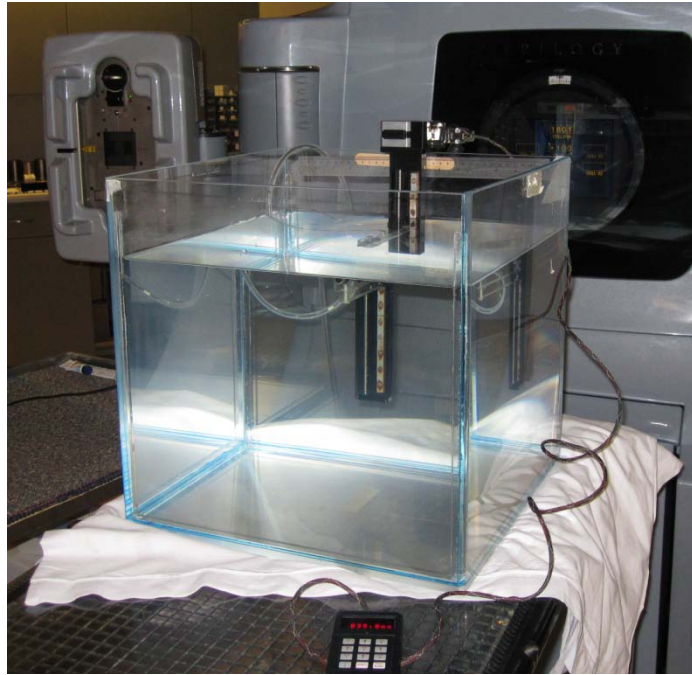


Figure 14 Plastic water phantom on treatment couch.

The surface of the water was set to 100 cm SSD. A Wellhofer CC04, which has a chamber volume of 0.04 cm^3 , was placed in the chamber holder inside the water tank. The chamber was set to isocenter and then driven to d_{max} of 1.5 cm, the depth of maximum dose for a 6 MV photon beam of a field size of 10 cm x 10 cm. This is the standard dose calibration geometry for the linear accelerator such that 1 MU is equal to 1 cGy.

Outside the room a Keithly 35040 electrometer, shown in Figure 15, was used to collect the readings in nC. The field size was set to a 10 cm x 10 cm and 200 MU were delivered. Three readings were taken with this setup.



Figure 15 Keithly 35040 electrometer.

3.3.2 Quasar[™] Respiratory Motion Phantom QA

After determining the calibration factor between absorbed dose and charge collected (cGy/nC), the respiratory motion phantom was placed on the treatment couch as seen in Figure 16. The phantom was lined up to the treatment isocenter that was defined in the TPS. The block marker (from the RPM[™] system) was placed on the platform on the respiratory motion phantom, and the viewfinder was used to verify the positioning of the block marker. The programmable drive attached to the phantom was set to the corresponding BPM for each phantom patient.

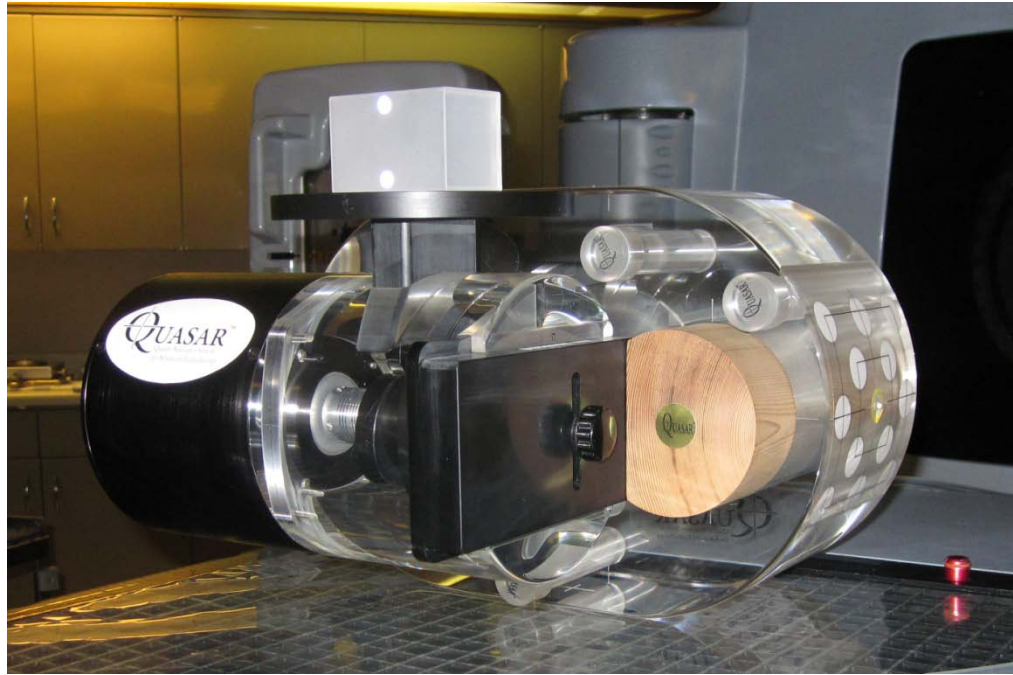


Figure 16 RGRT phantom patient (Quasar[™] Respiratory Motion Phantom).

Outside the treatment room, RPM[™] software, shown in Figure 17, was launched and the “patient” was loaded, and the tracking of the external marker was started. The treatment plan was loaded on the treatment console computer.

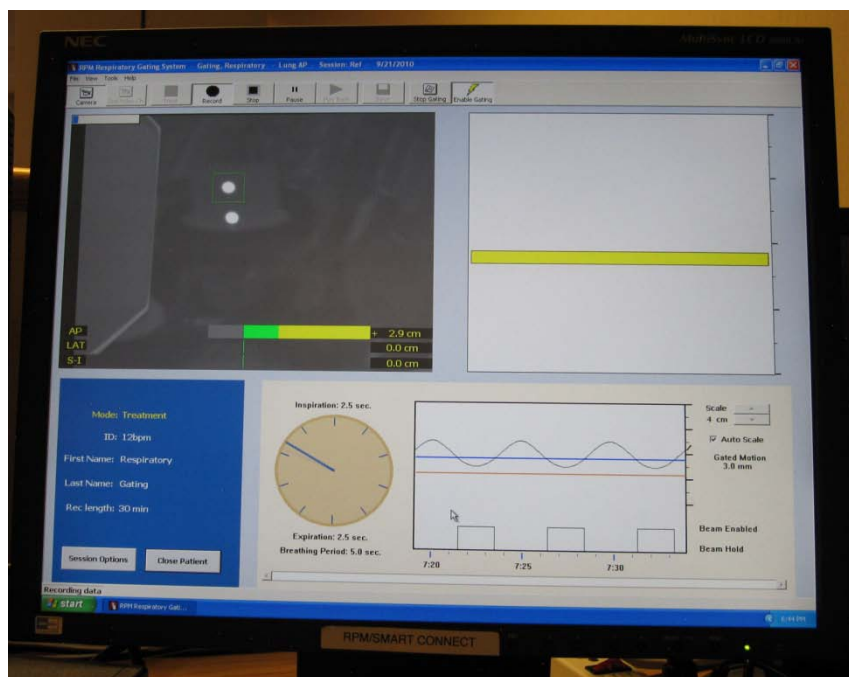


Figure 17 RPM™ software.

After aligning to the treatment isocenter, the treatment fields were delivered to the phantom. Each electrometer reading was recorded into an Excel spreadsheet, and a dose was calculated based on the relationship between absorbed dose and charge collected that was determined using the water tank and chamber under known calibration conditions ($d_{\max}$). The measured dose was compared to the TPS's calculated dose and RadCalc's® calculated dose at the treatment isocenter as seen in Figure 12. This process was completed for each phantom patient with the phantom in static mode and dynamic mode verified the localization of the tumor as well as proved the motion of the tumor was minimized as expected from the 4DCT scan.

3.3.3 MapCHECK™ QA

After ionization chamber measurements were completed, MapCHECK™ was placed on the IMF, and 10 cm of plastic water was placed on top, and therefore, the SSD was 90 cm. The setup can be seen in Figure 18.

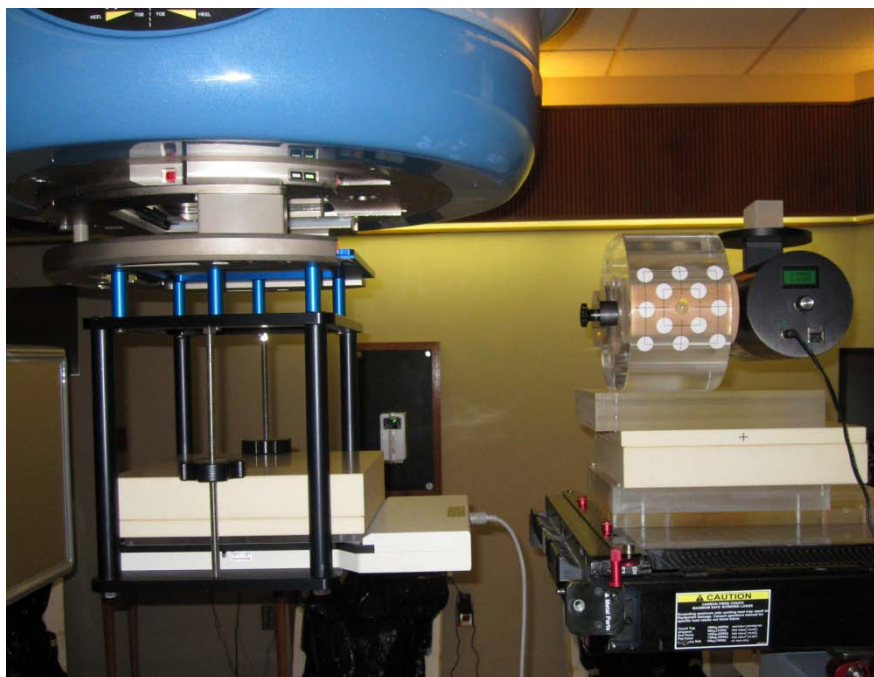


Figure 18 MapCHECK™ setup for respiratory motion phantom.

Outside the treatment room, RPM™ software was launched and the patient was loaded and the tracking of the external marker was started. The treatment plan was loaded on the treatment console computer. The MapCHECK™ software was also launched. A 6 MV dose calibration was performed by irradiating MapCHECK™ with a 10 cm x 10 cm field size and 224 MU, which delivers a dose of 180 cGy at 10 cm of depth. Next, the treatment fields were delivered one at a time in “gated” mode. After each treatment field measurement, the MapCHECK™ file was saved for evaluation of agreement between point dose (at treatment isocenter) and planar dose (at 10 cm

depth) and the TPS and RadCalc[®]. This process was completed for each phantom patient.

To make certain that the linear accelerator output is stable when the beam is turned on and off during gated delivery, experiments should be performed to ensure, that in the absence of detector motion, the output with and without gating are comparable (18). To do this each phantom patient verification plan was treated in “gated” and “non-gated” mode using MapCHECK[™] mounted in the IMF as shown in Figure 19. The central axis (CAX) point dose measurements taken in “gated” and “non-gated” mode were then compared to calculated TPS treatment isocenter point dose. The planar dose measurements taken in “gated” and “non-gated” mode were also compared to the calculated TPS planar dose at 10 cm depth. The planar dose evaluation was completed using MapCHECK[™] software. The DTA method, which was described in detail earlier, was used for the analysis of the planar dose, and the maximum percentage difference was set to 3% with a search radius of 3 mm.

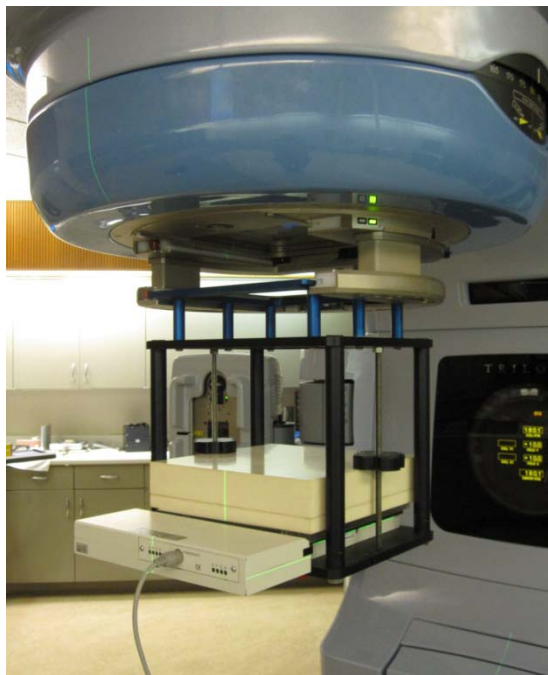


Figure 19 MapCHECK™ setup using IMF.

3.4 QA of RGRT Patients

Once the phantom patient measurements were completed, and the output of the machine was verified to be the same between “gated” mode and “non-gated” mode, QA was completed for the three RGRT patients using the same MapCHECK™ setup as seen in Figure 19. As described above, MapCHECK™ files were saved for evaluation of point dose and planar dose measurements compared to the TPS and RadCalc®.

4 Results

4.1 RGRT Phantom Patient QA

4.1.1 Relationship between Absorbed Dose and Charge Collected

The relationship between absorbed dose and charge collected for the ionization chamber was determined by placing the chamber in the standard dose calibration geometry for the linear accelerator such that 1 MU is equal to 1 cGy for a 10 cm x 10 cm field at a depth of 1.5 cm. The ionization readings were taken for 200 MU settings, which were equivalent to 200 cGy. The data for the conversion from ionization reading expressed in nC to dose is shown below.

Table 1 Relationship between absorbed dose and charge collected.

cGy	Energy/modality (MV)	Depth (cm)	Rdg ₁	Rdg ₃	Rdg ₂	Rdg _{ave}		
200	6	1.5	2.147	2.147	2.147	2.147	93.15	cGy/nC

Note: The accelerator had been previously calibrated (using Task Group 51) with an electrometer and ionization chamber that was traceable to an accredited calibration dosimetry lab (ADCL).

4.1.2 QuasarTM Respiratory Motion Phantom and Ionization Chamber

The following results are for each of the phantom patients (1, 2 and 3). The measurements were taken with an ionization chamber with the beam in “gated” mode and the respiratory motion phantom static and dynamic as described in Chapter 3. The geometry for the ionization measurements performed on the QuasarTM phantom is shown in Figure 12. The measurements were then compared to EclipseTM TPS and

RadCalc[®]. The percent difference between measured and calculated doses for all three phantom patients with the phantom in static mode and dynamic mode was less than 3% or within 1 cGy.

Table 2 Phantom patient #1 static ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2466	22.97	23.3	-1.3	
6x	2	LPO 40	0.2499	23.28	23.7	-1.9	
6x	3	LPO 80	0.2586	24.09	24.3	-0.7	
6x	4	LAO 120	0.2537	23.63	24.1	-1.8	
6x	5	LAO 160	0.2465	22.96	23.7	-3.3	
6x	6	RAO 200	0.2375	22.12	22.7	-2.4	
6x	7	RAO 240	0.2195	20.45	20.7	-1.3	
6x	8	RPO 280	0.2201	20.50	20.5	0.1	
6x	9	RPO 320	0.2289	21.32	21.7	-1.8	
			Total Dose	201.3	204.6	% Diff	-1.6%

Table 3 Phantom patient #1 static ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2466	22.97	22.9	0.4	
6x	2	LPO 40	0.2499	23.28	23.3	-0.2	
6x	3	LPO 80	0.2586	24.09	23.5	2.3	
6x	4	LAO 120	0.2537	23.63	23.3	1.3	
6x	5	LAO 160	0.2465	22.96	23.0	-0.2	
6x	6	RAO 200	0.2375	22.12	22.1	0.2	
6x	7	RAO 240	0.2195	20.45	20.8	-1.5	
6x	8	RPO 280	0.2201	20.50	20.1	2.0	
6x	9	RPO 320	0.2289	21.32	21.7	-2.0	
			Total Dose	201.3	200.7	% Diff	0.3%

Table 4 Phantom patient #1 dynamic ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2482	23.12	23.3	-0.7	
6x	2	LPO 40	0.2484	23.14	23.7	-2.6	
6x	3	LPO 80	0.2587	24.10	24.3	-0.7	
6x	4	LAO 120	0.2541	23.67	24.1	-1.7	
6x	5	LAO 160	0.2470	23.01	23.7	-3.1	
6x	6	RAO 200	0.2376	22.13	22.7	-2.4	
6x	7	RAO 240	0.2194	20.44	20.7	-1.4	
6x	8	RPO 280	0.2177	20.28	20.5	-1.0	
6x	9	RPO 320	0.2285	21.29	21.7	-2.0	
			Total Dose	201.2	204.6	% Diff	-1.7%

Table 5 Phantom patient #1 dynamic ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2482	23.12	22.9	1.1	
6x	2	LPO 40	0.2484	23.14	23.3	-0.8	
6x	3	LPO 80	0.2587	24.10	23.5	2.4	
6x	4	LAO 120	0.2541	23.67	23.3	1.5	
6x	5	LAO 160	0.2470	23.01	23.0	0.0	
6x	6	RAO 200	0.2376	22.13	22.1	0.2	
6x	7	RAO 240	0.2194	20.44	20.8	-1.6	
6x	8	RPO 280	0.2177	20.28	20.1	0.9	
6x	9	RPO 320	0.2285	21.29	21.7	-2.1	
			Total Dose	201.2	200.7	% Diff	0.2%

Table 6 Phantom patient #2 static ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2491	23.20	23.6	-1.5	
6x	2	LPO 40	0.2554	23.79	24.1	-1.1	
6x	3	LPO 80	0.2585	24.08	24.5	-1.9	
6x	4	LAO 120	0.2610	24.31	24.3	0.0	
6x	5	LAO 160	0.2526	23.53	23.9	-1.5	
6x	6	RAO 200	0.2429	22.63	22.8	-0.9	
6x	7	RAO 240	0.2234	20.81	20.9	-0.3	
6x	8	RPO 280	0.2224	20.72	20.6	0.4	
6x	9	RPO 320	0.2336	21.76	21.9	-0.7	
			Total Dose	204.8	206.6	% Diff	-0.9%

Table 7 Phantom patient #2 static ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2491	23.20	23.2	0.2	
6x	2	LPO 40	0.2554	23.79	23.6	0.7	
6x	3	LPO 80	0.2585	24.08	23.8	1.1	
6x	4	LAO 120	0.2610	24.31	23.6	2.9	
6x	5	LAO 160	0.2526	23.53	23.3	0.9	
6x	6	RAO 200	0.2429	22.63	22.5	0.6	
6x	7	RAO 240	0.2234	20.81	21.0	-1.1	
6x	8	RPO 280	0.2224	20.72	20.4	1.6	
6x	9	RPO 320	0.2336	21.76	22.0	-1.2	
			Total Dose	204.8	203.5	% Diff	0.7%

Table 8 Phantom patient #2 dynamic ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2459	22.91	23.6	-2.9	
6x	2	LPO 40	0.2546	23.72	24.1	-1.5	
6x	3	LPO 80	0.2577	24.01	24.5	-2.2	
6x	4	LAO 120	0.2611	24.32	24.3	0.1	
6x	5	LAO 160	0.2527	23.54	23.9	-1.5	
6x	6	RAO 200	0.2443	22.76	22.8	-0.3	
6x	7	RAO 240	0.2225	20.73	20.9	-0.7	
6x	8	RPO 280	0.2226	20.74	20.6	0.4	
6x	9	RPO 320	0.2317	21.58	21.9	-1.5	
			Total Dose	204.3	206.6	% Diff	-1.1%

Table 9 Phantom patient #2 dynamic ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2459	22.91	23.2	-1.1	
6x	2	LPO 40	0.2546	23.72	23.6	0.4	
6x	3	LPO 80	0.2577	24.01	23.8	0.8	
6x	4	LAO 120	0.2611	24.32	23.6	2.9	
6x	5	LAO 160	0.2527	23.54	23.3	1.0	
6x	6	RAO 200	0.2443	22.76	22.5	1.2	
6x	7	RAO 240	0.2225	20.73	21.0	-1.5	
6x	8	RPO 280	0.2226	20.74	20.4	1.7	
6x	9	RPO 320	0.2317	21.58	22.0	-2.1	
			Total Dose	204.3	203.5	% Diff	0.4%

Table 10 Phantom patient #3 static ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2482	23.12	23.3	-0.8	
6x	2	LPO 40	0.2506	23.34	23.8	-2.0	
6x	3	LPO 80	0.2583	24.06	24.3	-1.0	
6x	4	LAO 120	0.2541	23.67	24.0	-1.4	
6x	5	LAO 160	0.2482	23.12	23.7	-2.5	
6x	6	RAO 200	0.2380	22.17	22.6	-1.9	
6x	7	RAO 240	0.2183	20.34	20.7	-1.8	
6x	8	RPO 280	0.2203	20.52	20.4	0.6	
6x	9	RPO 320	0.2295	21.38	21.7	-1.5	
			Total Dose	201.7	204.5	% Diff	-1.4%

Table 11 Phantom patient #3 static ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2482	23.12	22.9	1.1	
6x	2	LPO 40	0.2506	23.34	23.3	0.1	
6x	3	LPO 80	0.2583	24.06	23.5	2.2	
6x	4	LAO 120	0.2541	23.67	23.3	1.5	
6x	5	LAO 160	0.2482	23.12	23.0	0.5	
6x	6	RAO 200	0.2380	22.17	22.2	-0.1	
6x	7	RAO 240	0.2183	20.34	20.8	-2.1	
6x	8	RPO 280	0.2203	20.52	20.2	1.6	
6x	9	RPO 320	0.2295	21.38	21.7	-1.7	
			Total Dose	201.7	200.9	% Diff	0.4%

Table 12 Phantom patient #3 dynamic ionization chamber measurements compared to Eclipse[™] TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2461	22.93	23.3	-1.6	
6x	2	LPO 40	0.2456	22.88	23.8	-4.0	
6x	3	LPO 80	0.2560	23.85	24.3	-1.9	
6x	4	LAO 120	0.2547	23.73	24.0	-1.2	
6x	5	LAO 160	0.2479	23.09	23.7	-2.6	
6x	6	RAO 200	0.2376	22.13	22.6	-2.1	
6x	7	RAO 240	0.2186	20.36	20.7	-1.7	
6x	8	RPO 280	0.2195	20.45	20.4	0.2	
6x	9	RPO 320	0.2288	21.31	21.7	-1.8	
			Total Dose	200.7	204.5	% Diff	-1.9%

Table 13 Phantom patient #3 dynamic ionization chamber measurements compared to RadCalc[®].

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	0.2461	22.93	22.9	0.2	
6x	2	LPO 40	0.2456	22.88	23.3	-1.9	
6x	3	LPO 80	0.2560	23.85	23.5	1.3	
6x	4	LAO 120	0.2547	23.73	23.3	1.7	
6x	5	LAO 160	0.2479	23.09	23.0	0.3	
6x	6	RAO 200	0.2376	22.13	22.2	-0.3	
6x	7	RAO 240	0.2186	20.36	20.8	-1.9	
6x	8	RPO 280	0.2195	20.45	20.2	1.2	
6x	9	RPO 320	0.2288	21.31	21.7	-2.0	
			Total Dose	200.7	200.9	% Diff	-0.1%

A summary of the comparisons between the ionization measurements taken in a static phantom and a dynamic phantom can be seen below.

Table 14 Comparison summary between static and dynamic ionization chamber measurements compared to Eclipse[™] TPS.

	Dynamic Difference	Static Difference
Phantom Patient #1	-1.7%	-1.6%
Phantom Patient #2	-1.1%	-0.9%
Phantom Patient #3	-1.9%	-1.4%
Average	-1.6%	-1.3%

Table 15 Comparison summary between static and dynamic ionization chamber measurements compared to RadCalc[®].

	Dynamic Difference	Static Difference
Phantom Patient #1	0.2%	0.3%
Phantom Patient #2	0.4%	0.7%
Phantom Patient #3	-0.1%	0.4%
Average	0.2%	0.4%

4.1.3 MapCHECK™

The following results are for each of the phantom patients (1, 2 and 3). The measurements were taken with MapCHECK™ with the beam in “non-gated” and “gated” mode as described in Chapter 3. The geometry for the measurements performed on the MapCHECK™ phantom is shown in Figure 13. The CAX point dose measurements, both “non-gated” and “gated”, were then compared to the Eclipse™ TPS and RadCalc®. The percent difference between measured and calculated point doses for all three phantom patients, with the phantom in “non-gated” and “gated” mode, was less than 3% or within 1 cGy. The planar dose measurements taken in “non-gated” and “gated” mode were also compared to calculated TPS planar dose. The MapCHECK™ diagonal profiles of a beam composite for each phantom patient plan can be seen below in Figures 20 - 25. Note that Set 1 is measured data, and Set 2 is calculated data from the Eclipse™ TPS. To be concise the complete MapCHECK™ evaluation, which includes individual beam comparisons, can be seen in the Appendix rather than the body of the text. Note that the DTA method was used for the analysis of the planar dose, and the maximum percentage difference was set to 3% with a search radius of 3 mm. The analysis of all individual beam comparisons for each phantom patient showed that 100% of the points measured passed with the criteria set to 3% and 3 mm with the exception of one field in which 96% of the points passed.

Table 16 Phantom patient #1 non-gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.16	22.16	21.8	1.6	
6x	2	LPO 40	19.67	19.67	19.6	0.4	
6x	3	LPO 80	19.32	19.32	19.1	1.1	
6x	4	LAO 120	19.16	19.16	19.1	0.3	
6x	5	LAO 160	20.30	20.30	20.4	-0.5	
6x	6	RAO 200	23.03	23.03	23.0	0.1	
6x	7	RAO 240	33.55	33.55	33.1	1.3	
6x	8	RPO 280	35.97	35.97	35.2	2.1	
6x	9	RPO 320	25.33	25.33	25.4	-0.3	
			Total Dose	218.5	216.7	% Diff	0.8%

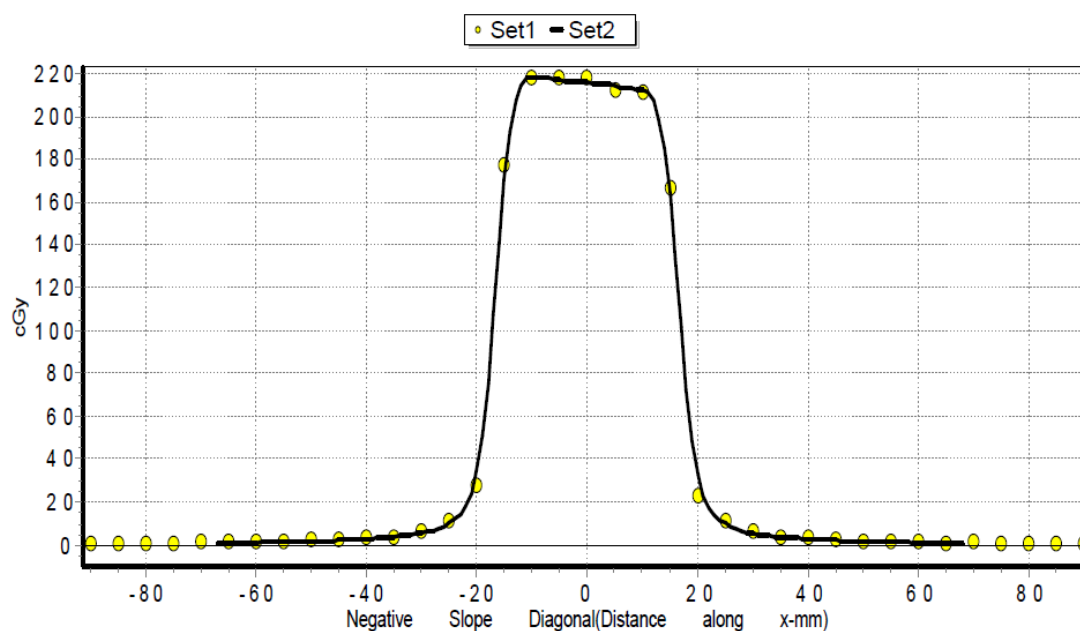


Figure 20 Phantom patient #1 profile of measured non-gated composite dose plane compared to Eclipse™ dose plane.

Table 17 Phantom patient #1 non-gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.16	22.16	21.7	2.1	
6x	2	LPO 40	19.67	19.67	19.5	0.9	
6x	3	LPO 80	19.32	19.32	19.0	1.7	
6x	4	LAO 120	19.16	19.16	19.0	0.8	
6x	5	LAO 160	20.30	20.30	20.3	0.0	
6x	6	RAO 200	23.03	23.03	22.8	1.0	
6x	7	RAO 240	33.55	33.55	33.2	1.0	
6x	8	RPO 280	35.97	35.97	36.2	-0.6	
6x	9	RPO 320	25.33	25.33	25.3	0.1	
			Total Dose	218.5	217.0	% Diff	0.7%

Table 18 Phantom patient #1 gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.35	22.35	21.8	2.5	
6x	2	LPO 40	19.89	19.89	19.6	1.5	
6x	3	LPO 80	19.53	19.53	19.1	2.2	
6x	4	LAO 120	19.39	19.39	19.1	1.5	
6x	5	LAO 160	20.49	20.49	20.4	0.4	
6x	6	RAO 200	23.23	23.23	23.0	1.0	
6x	7	RAO 240	34.00	34.00	33.1	2.6	
6x	8	RPO 280	36.48	36.48	35.6	2.4	
6x	9	RPO 320	25.65	25.65	25.4	1.0	
			Total Dose	221.0	216.7	% Diff	1.8%

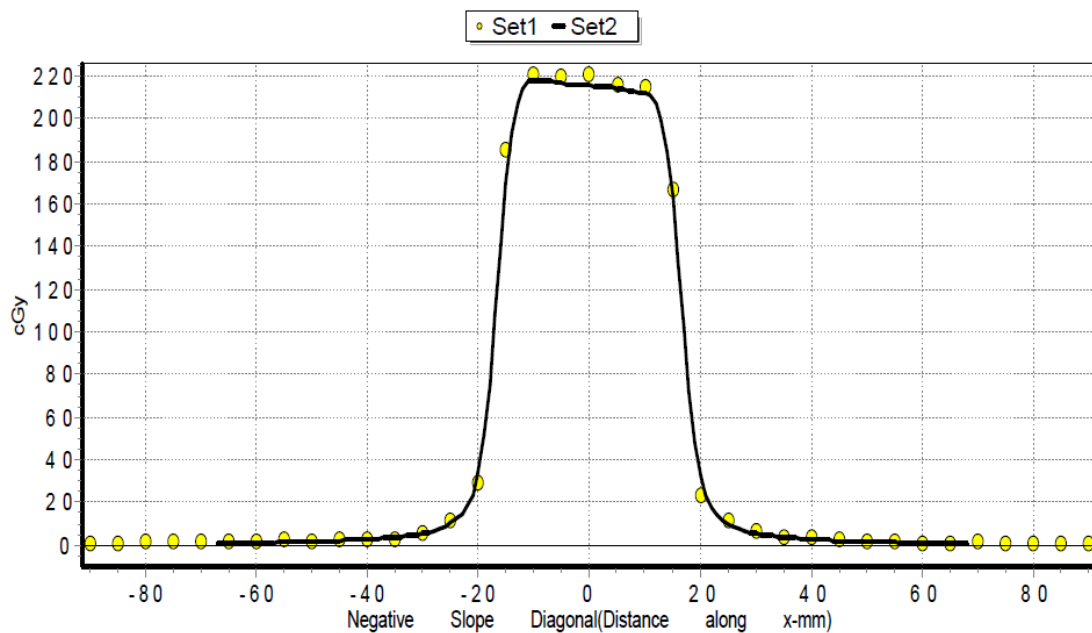


Figure 21 Phantom patient #1 profile of measured gated composite dose plane compared to Eclipse™ dose plane.

Table 19 Phantom patient #1 gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.35	22.35	21.7	2.9	
6x	2	LPO 40	19.89	19.89	19.5	2.0	
6x	3	LPO 80	19.53	19.53	19.0	2.7	
6x	4	LAO 120	19.39	19.39	19.0	1.8	
6x	5	LAO 160	20.49	20.49	20.3	0.9	
6x	6	RAO 200	23.23	23.23	22.8	1.9	
6x	7	RAO 240	34.00	34.00	33.2	2.3	
6x	8	RPO 280	36.48	36.48	36.2	0.8	
6x	9	RPO 320	25.65	25.65	25.3	1.4	
			Total Dose	221.0	217.0	% Diff	1.8%

Table 20 Phantom patient #2 non-gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.15	22.15	22.0	0.7	
6x	2	LPO 40	20.15	20.15	19.9	1.2	
6x	3	LPO 80	19.32	19.32	19.3	0.1	
6x	4	LAO 120	19.69	19.69	19.4	1.5	
6x	5	LAO 160	20.77	20.77	20.7	0.3	
6x	6	RAO 200	23.50	23.50	23.3	0.9	
6x	7	RAO 240	34.16	34.16	33.6	1.6	
6x	8	RPO 280	36.46	36.46	35.7	2.1	
6x	9	RPO 320	25.86	25.86	25.7	0.6	
			Total Dose	222.1	219.6	% Diff	1.1%

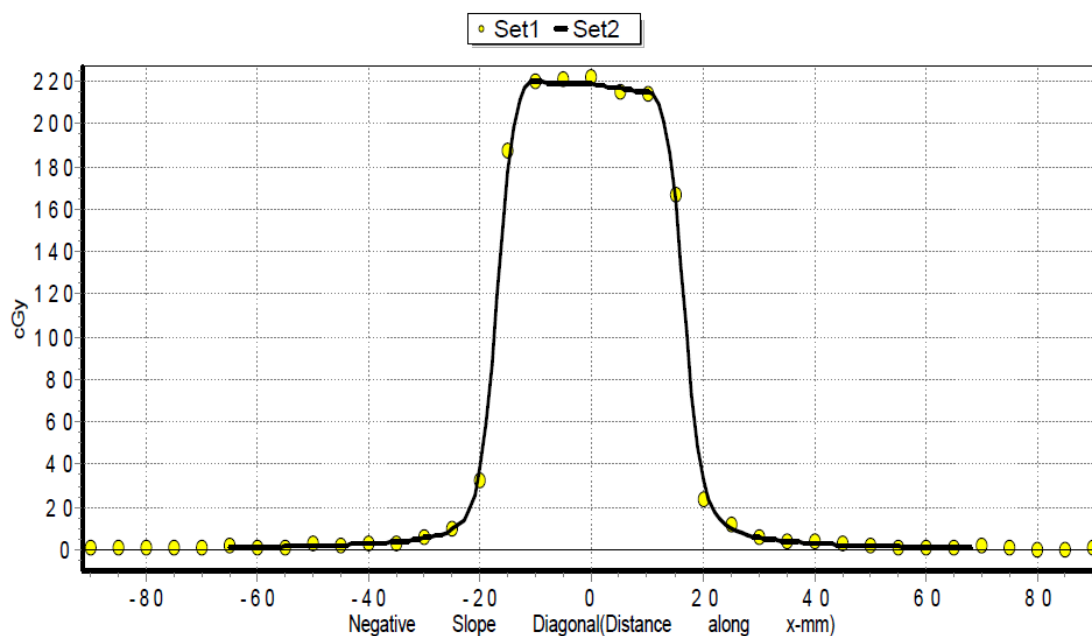


Figure 22 Phantom patient #2 profile of measured non-gated composite dose plane compared to Eclipse™ dose plane.

Table 21 Phantom patient #2 non-gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.15	22.15	21.9	1.1	
6x	2	LPO 40	20.15	20.15	19.8	1.7	
6x	3	LPO 80	19.32	19.32	19.2	0.6	
6x	4	LAO 120	19.69	19.69	19.3	2.0	
6x	5	LAO 160	20.77	20.77	20.5	1.3	
6x	6	RAO 200	23.50	23.50	23.1	1.7	
6x	7	RAO 240	34.16	34.16	33.3	2.5	
6x	8	RPO 280	36.46	36.46	36.1	1.0	
6x	9	RPO 320	25.86	25.86	25.6	1.0	
			Total Dose	222.1	218.8	% Diff	1.5%

Table 22 Phantom patient #2 gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.10	22.10	22.0	0.5	
6x	2	LPO 40	20.13	20.13	19.9	1.1	
6x	3	LPO 80	19.37	19.37	19.3	0.4	
6x	4	LAO 120	19.77	19.77	19.4	1.9	
6x	5	LAO 160	20.77	20.77	20.7	0.3	
6x	6	RAO 200	23.65	23.65	23.3	1.5	
6x	7	RAO 240	34.20	34.20	33.6	1.8	
6x	8	RPO 280	36.56	36.56	35.7	2.4	
6x	9	RPO 320	25.96	25.96	25.7	1.0	
			Total Dose	222.5	219.6	% Diff	1.3%

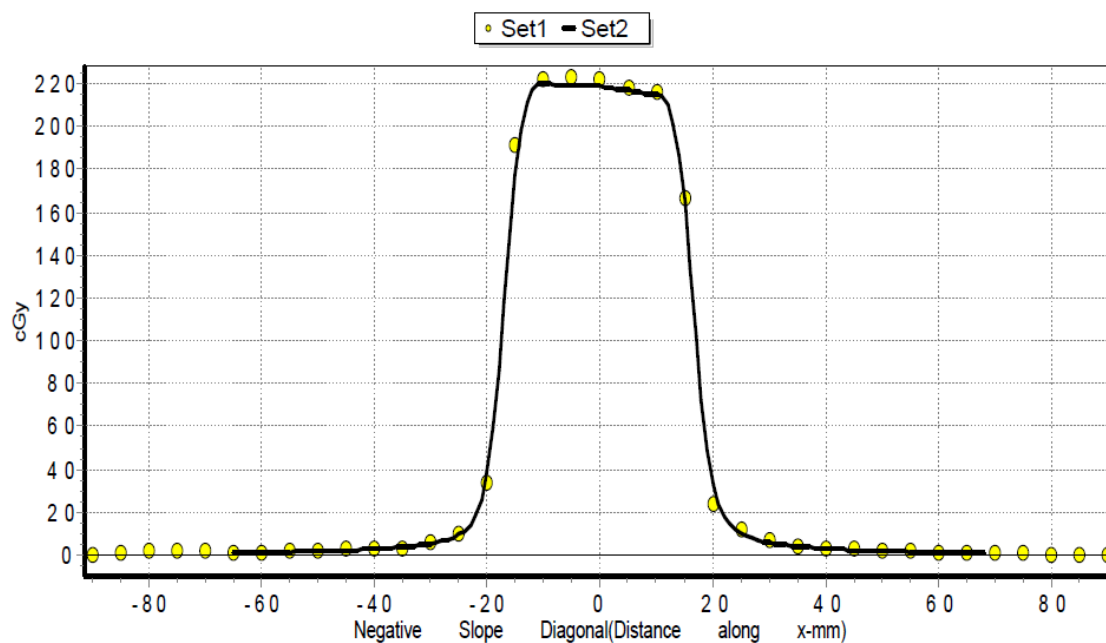


Figure 23 Phantom patient #2 profile of measured gated composite dose plane compared to Eclipse™ dose plane.

Table 23 Phantom patient #2 gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.10	22.10	21.9	0.9	
6x	2	LPO 40	20.13	20.13	19.8	1.6	
6x	3	LPO 80	19.37	19.37	19.2	0.9	
6x	4	LAO 120	19.77	19.77	19.3	2.4	
6x	5	LAO 160	20.77	20.77	20.5	1.3	
6x	6	RAO 200	23.65	23.65	23.2	1.9	
6x	7	RAO 240	34.20	34.20	33.7	1.5	
6x	8	RPO 280	36.56	36.56	36.1	1.3	
6x	9	RPO 320	25.96	25.96	25.6	1.4	
			Total Dose	222.5	219.3	% Diff	1.4%

Table 24 Phantom patient #3 non-gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.07	22.07	21.7	1.7	
6x	2	LPO 40	19.70	19.70	19.7	0.0	
6x	3	LPO 80	19.35	19.35	19.1	1.3	
6x	4	LAO 120	19.20	19.20	19.2	0.0	
6x	5	LAO 160	20.40	20.40	20.5	-0.5	
6x	6	RAO 200	22.97	22.97	23.0	-0.1	
6x	7	RAO 240	33.67	33.67	33.2	1.4	
6x	8	RPO 280	36.05	36.05	35.2	2.4	
6x	9	RPO 320	25.48	25.48	25.4	0.3	
			Total Dose	218.9	217.0	% Diff	0.9%

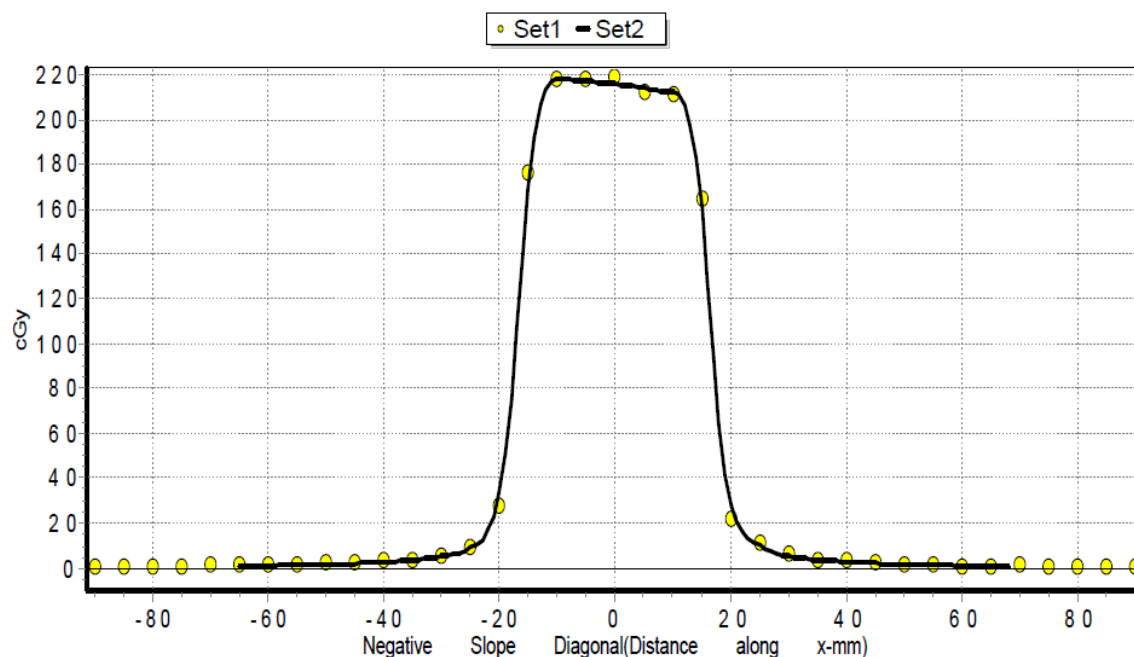


Figure 24 Phantom patient #3 profile of measured non-gated composite dose plane compared to Eclipse™ dose plane.

Table 25 Phantom patient #3 non-gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.07	22.07	21.6	1.9	
6x	2	LPO 40	19.70	19.70	19.5	1.0	
6x	3	LPO 80	19.35	19.35	19.0	1.8	
6x	4	LAO 120	19.20	19.20	19.0	1.0	
6x	5	LAO 160	20.40	20.40	20.3	0.5	
6x	6	RAO 200	22.97	22.97	22.8	0.7	
6x	7	RAO 240	33.67	33.67	32.9	2.3	
6x	8	RPO 280	36.05	36.05	35.6	1.2	
6x	9	RPO 320	25.48	25.48	25.3	0.7	
			Total Dose	218.9	216.0	% Diff	1.3%

Table 26 Phantom patient #3 gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.24	22.24	21.7	2.4	
6x	2	LPO 40	19.78	19.78	19.7	0.4	
6x	3	LPO 80	19.37	19.37	19.1	1.4	
6x	4	LAO 120	19.39	19.39	19.2	1.0	
6x	5	LAO 160	20.54	20.54	20.5	0.2	
6x	6	RAO 200	23.17	23.17	23.0	0.7	
6x	7	RAO 240	33.93	33.93	33.2	2.2	
6x	8	RPO 280	36.39	36.39	35.5	2.4	
6x	9	RPO 320	25.59	25.59	25.4	0.7	
			Total Dose	220.4	217.0	% Diff	1.4%

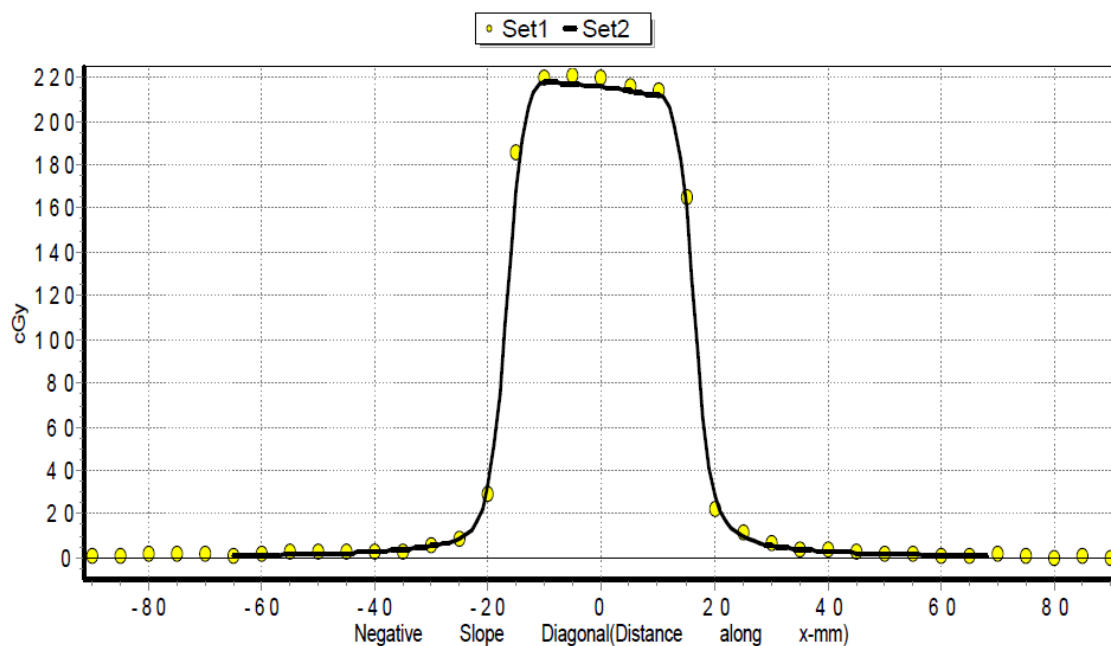


Figure 25 Phantom patient #3 profile of measured gated composite dose plane compared to Eclipse™ TPS dose plane.

Table 27 Phantom patient #3 gated MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.24	22.24	21.6	2.7	
6x	2	LPO 40	19.78	19.78	19.5	1.4	
6x	3	LPO 80	19.37	19.37	19.0	1.9	
6x	4	LAO 120	19.39	19.39	19.0	2.0	
6x	5	LAO 160	20.54	20.54	20.3	1.2	
6x	6	RAO 200	23.17	23.17	22.8	1.6	
6x	7	RAO 240	33.93	33.93	33.2	2.1	
6x	8	RPO 280	36.39	36.39	35.6	2.1	
6x	9	RPO 320	25.59	25.59	25.3	1.1	
			Total Dose	220.4	216.4	% Diff	1.8%

A summary of the comparisons between the MapCHECK™ CAX measurements taken in “non-gated” and “gated” mode can be seen below.

Table 28 Comparison summary between gated and non-gated MapCHECK™ CAX measurements compared to Eclipse™ TPS.

	Gated Difference	Non-Gated Difference
Phantom Patient #1	1.8%	0.8%
Phantom Patient #2	1.3%	1.1%
Phantom Patient #3	1.4%	0.9%
Average	1.5%	0.9%

Table 29 Comparison summary between gated and non-gated MapCHECK™ CAX measurements compared to RadCalc®.

	Gated Difference	Non-Gated Difference
Phantom Patient #1	1.8%	0.7%
Phantom Patient #2	1.4%	1.5%
Phantom Patient #3	1.8%	1.3%
Average	1.7%	1.2%

4.2 RGRT Patient QA

4.2.1 MapCHECK™

The following results are for three RGRT patients. The measurements were taken with MapCHECK™ as described in Chapter 3. The CAX point dose measurements were then compared to RadCalc® and Eclipse™ TPS, and it was found that the comparison between the two systems was found to be very similar. Therefore, only the RadCalc® comparisons are shown below. The percent difference between measured and calculated point doses for all three RGRT patients was less than 3% or

within 1 cGy. The planar dose measurements were also compared to calculated TPS planar dose. The MapCHECK™ diagonal profiles of a beam composite for each phantom patient plan can be seen below in Figures 26 - 28. Note that Set 1 is measured data, and Set 2 is calculated data from the TPS. To be concise the complete MapCHECK™ evaluation, which includes individual beam comparisons, can be seen in the Appendix rather than the body of the text. Note that the DTA method was used for the analysis of the planar dose, and the maximum percentage difference was set to 3% with a search radius of 3 mm. The analysis of all individual beam comparisons for each RGRT patient showed that 94% of the points measured passed with the passing criteria set to 3% and 3 mm with the exception of one field in which 91.2% of the points passed.

Table 30 RGRT patient #1 MapCHECK™ CAX measurement compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)	
6x	1	PA	22.65	22.65	22.2	2.0	
6x	2	LPO 40	30.07	30.07	30.9	-2.8	
6x	3	LPO 80	16.28	16.28	16.4	-0.7	
6x	4	LAO 120	13.20	13.20	12.9	2.3	
6x	5	LAO 160	16.60	16.60	17.1	-3.0	
6x	6	RAO 200	21.44	21.44	21.5	-0.3	
6x	7	RAO 240	28.54	28.54	28.5	0.1	
6x	8	RPO 280	21.44	21.44	21.6	-0.7	
6x	9	RPO 320	25.78	25.78	26.1	-1.2	
			Total Dose	196.0	197.2	% Diff	-0.6%

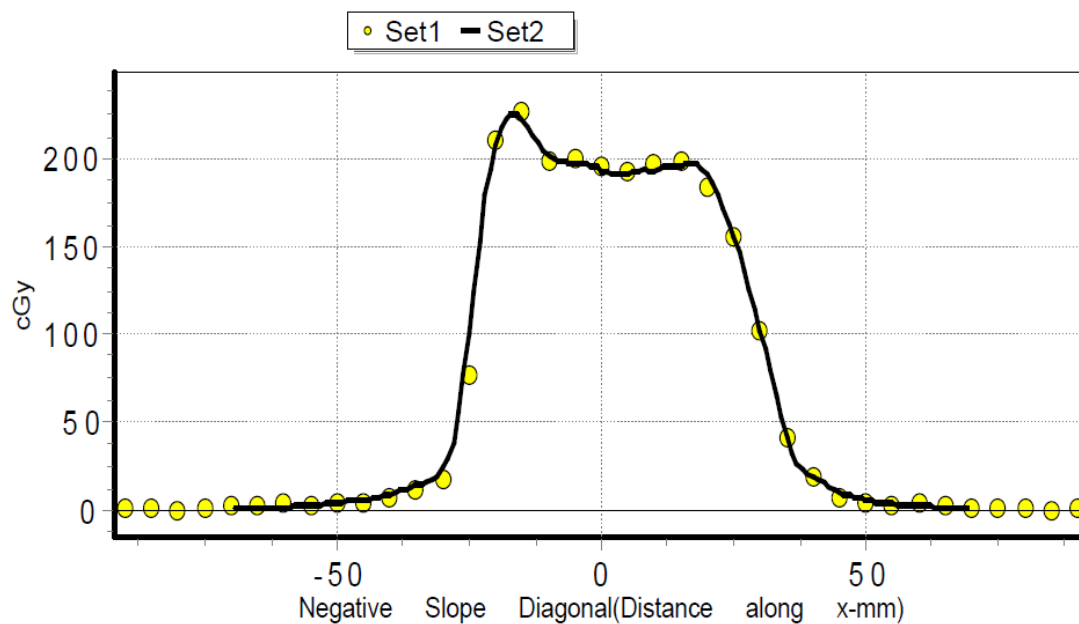


Figure 26 RGRT patient #1 profile of measured dose plane compared to Eclipse™ dose plane.

Table 31 RGRT patient #2 MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)
6x	1	PA	23.86	23.86	23.6	1.1
6x	2	LPO 40	16.89	16.89	16.6	1.7
6x	3	LPO 80	20.01	20.01	20.1	-0.4
6x	4	LAO 120	28.57	28.57	28.3	0.9
6x	5	LAO 160	31.78	31.78	32.2	-1.3
6x	6	RAO 200	21.51	21.51	21.2	1.4
6x	7	RAO 240	20.96	20.96	21.0	-0.2
6x	8	RPO 280	26.73	26.73	26.7	0.1
6x	9	RPO 320	37.85	37.85	38.5	-1.7
			Total Dose	228.2	228.2	% Diff 0.0%

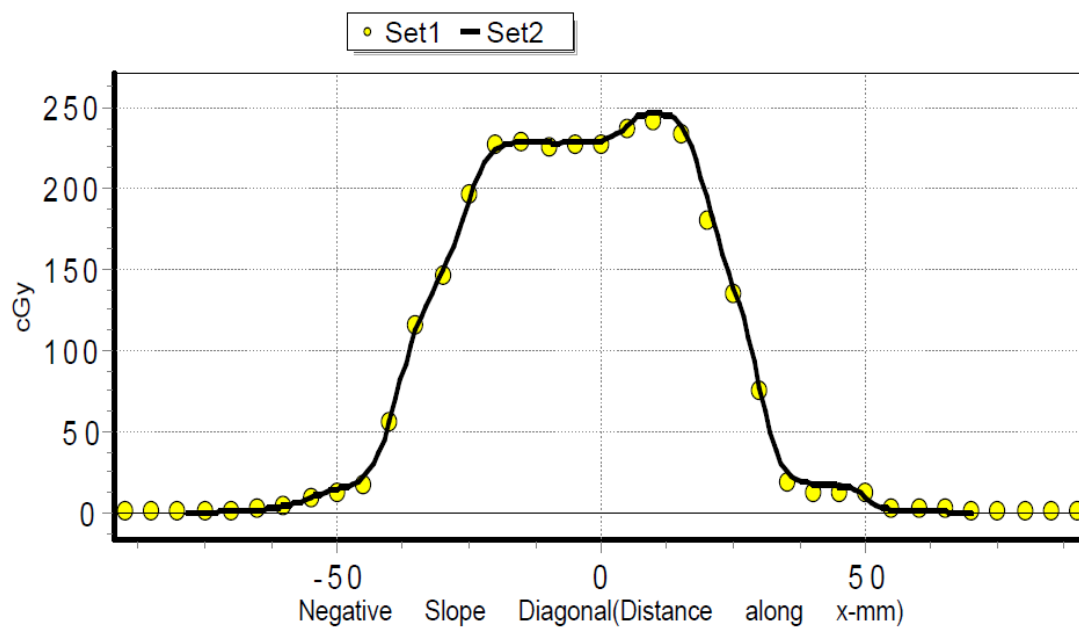


Figure 27 RGRT patient #2 profile of measured dose plane compared to Eclipse™ dose plane.

Table 32 RGRT patient #3 MapCHECK™ CAX measurements compared to RadCalc®.

Energy	TX Beam Number	Field Description	Reading	Meas Dose (cGy)	Plan (cGy)	Diff (%)
6x	1	PA	27.27	27.27	27.2	0.3
6x	2	LPO 40	19.23	19.23	18.7	2.8
6x	3	LPO 80	23.36	23.36	23.0	1.5
6x	4	LAO 120	22.18	22.18	21.8	1.7
6x	5	LAO 160	28.22	28.22	28.4	-0.6
6x	6	RAO 200	26.50	26.50	25.9	2.3
6x	7	RAO 240	19.18	19.18	18.8	2.0
6x	8	RPO 280	23.72	23.72	23.4	1.3
6x	9	RPO 320	30.96	30.96	30.3	2.1
			Total Dose	220.6	217.5	% Diff 1.4%

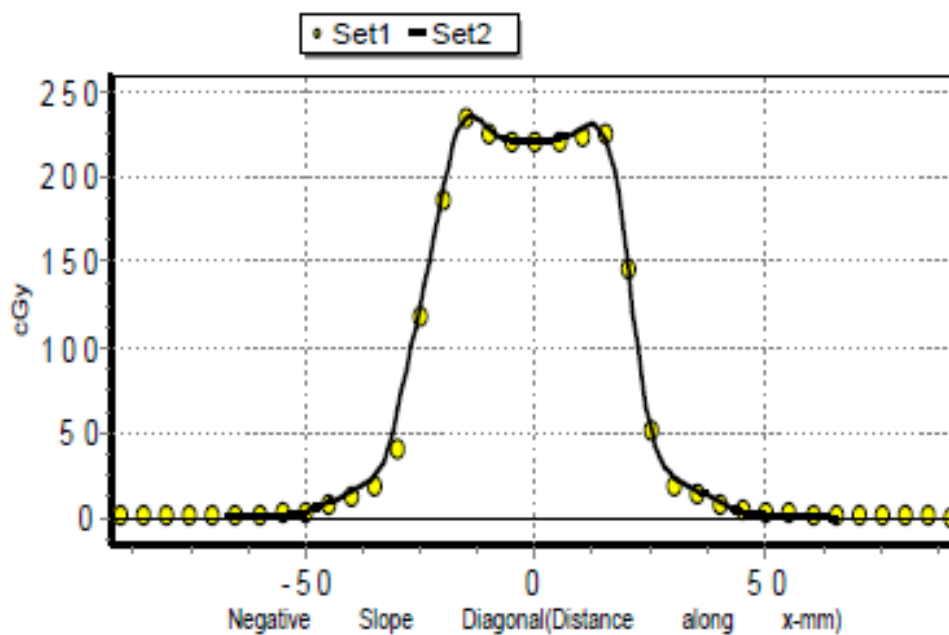


Figure 28 RGRT patient #3 profile of measured dose plane compared to Eclipse™ dose plane.

Table 33 Comparison summary between MapCHECK™ CAX measurements compared to RadCalc®.

	Non-Gated
RGRT Patient #1	-0.6%
RGRT Patient #2	0.0%
RGRT Patient #3	1.4%
Average	0.3%

5 Discussion

5.1 Discussion of RGRT Phantom Patient QA

5.1.1 Quasar[™] Respiratory Motion Phantom QA

Acceptable agreement between measured and calculated point doses at the facility is currently 3% and 3 mm or 1 cGy. As shown in the results, the percent difference between measured CAX point doses and calculated point doses for all three phantom patients with the phantom in static and dynamic mode was within 3% or 1 cGy. In fact, the patient average of total measured CAX dose compared to the total calculated plan CAX dose from the Eclipse[™] TPS for static mode was -1.3% and for dynamic mode the average was -1.6%. The results show a 0.3% deviation in absolute dose between a static and dynamic delivery. RadCalc[®] showed similar agreement of 0.4% and 0.2% respectively with a 0.2% deviation. These results indicate that the point doses measured with a moving phantom are consistent with the point doses measured on a static phantom. Chen *et al.* (27) similarly concluded that the dose distribution on a moving phantom with the treatment machine under gated operation showed no significant difference from the stationary phantom with the treatment machine not under gated operation.

5.1.2 MapCHECK[™] QA

As mentioned above, acceptable agreement between measured and calculated point doses at the facility is currently 3% and 3 mm or 1 cGy. As shown in the results, the percent difference between measured CAX point doses and calculated

point doses for all three phantom patients with the beam in “non-gated”, and “gated” mode was within 3% and 3 mm or 1 cGy. The patient average of the total measured CAX dose compared to the total calculated plan CAX dose from the Eclipse™ TPS for “non-gated” mode was 0.9%, and for “gated” mode the average was 1.5%. The results show a 0.6% deviation in absolute dose between a “non-gated” and “gated” delivery. RadCalc® showed similar agreement of 1.2% and 1.7% respectively with a 0.5% deviation. This deviation is negligible, and confirms that there is no significant difference in output of the machine between “non-gated” and “gated” mode. Ramsey *et al.* (28) also had similar results with static tests using an ionization chamber and Varian equipment, which showed 0.8% deviation in absolute dose from a “non-gated” delivery.

The acceptance criteria for agreement between measured and calculated planar dose are currently at least 90% of measured points pass at 3% with a DTA of 3mm. As mentioned in the results, analysis of all individual beam comparisons for each phantom patient showed that 100% of the points measured passed with the passing criteria set to 3% and 3 mm with the exception of one field in which 96% of the points passed. This provides further confidence that the output of the machine between “non-gated” and “gated” mode is consistent. Kubo *et al.* (29) had a similar conclusion and found similar agreement between “non-gated” and “gated” treatment modes when evaluating the combination of ionization chamber and film results for several different gating modes.

5.2 Discussion of RGRT Patient QA

As shown in the results, the percent difference between measured CAX point doses and calculated point doses for all three RGRT patients was within 3% or 1 cGy. The total measured CAX dose compared to the total calculated plan CAX dose from the TPS was an average of 0.3%.

The analysis of all individual beam comparisons for each RGRT patient showed that 94% of the points measured passed with the passing criteria set to 3% and 3 mm with the exception of one field in which 91.2% of the points passed. It should be noted that if any of the variables, such as dose rate, are varied additional dosimetric verification should be performed.

6 Conclusion and Future work

6.1 Conclusion

The purpose of this study was to provide dosimetric verification for the complex treatment technique, RGRT. The QuasarTM respiratory motion phantom allows one to simulate respiratory motion and irradiate a moving treatment target, which are two very important qualifications of a suitable phantom for dosimetric verification. As discussed earlier, Task Group 76 reported (12) that the phantom should produce cyclical motion similar to respiration, the gating feedback mechanism must detect phantom motion, the phantom should allow attachment of dose measuring detectors, and finally, the phantom should be reliable and have a reasonable cost.

I confirmed with the dosimetric verification the ability to accurately measure the predicted or calculated dose from the TPS, validated the dose calculation algorithm used in the TPS and validated RadCalc[®], the independent monitor unit calculation. Agreement between the two algorithms, which included measurements within a complex and heterogeneous phantom as well as homogenous phantom, lends great confidence in our ability to accurately treat the patient as planned.

RGRT is a very attractive treatment technique in that it has the potential to achieve higher target dose, lower healthy tissue dose, higher chances for local control, lower chances for complications, etc. Dosimetric verification is a very important aspect of the implementation of RGRT, and it should not be taken lightly. It should be noted that dosimetric verification is only one very important aspect of the

implementation of RGRT. The implementation process is very complex, and each aspect should be individually evaluated and verified.

6.2 Future Work

The effect of dose rate on dosimetric agreement between “gated” and “non-gated” treatment modes could be investigated using the same phantom patients. For example, dose rates of 400 MU/min and 600 MU/min could be used when measuring CAX point doses as well as planar doses.

Sun Nuclear manufactures a product called MotionSim XY/4D[™] which is a 3-D motion simulator. MotionSim would move MapCHECK[™] in 3-D during measurements of RGRT treatment fields. MapCHECK[™] accompanied with the MotionSim XY/4D[™] would be a very interesting QA tool for dosimetric verification of RGRT.

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Appendices

Appendix A – Phantom Patients “Non-gated” and “Gated” MapCHECK™ Results

QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 57
Passed : 57
Failed : 0
% Passed : 100

Dose Values in cGy

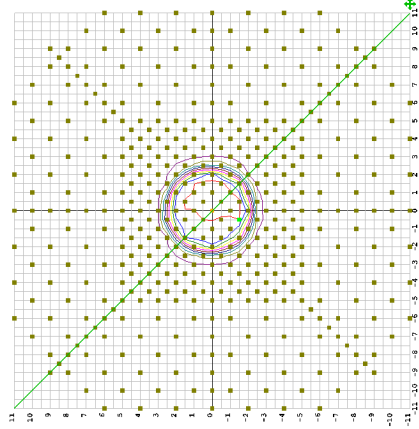
	Cax	Normal	Picked
Set1	22.35	21.57	22.35
Set2	21.67	20.81	21.67
Set1-Set2	0.69	0.76	0.69
% Diff	3.30	3.67	3.30
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5	0,0

Notes

Gated Beam 1

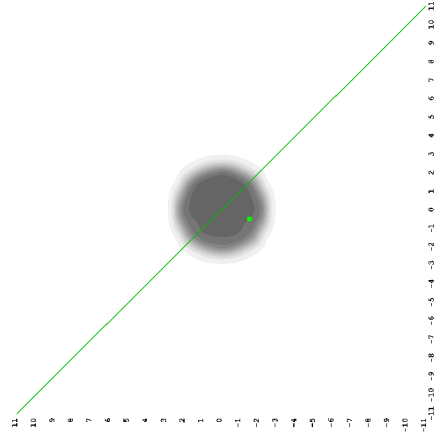
Reviewed By :

Set1

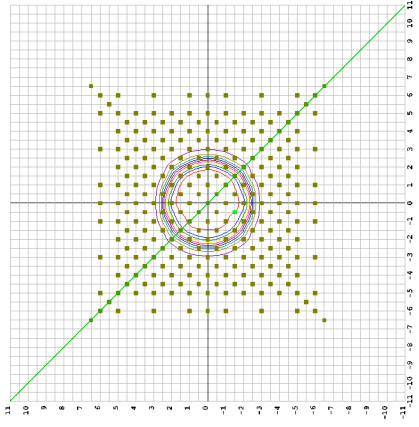


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\10BPM Gated\1.txt

Set1-Set2

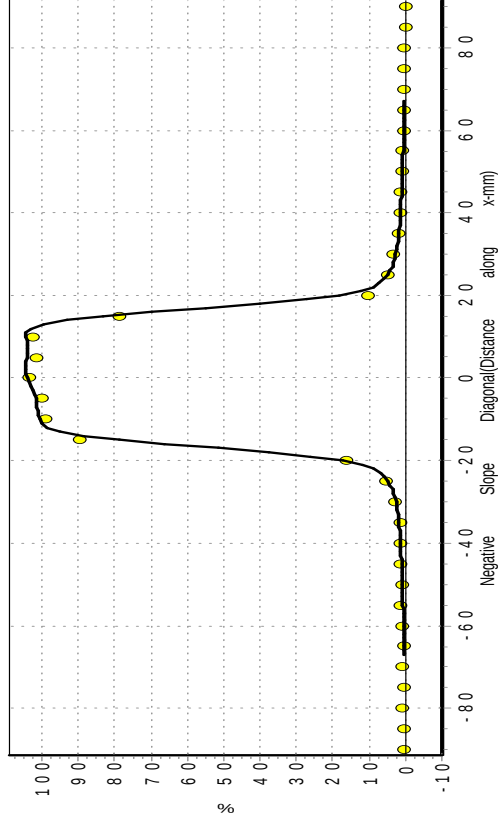


Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #1 Eclipse Dose Planes\Beam 1.dcm

• Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

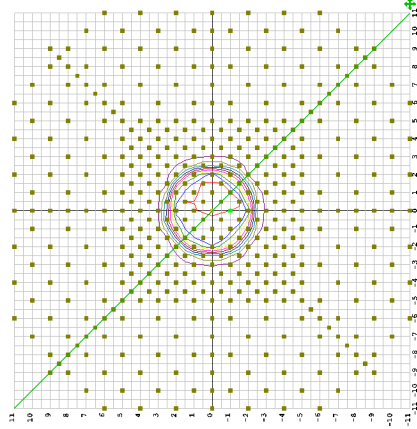
Dose Values in cGy	
Cax	Picked
Set1	19.89
Set2	19.62
Set1-Set2	0.32
% Diff	1.64
DTA(mm)	0.00
Coords (y,x) cm	0.0 -1.0

Notes

Gated Beam 2

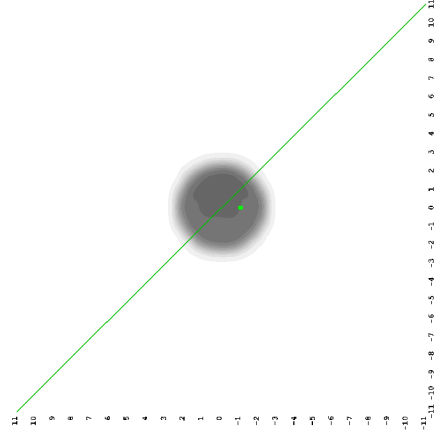
Reviewed By :

Set1

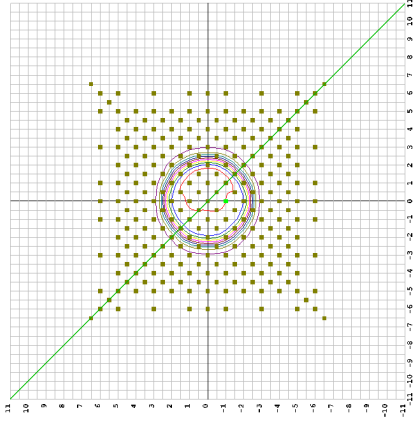


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\10BPM Gated\2.txt

Set1-Set2

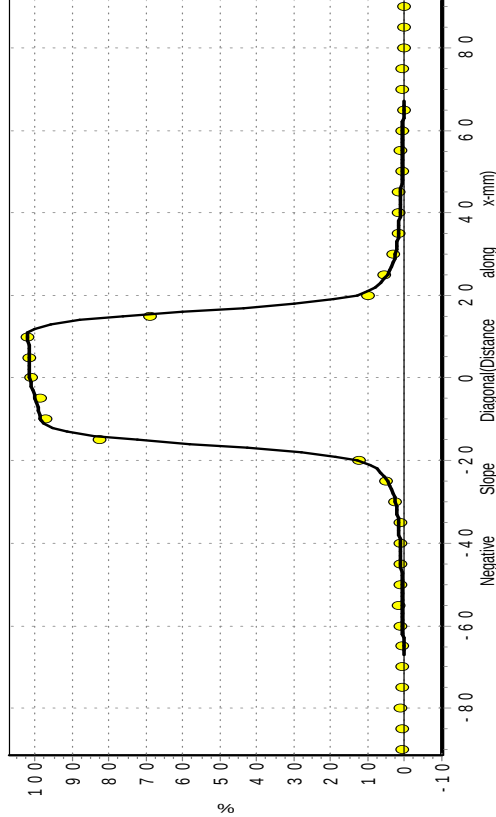


Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #1 Eclipse Dose Planes\Beam 2.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 57
Passed : 57
Failed : 0
% Passed : 100

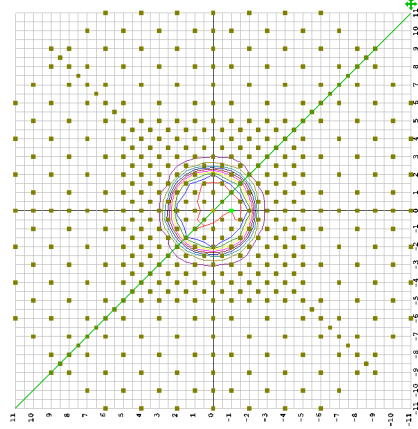
Dose Values in cGy	
Cax	Picked
Set1	Normal
Set1	19.53
Set2	19.09
Set1-Set2	18.62
Set1-Set2	19.01
% Diff	0.52
% Diff	0.48
DTA(mm)	2.80
DTA(mm)	2.56
Coords (y,x) cm	0.00
Coords (y,x) cm	0.00
Coords (y,x) cm	-1.0
Coords (y,x) cm	0.0

Notes

Gated Beam 3

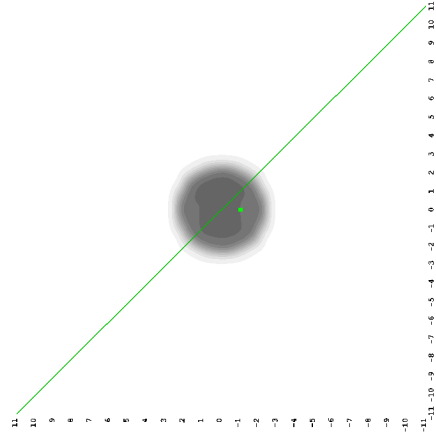
Reviewed By :

Set1

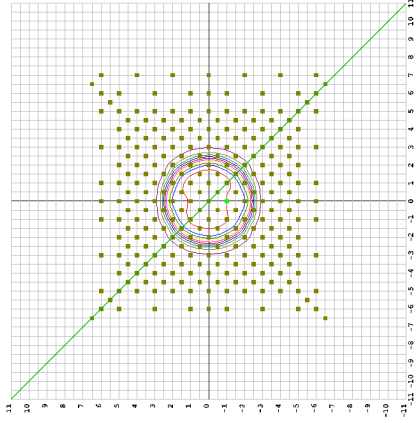


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Set1-Set2

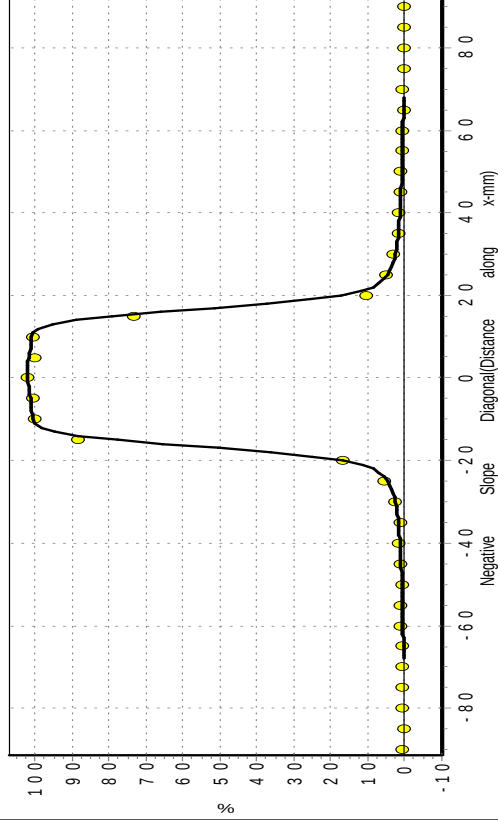


Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #1 Eclipse Dose Planes\Beam 3.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	19.39	19.03
Set2	19.06	18.76
Set1-Set2	0.32	0.26
% Diff	1.71	1.40
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1,0

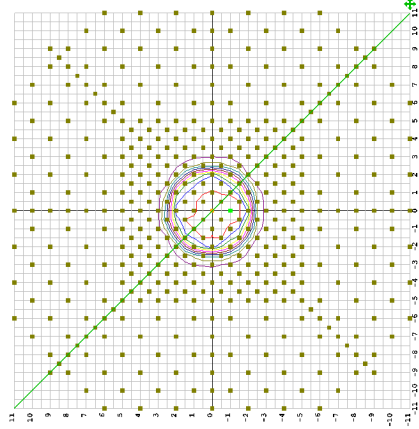
Notes

Gated Beam 4

Reviewed By :

Set1

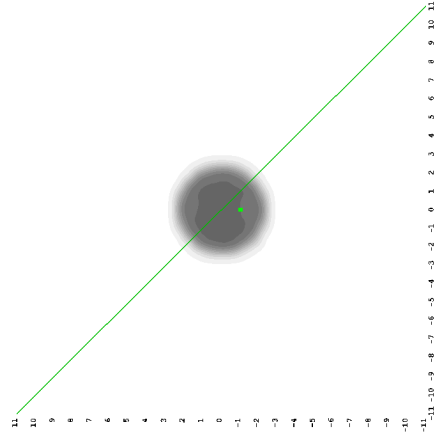
Relative
100
90
80
70
60
50
40
30
20
10
0



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Check Gated\10BPM Gated\4.txt

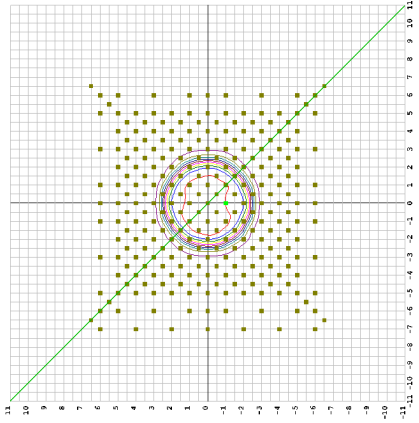
Set1-Set2

Relative
100
90
80
70
60
50
40
30
20
10
0



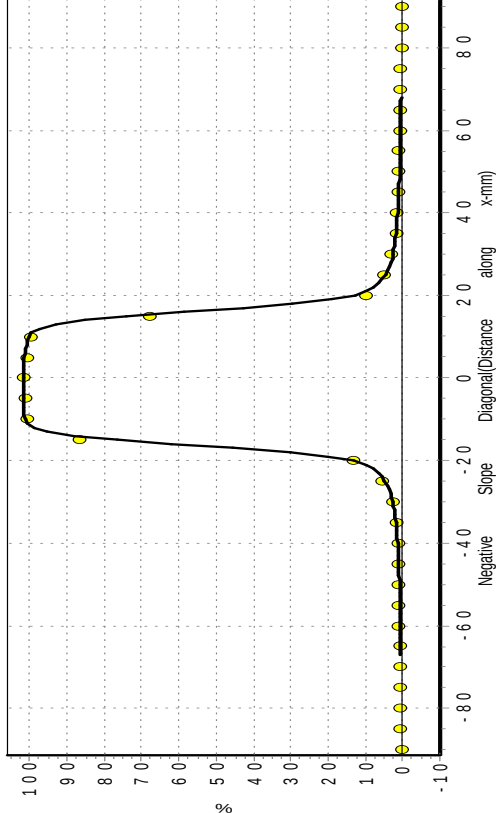
Set2

Relative
100
90
80
70
60
50
40
30
20
10
0



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 4.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 58
Passed : 58
Failed : 0
% Passed : 100

Dose Values in cGy	
Cax	Picked
Normal	
Set1	20.49
Set2	20.34
Set1-Set2	0.14
% Diff	0.79
DTA(mm)	0.00
Coords (y,x) cm	0.0 -2.0

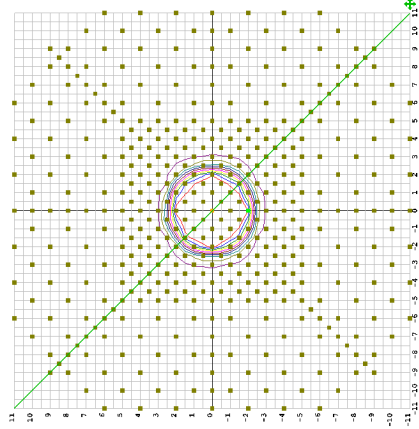
Notes

Gated Beam 5

Reviewed By :

Set1

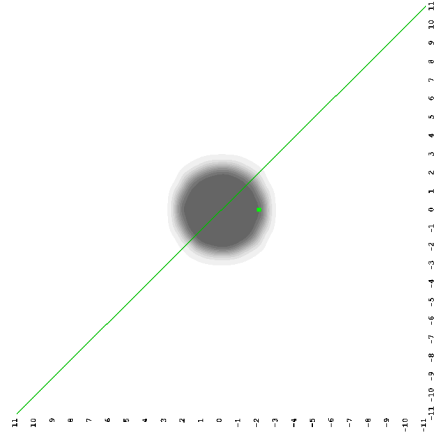
Relative



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Gated\10BPM Gated\5.txt

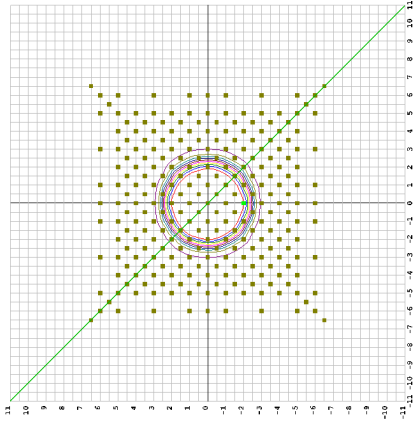
Set1-Set2

Relative



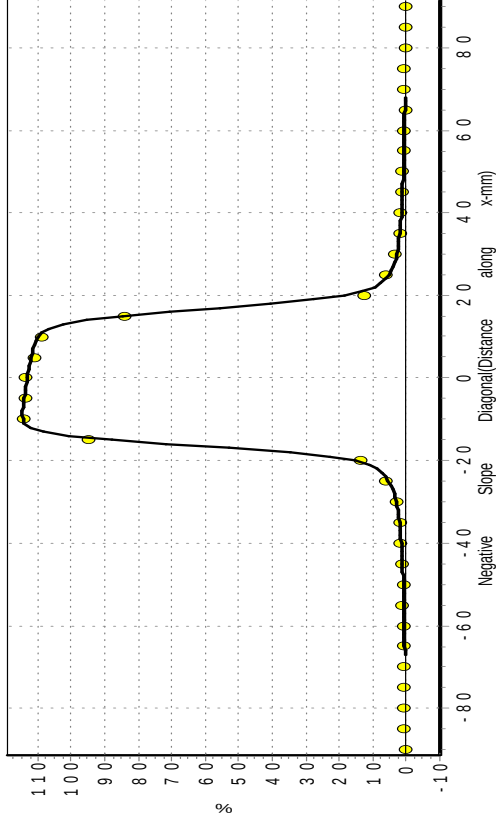
Set2

Relative



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 5.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	23.23	23.25
Set2	22.89	22.61
Set1-Set2	0.34	0.64
% Diff	1.50	2.83
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

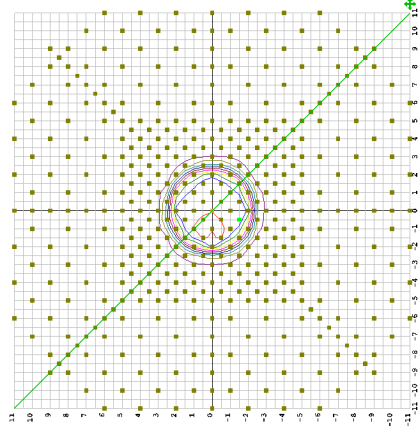
Notes

Gated Beam 6

Reviewed By :

Set1

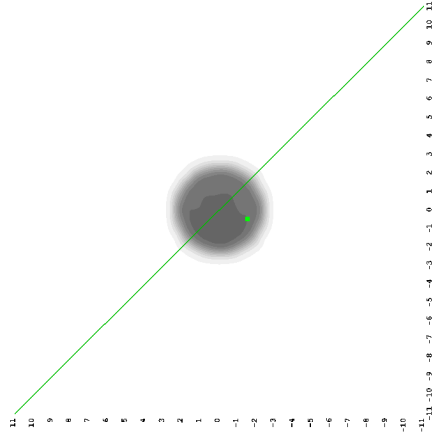
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Gated\10BPM Gated\6.txt

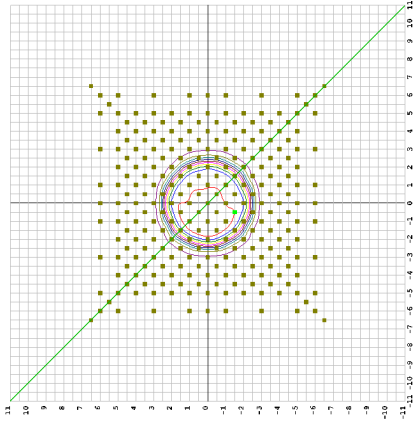
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



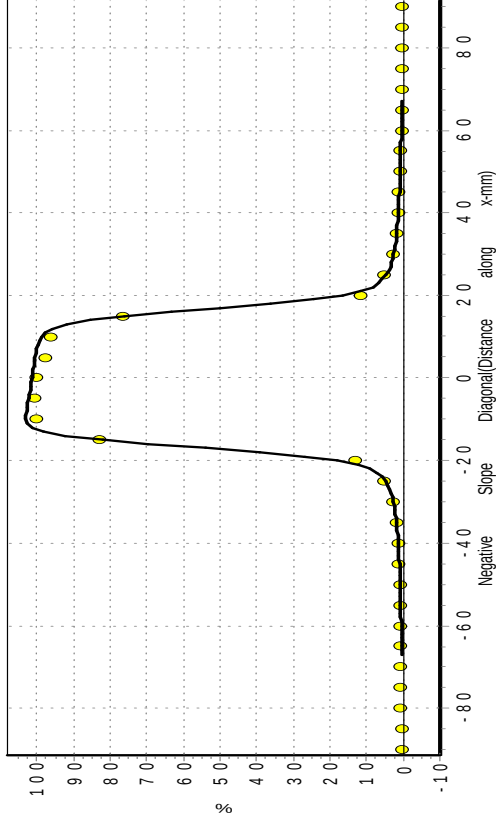
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 6.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 53
Failed : 2
% Passed : 96.4

Dose Values in cGy		
	Cax	Picked
Set1	34.00	34.10
Set2	35.03	36.51
Set1-Set2	-1.03	-2.41
% Diff	-2.81	-6.59
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-0.5,-0.5

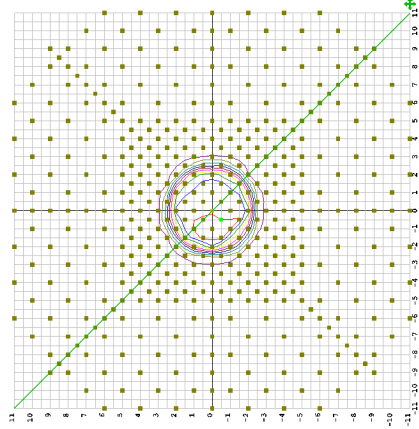
Notes

Gated Beam 7

Reviewed By :

Set1

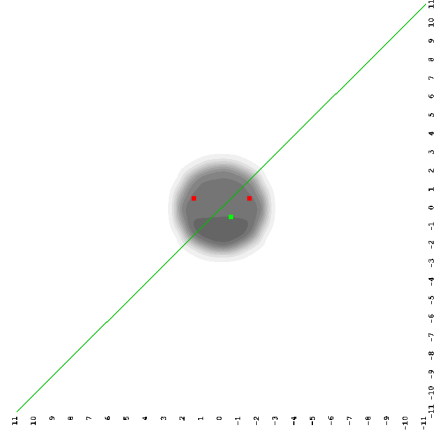
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Gated\10BPM Gated\7.txt

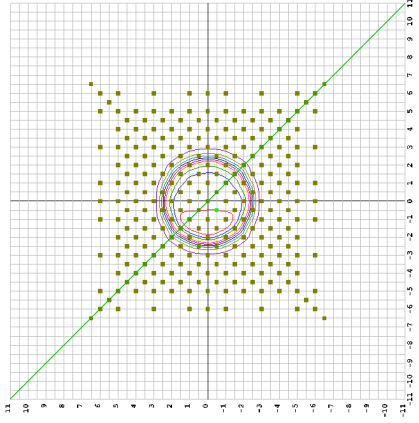
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



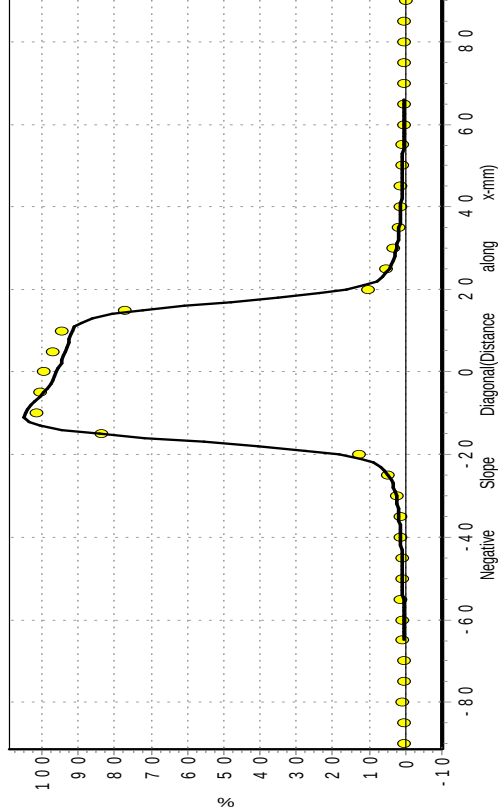
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 8.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	36.48	37.32
Set2	35.03	35.76
Set1-Set2	1.45	1.55
% Diff	4.05	4.34
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

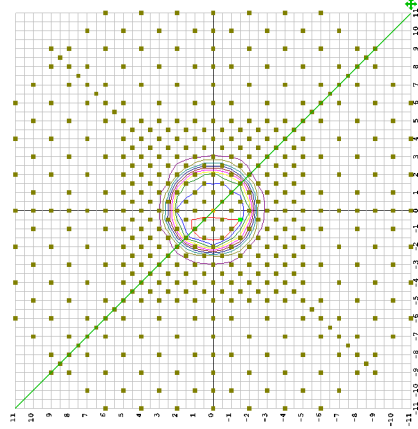
Notes

Gated Beam 8

Reviewed By :

Set1

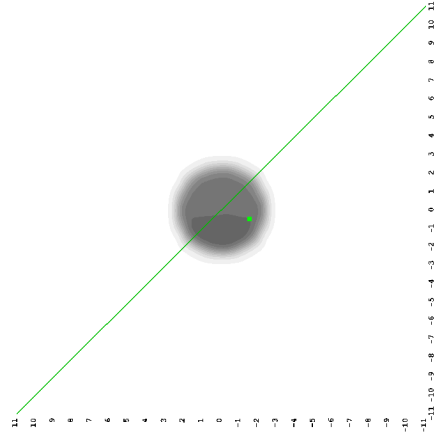
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



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Check Gated\10BPM Gated\8.txt

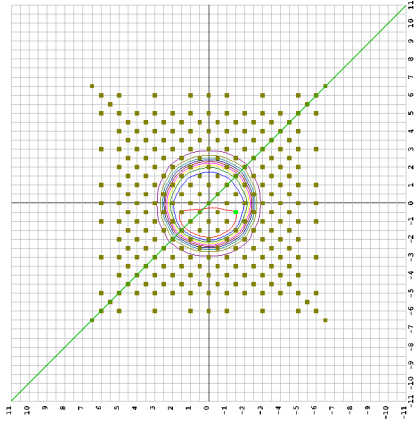
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



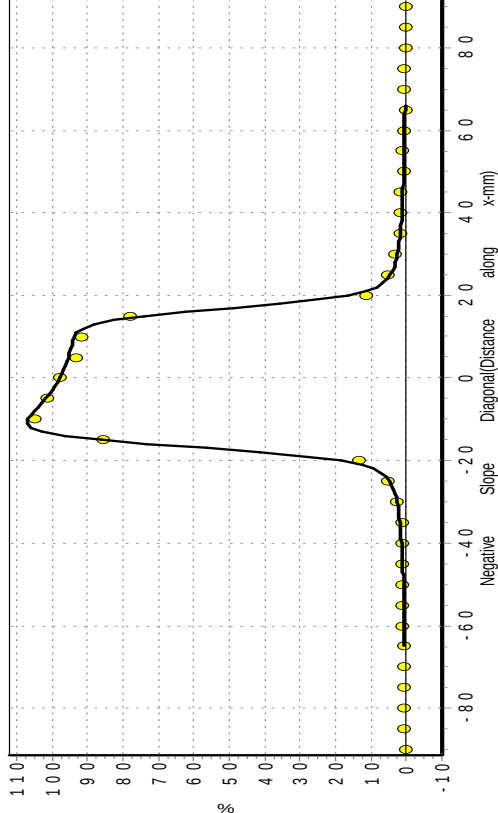
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 8.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

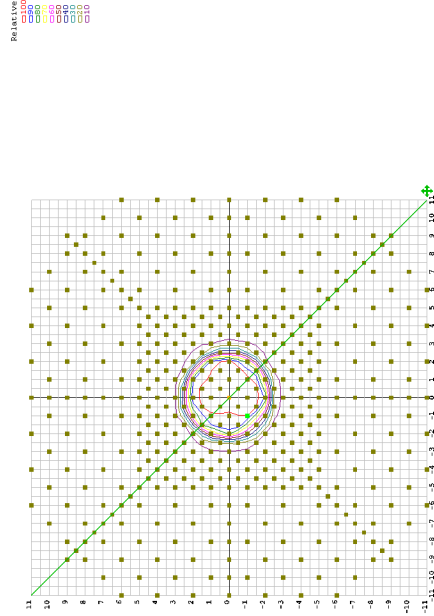
Dose Values in cGy	
Cax	Picked
Set1	25.65
Set2	25.29
Set1-Set2	0.36
% Diff	1.47
DTA(mm)	0.00
Coords (y,x) cm	-1,-1

Notes

Gated Beam 9

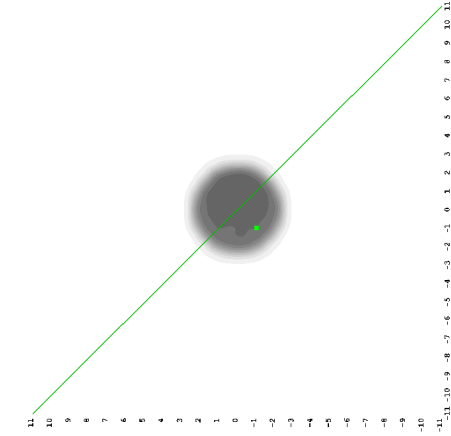
Reviewed By :

Set1

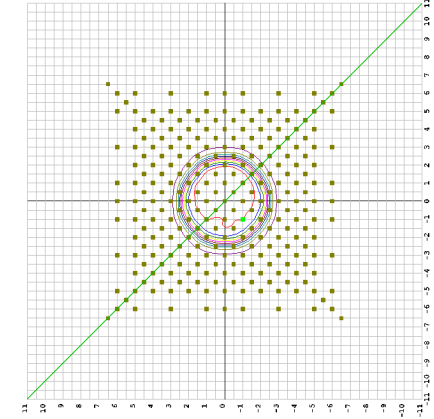


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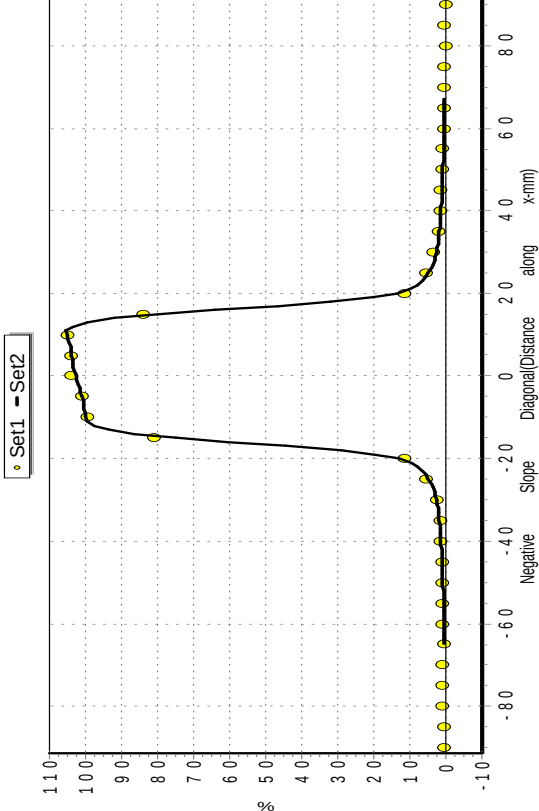
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #1 Eclipse Dose Planes\Beam 9.dcm



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 57
Passed : 57
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	22.16	21.75
Set2	21.67	21.27
Set1-Set2	0.49	0.48
% Diff	2.30	2.27
DTA(mm)	0.00	0.00
Coords (y,x) cm	0.0	-1.0

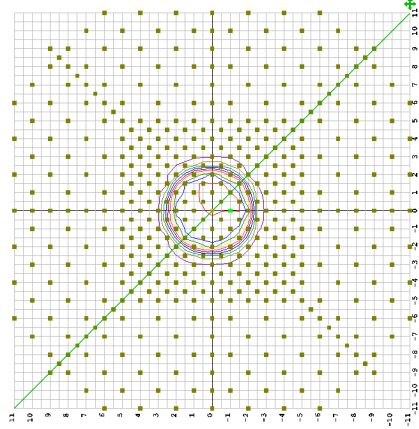
Notes

Non-gated Beam 1

Reviewed By :

Set1

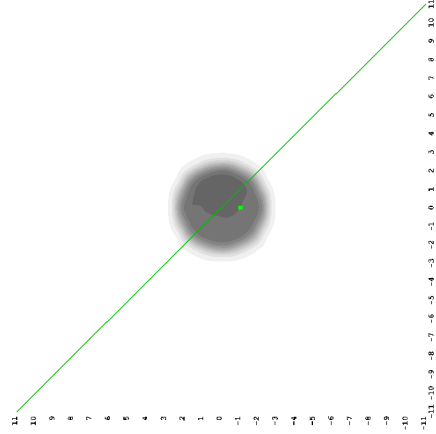
Relative



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Non Gated\10 bpm non gated\1.txt

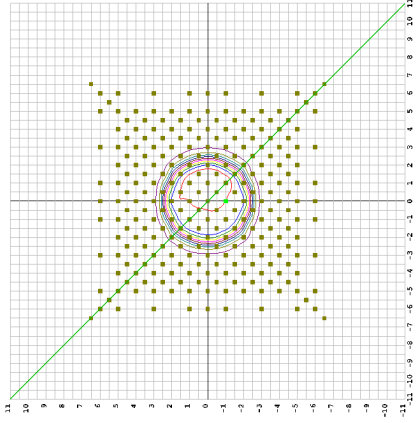
Set1-Set2

Relative



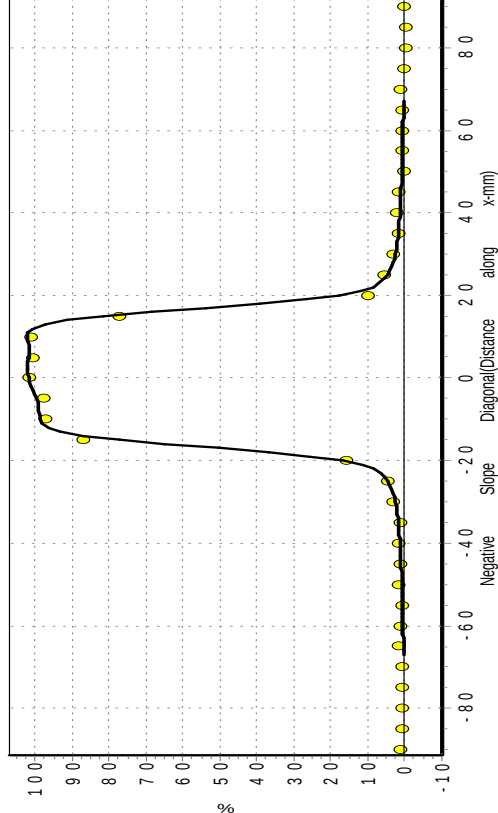
Set2

Relative



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 1.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

Dose Values in cGy	
Cax	Picked
Normal	
Set1	19.67 19.82 19.67
Set2	19.57 19.99 19.57
Set1-Set2	0.11 -0.17 0.11
% Diff	0.53 -0.83 0.53
DTA(mm)	0.00 0.00 0.00
Coords (y,x) cm	0,0 -0.5,1.5 0,0

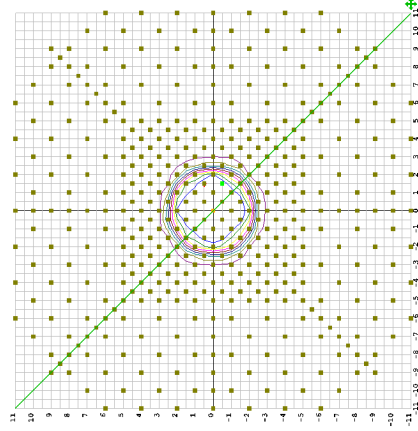
Notes

Non-gated Beam 2

Reviewed By :

Set1

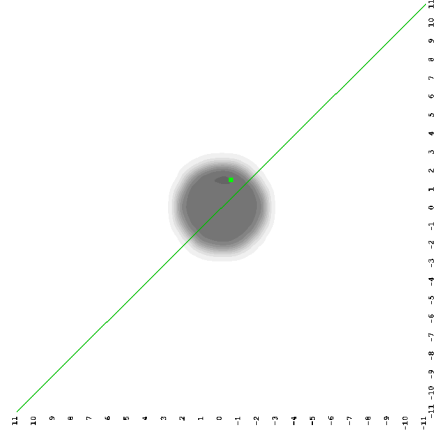
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



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Check Non Gated\10 bpm non gated\2.txt

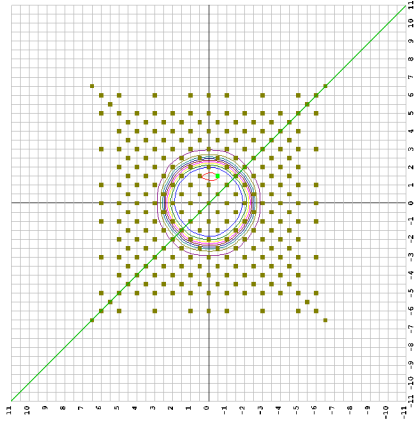
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



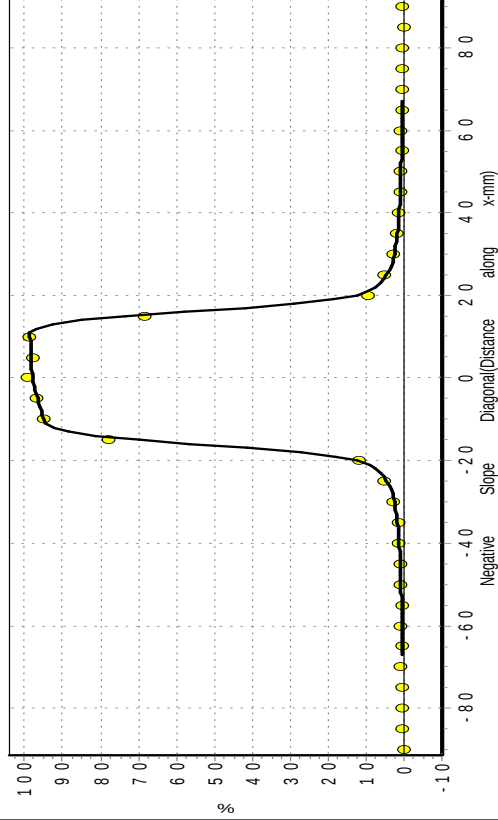
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 2.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 57
Passed : 57
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	19.32	16.85
Set2	19.01	16.94
Set1-Set2	0.31	-0.09
% Diff	1.83	-0.54
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

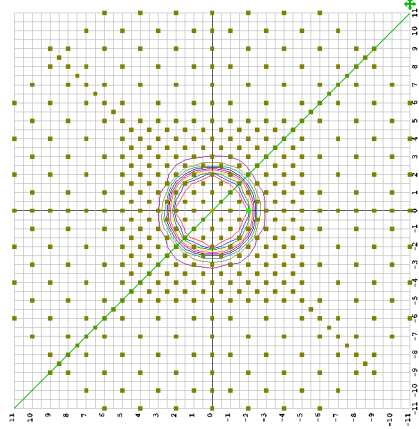
Notes

Non-gated Beam 3

Reviewed By :

Set1

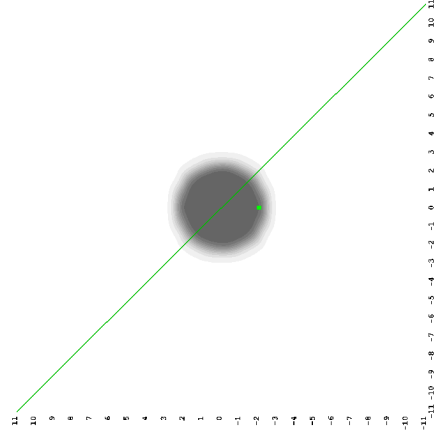
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



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Check Non Gated\10 bpm non gated\3.txt

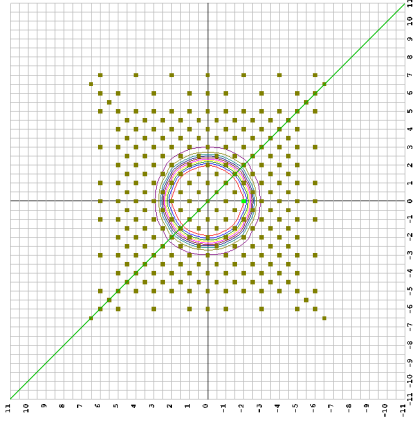
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



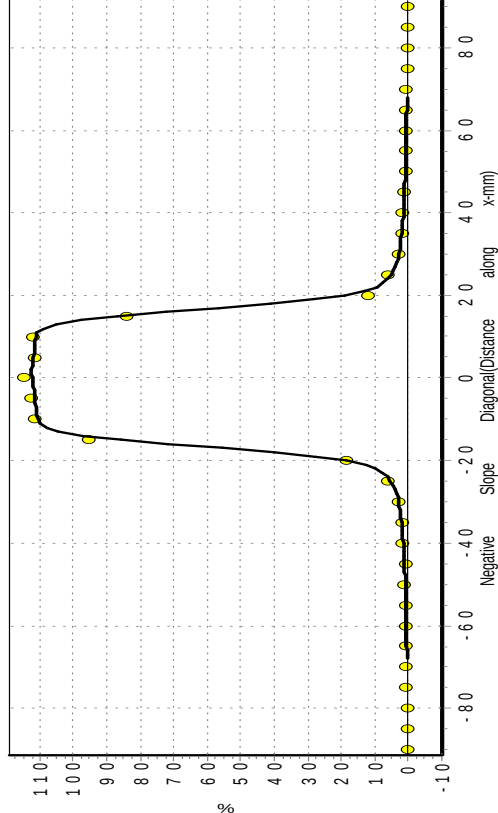
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 3.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 58
Passed : 58
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	19.16	19.16
Set2	19.06	16.82
Set1-Set2	0.10	-0.09
% Diff	0.59	-0.53
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

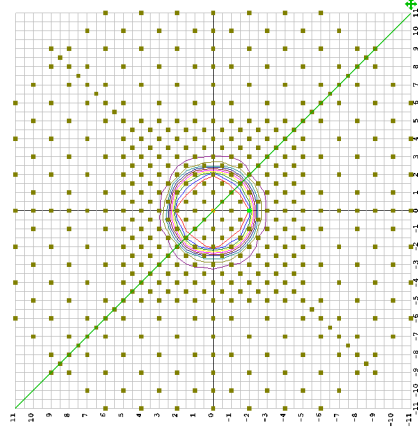
Notes

Non-gated Beam 4

Reviewed By :

Set1

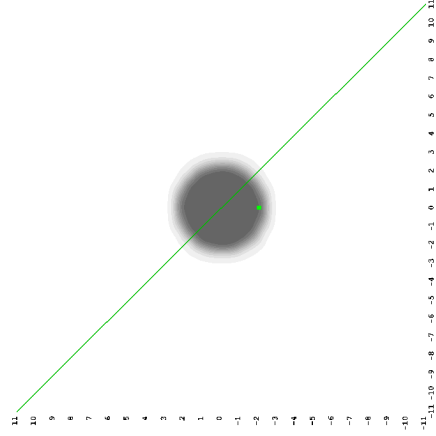
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Non Gated\10 bpm non gated\4.txt

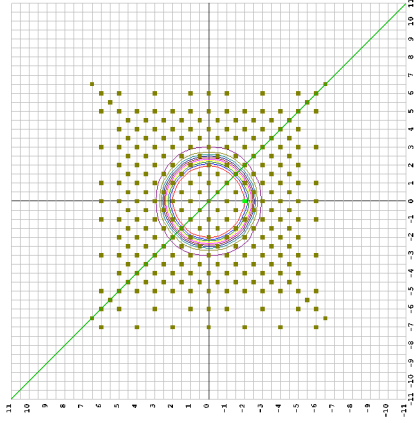
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



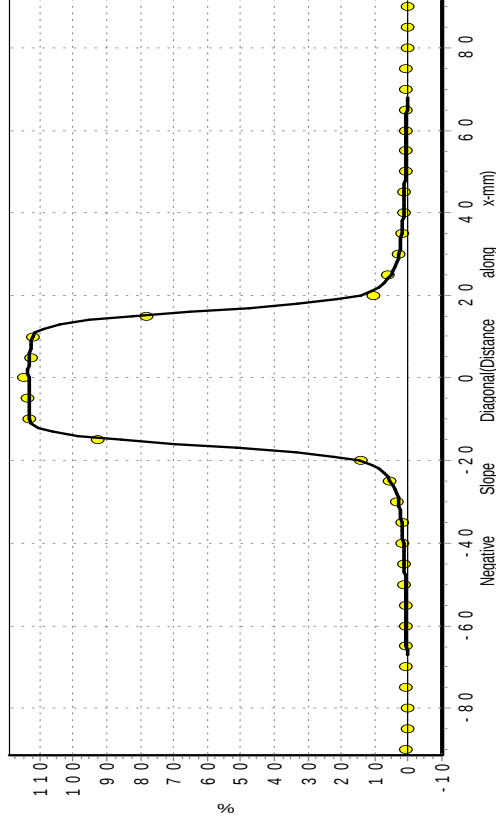
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 4.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 58
Passed : 58
Failed : 0
% Passed : 100

Dose Values in cGy	
Cax	Picked
Normal	
Set1	20.30 18.04 20.30
Set2	20.34 18.00 20.34
Set1-Set2	-0.04 0.04 -0.04
% Diff	-0.24 0.21 -0.24
DTA(mm)	0.00 0.00 0.00
Coords (y,x) cm	0,0 -2,0 0,0

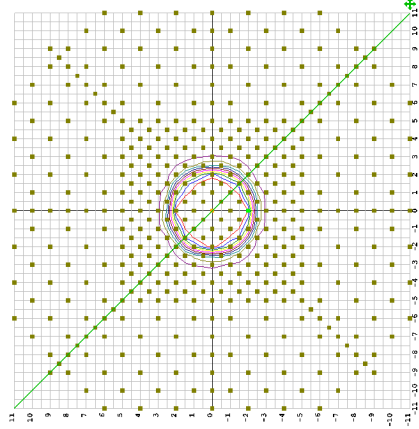
Notes

Non-gated Beam 5

Reviewed By :

Set1

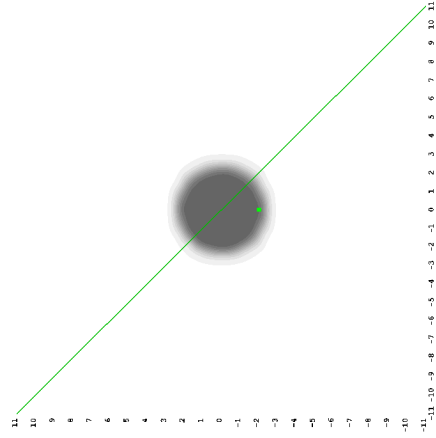
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Non Gated\10 bpm non gated\5.txt

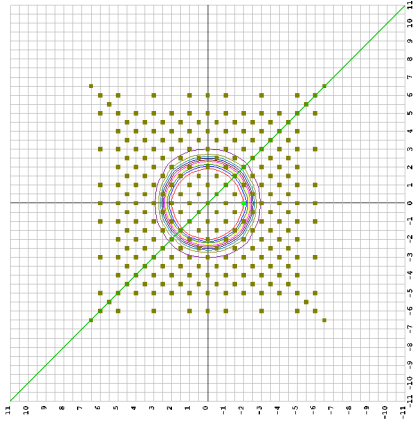
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



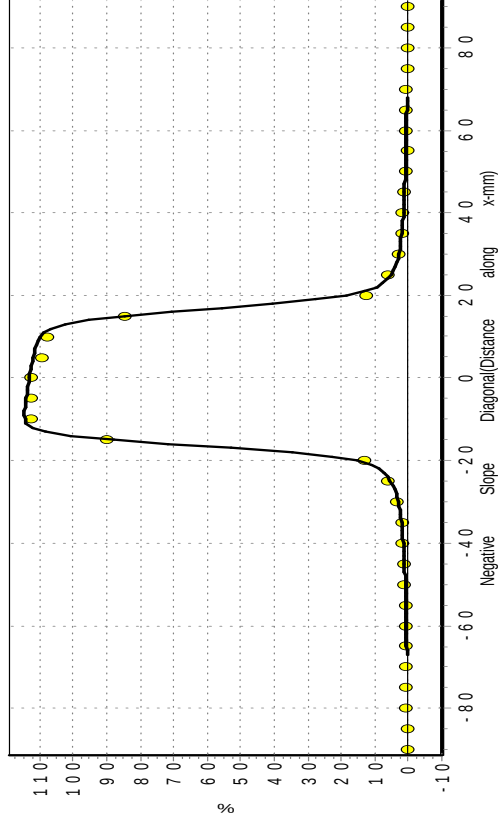
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 5.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 58
Passed : 58
Failed : 0
% Passed : 100

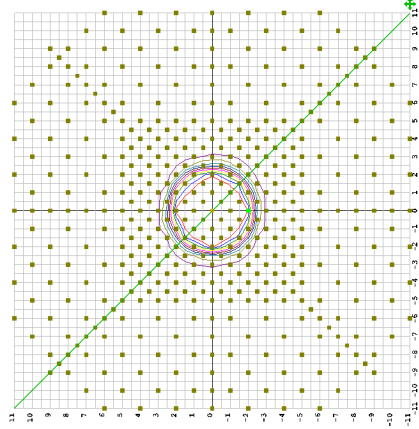
Dose Values in cGy		
	Cax	Picked
Set1	23.03	20.44
Set2	22.89	20.33
Set1-Set2	0.14	0.11
% Diff	0.67	0.56
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 6

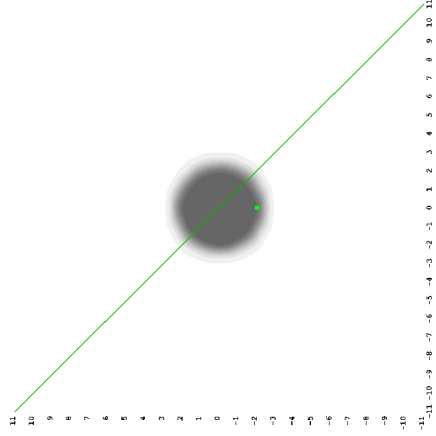
Reviewed By :

Set1

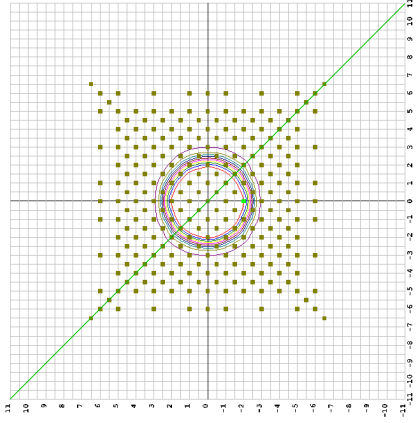


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Set1-Set2

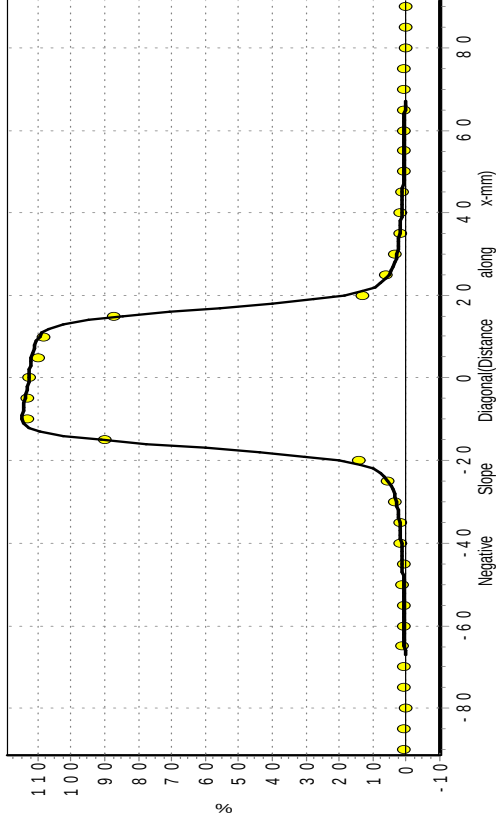


Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #1 Eclipse Dose Planes\Beam 6.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 58
Passed : 58
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	33.55	33.55
Set2	32.97	32.97
Set1-Set2	0.58	0.58
% Diff	1.96	1.96
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

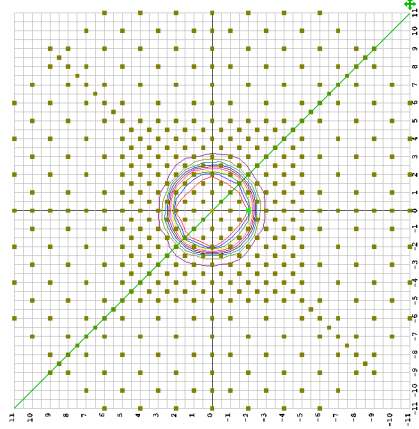
Notes

Non-gated Beam 7

Reviewed By :

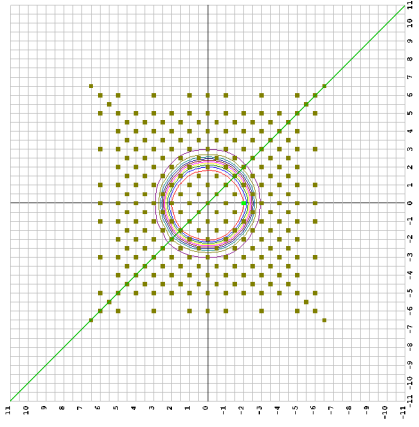
Set1

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100

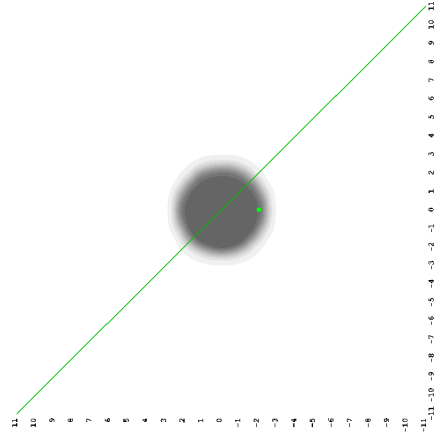


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Check Non Gated\10 bpm non gated\7.txt

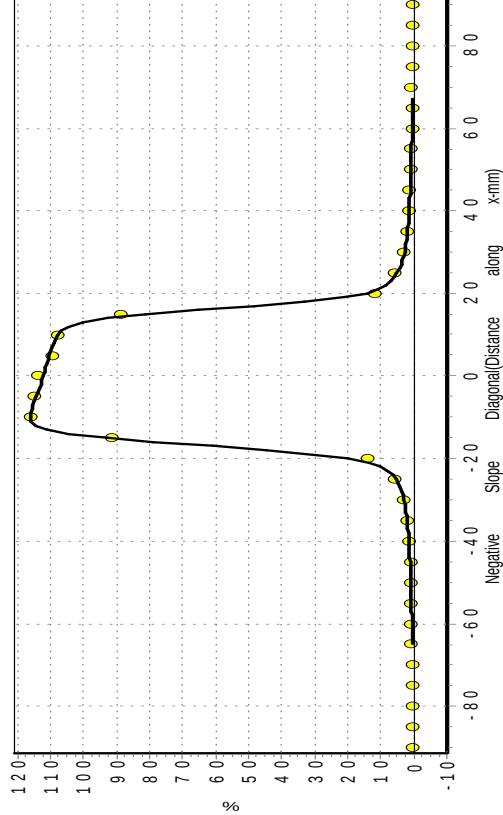
C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 7.dcm

Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	35.97	36.69
Set2	35.03	35.76
Set1-Set2	0.94	0.93
% Diff	2.64	2.59
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

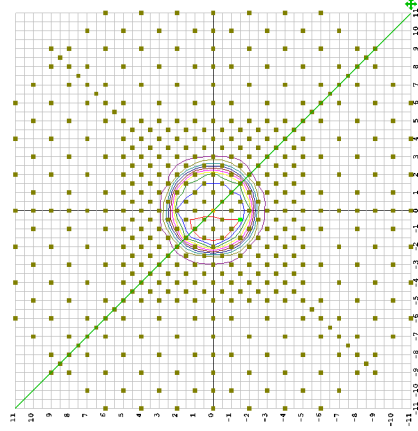
Notes

Non-gated Beam 8

Reviewed By :

Set1

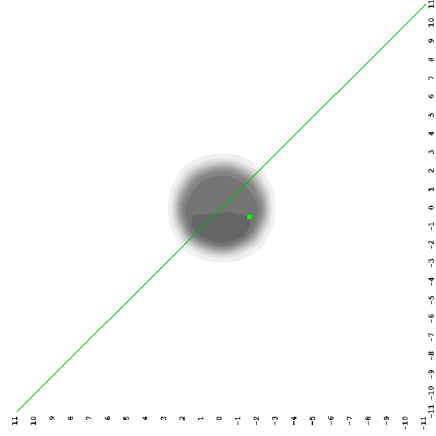
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



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Check Non Gated\10 bpm non gated\8.txt

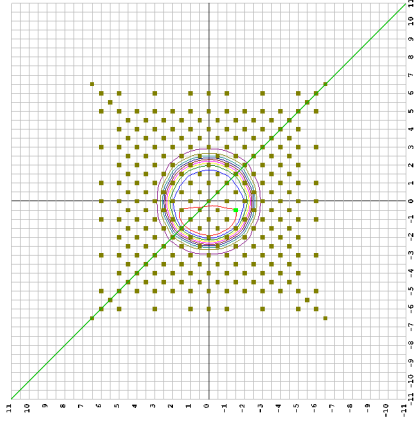
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



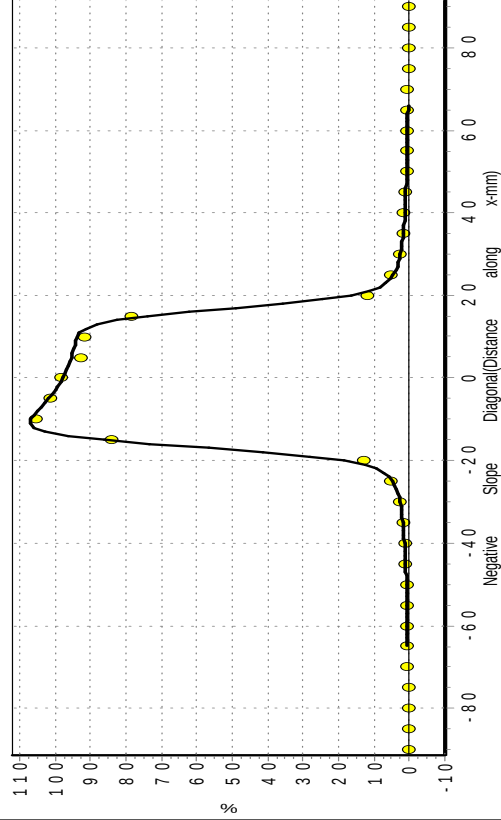
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



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ntom Patient #1 Eclipse Dose Planes\Beam 8.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #1
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
D to A (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	25.33	25.33
Set2	25.29	25.29
Set1-Set2	0.04	0.04
% Diff	0.17	0.17
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1,-1

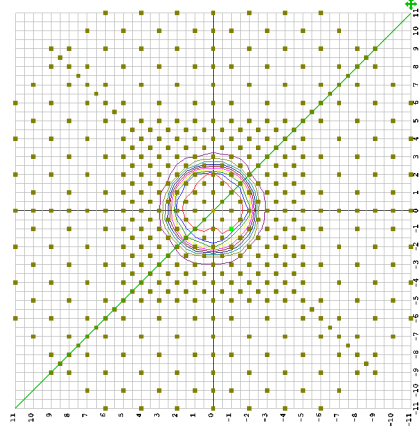
Notes

Non-gated Beam 9

Reviewed By :

Set1

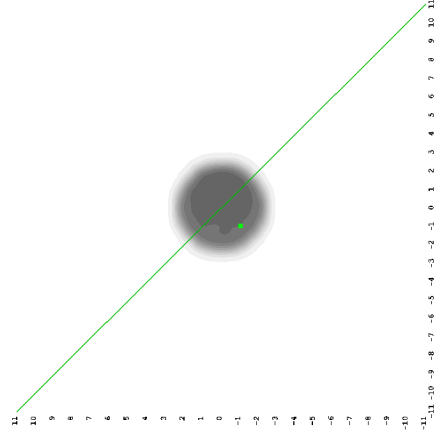
Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Non Gated\10 bpm non gated\9.txt

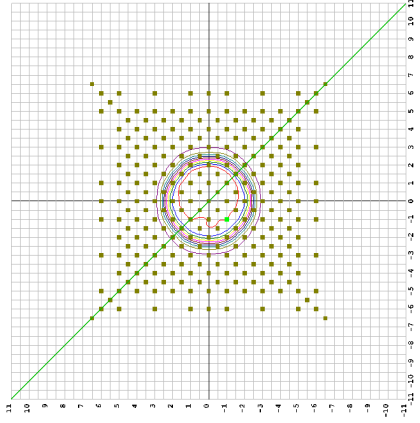
Set1-Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



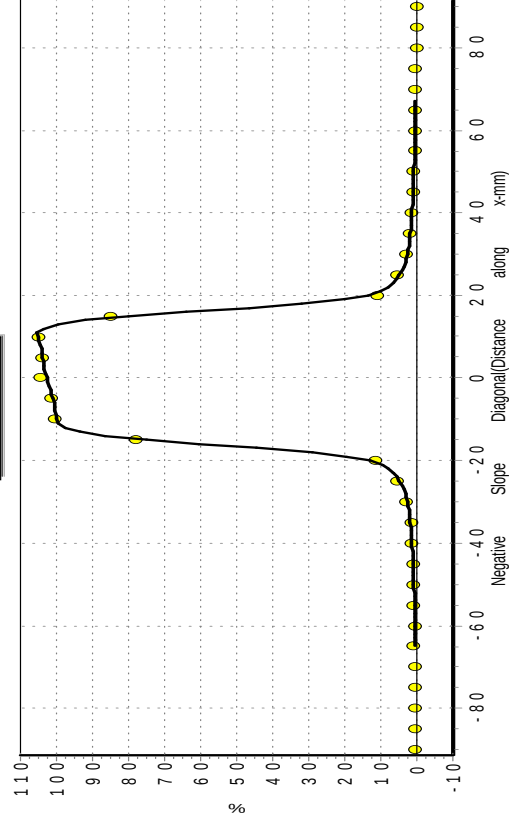
Set2

Relative
100
80
60
40
20
0
-20
-40
-60
-80
-100



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #1 Eclipse Dose Planes\Beam 9.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

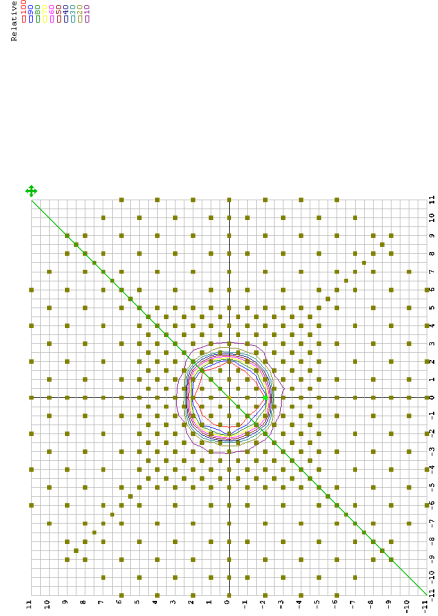
Dose Values in cGy	
Cax	Picked
Normal	
Set1	22.10 20.36 22.10
Set2	21.92 19.90 21.92
Set1-Set2	0.18 0.46 0.18
% Diff	0.92 2.31 0.92
DTA(mm)	0.00 0.00 0.00
Coords (y,x) cm	0,0 -2,0 0,0

Notes

Gated Beam 1

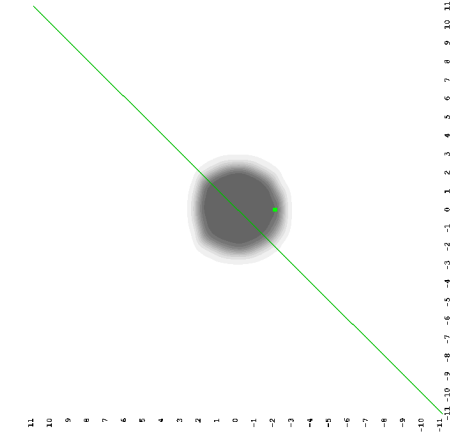
Reviewed By :

Set1

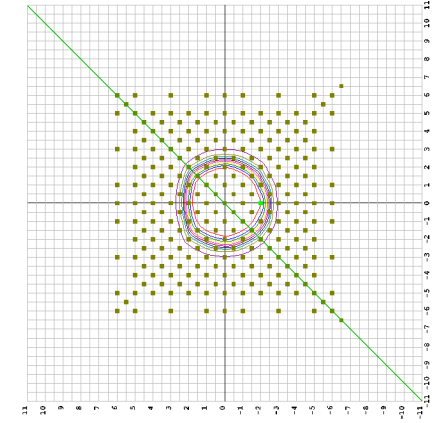


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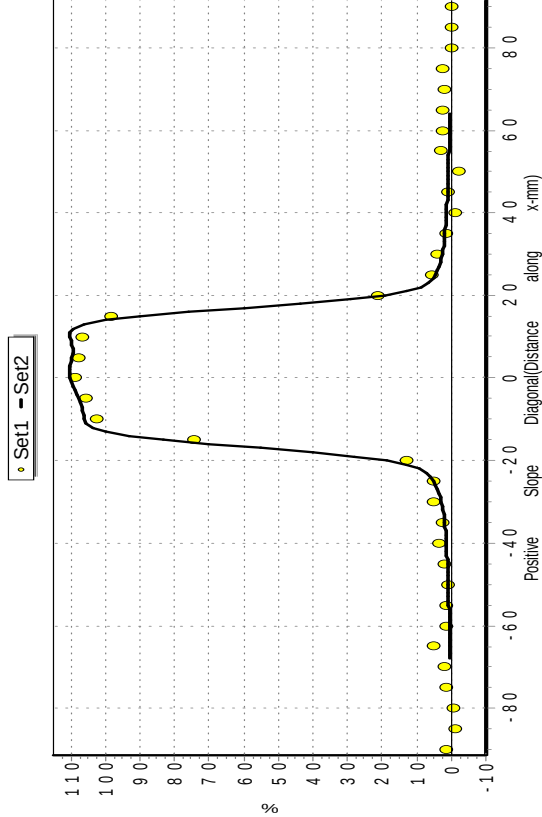
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 1.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

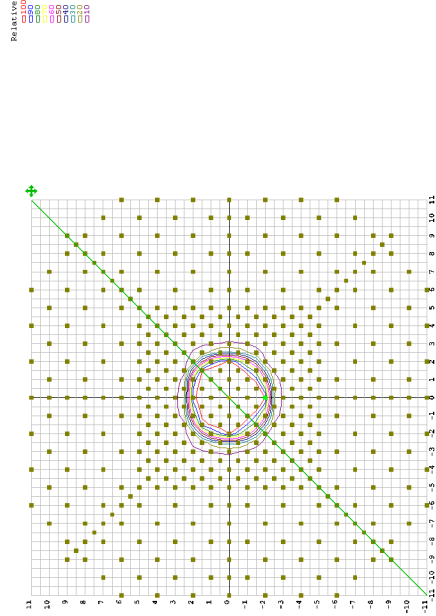
Dose Values in cGy		
	Cax	Picked
Set1	20.13	17.89
Set2	19.80	17.71
Set1-Set2	0.33	0.17
% Diff	1.85	0.97
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 2

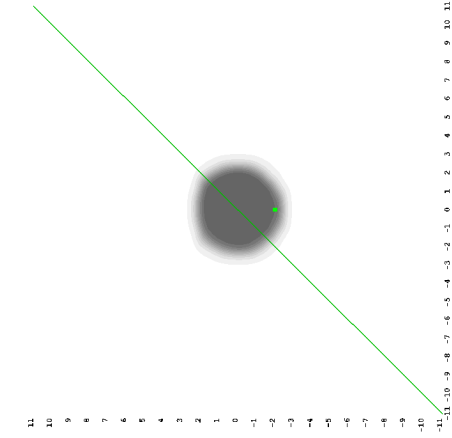
Reviewed By :

Set1

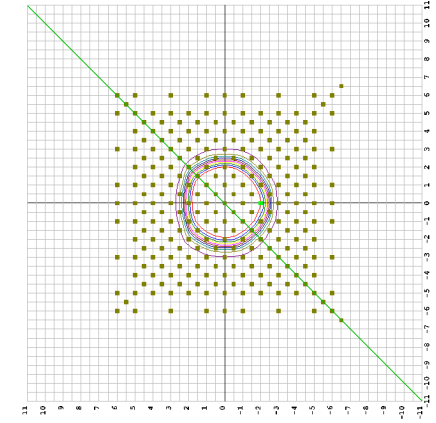


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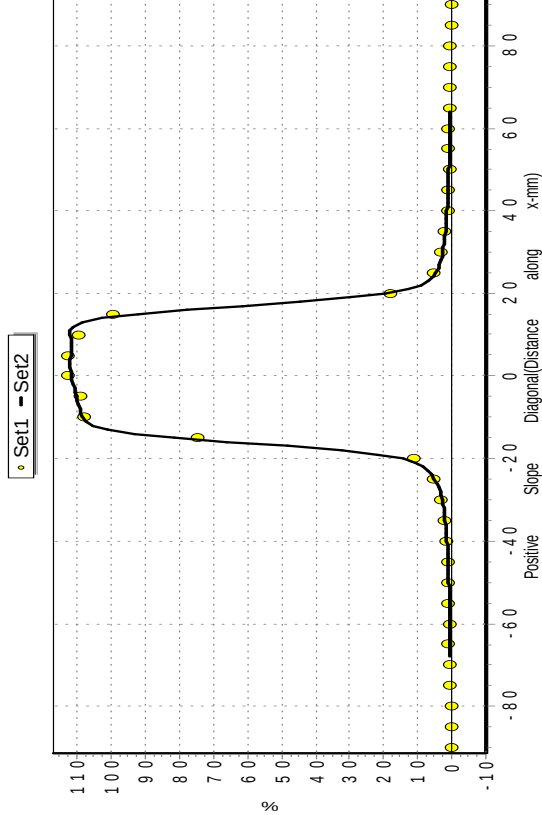
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 2.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

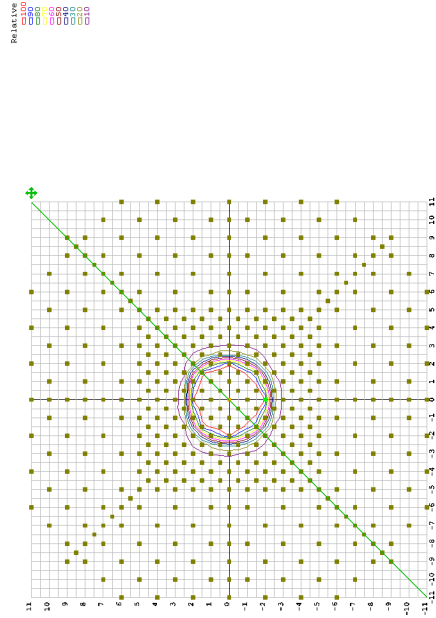
Dose Values in cGy	
Cax	Picked
Normal	
Set1	19.37 17.44 19.37
Set2	19.24 17.38 19.24
Set1-Set2	0.13 0.05 0.13
% Diff	0.76 0.31 0.76
DTA(mm)	0.00 0.00 0.00
Coords (y,x) cm	0,0 -2,0 0,0

Notes

Gated Beam 3

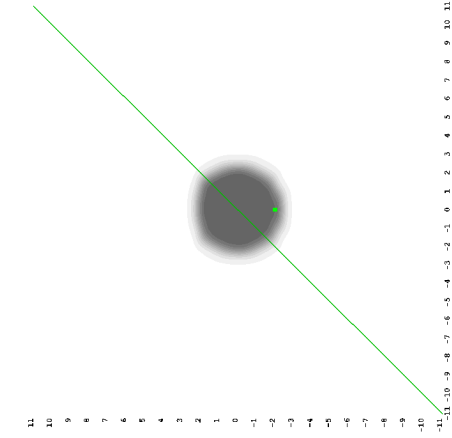
Reviewed By :

Set1

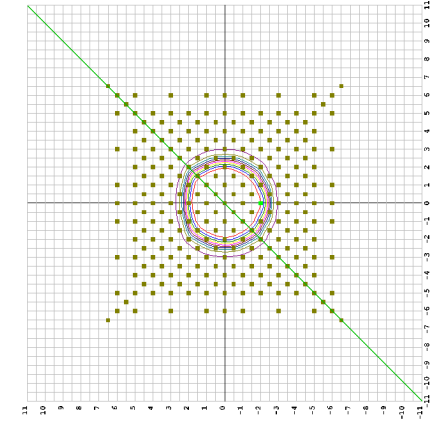


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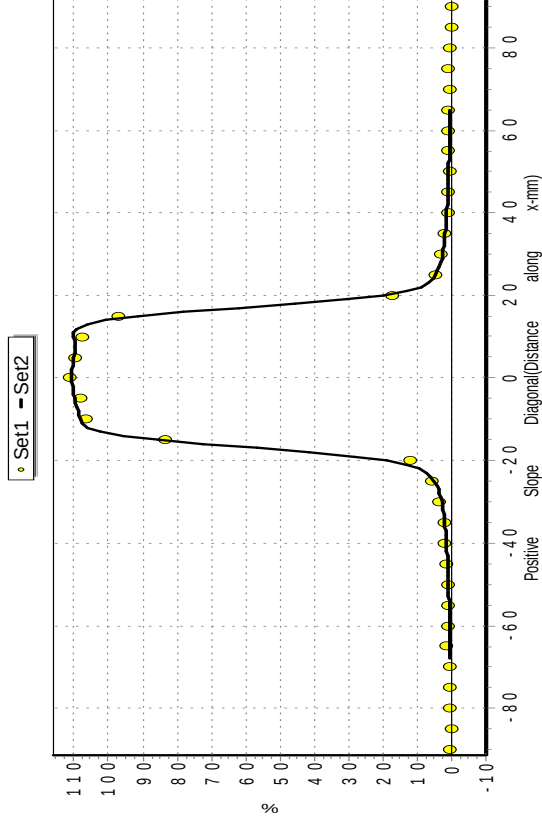
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 3.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

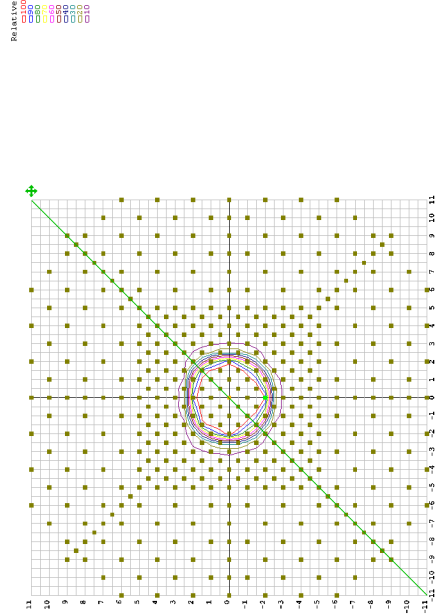
Dose Values in cGy		
	Cax	Picked
Set1	19.77	17.66
Set2	19.33	17.32
Set1-Set2	0.44	0.34
% Diff	2.52	1.95
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 4

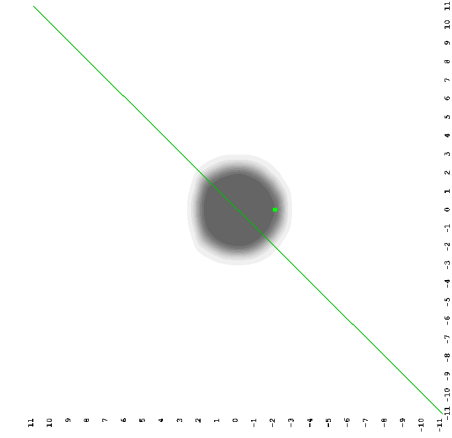
Reviewed By :

Set1

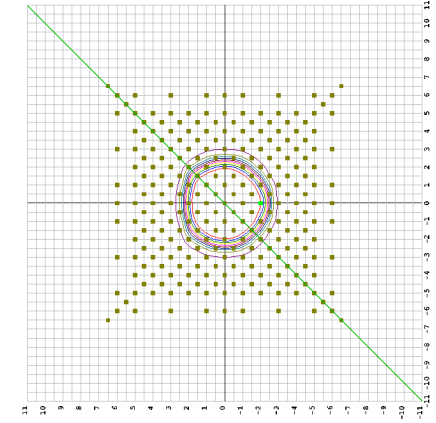


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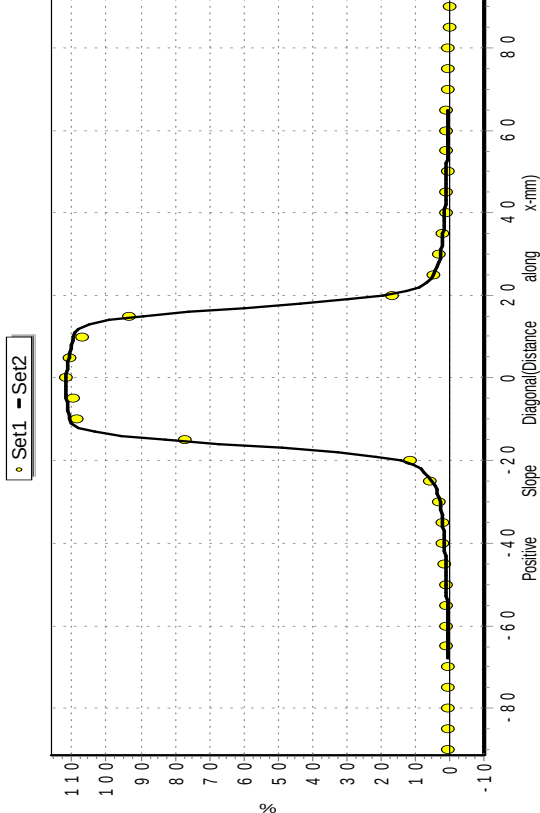
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 4.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

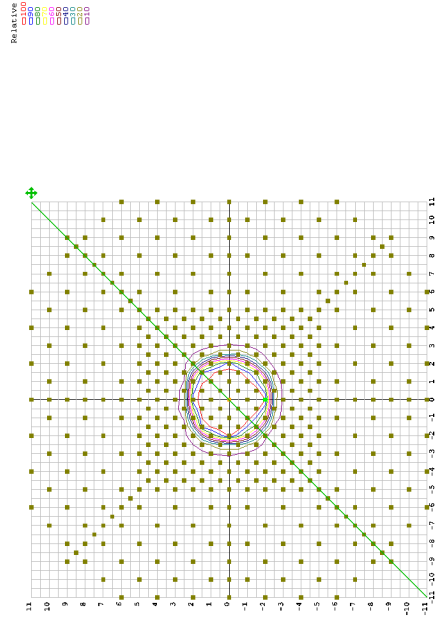
Dose Values in cGy	
Cax	Picked
Normal	
Set1	20.77
Set2	20.77
Set1-Set2	0.00
% Diff	0.00
DTA(mm)	0.00
Coords (y,x) cm	0.0 -2.0

Notes

Gated Beam 5

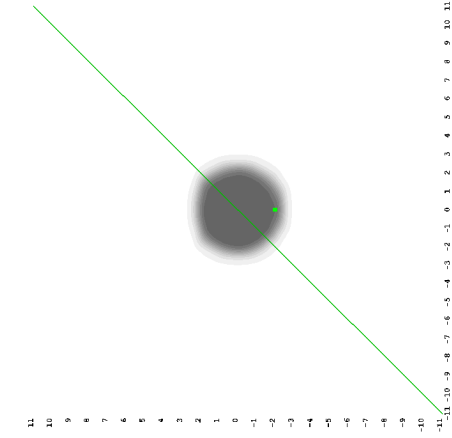
Reviewed By :

Set1

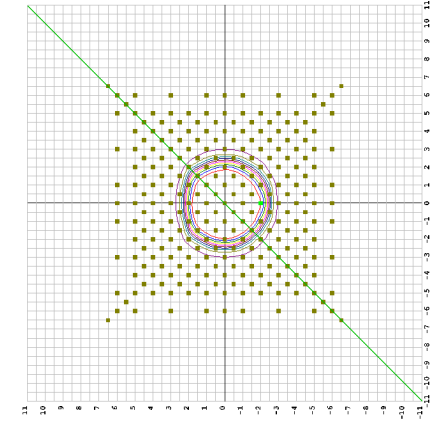


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\12BPM Gated\5.txt

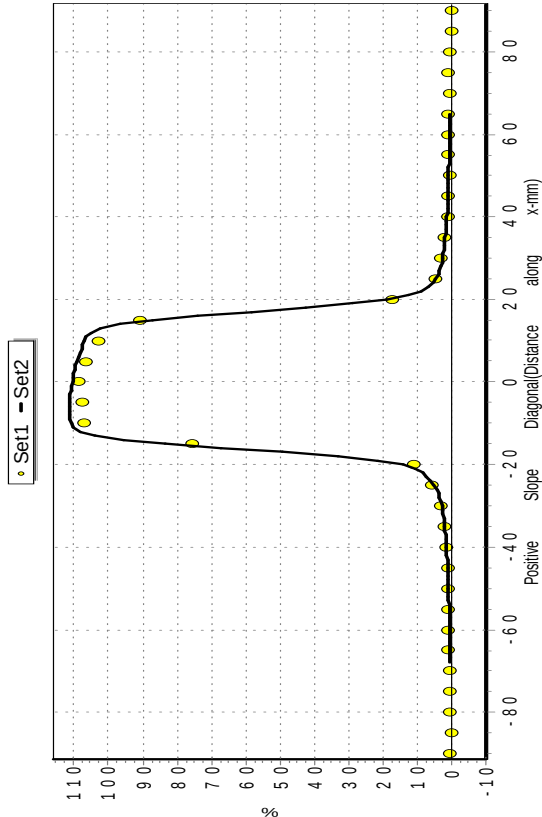
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 5.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

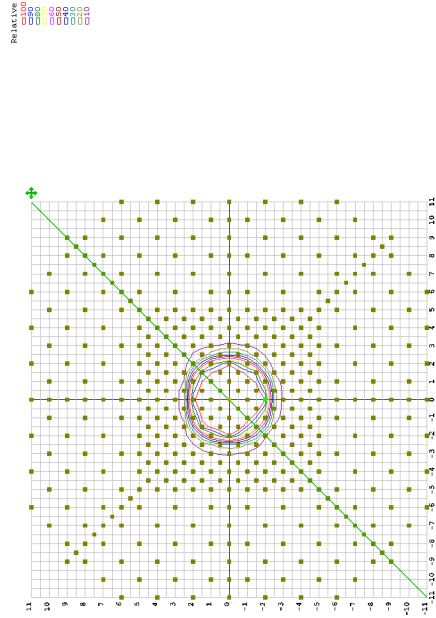
Dose Values in cGy		
	Cax	Picked
Set1	23.65	21.18
Set2	23.17	20.86
Set1-Set2	0.48	0.32
% Diff	2.29	1.54
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 6

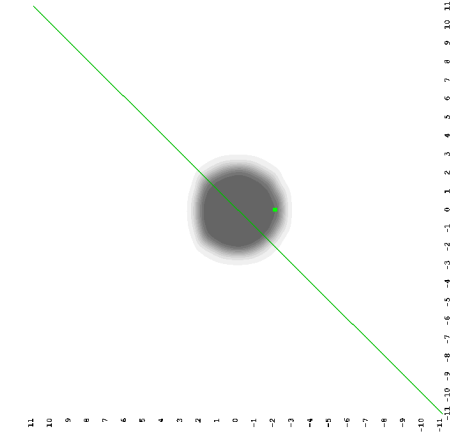
Reviewed By :

Set1

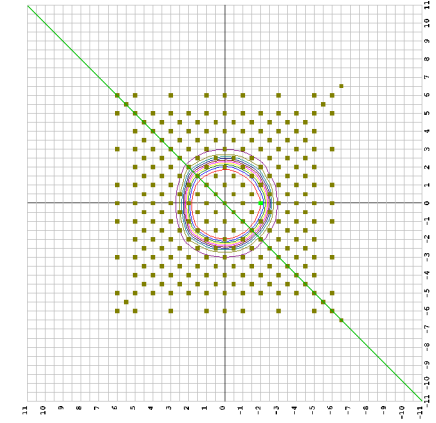


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\12BPM Gated\6.txt

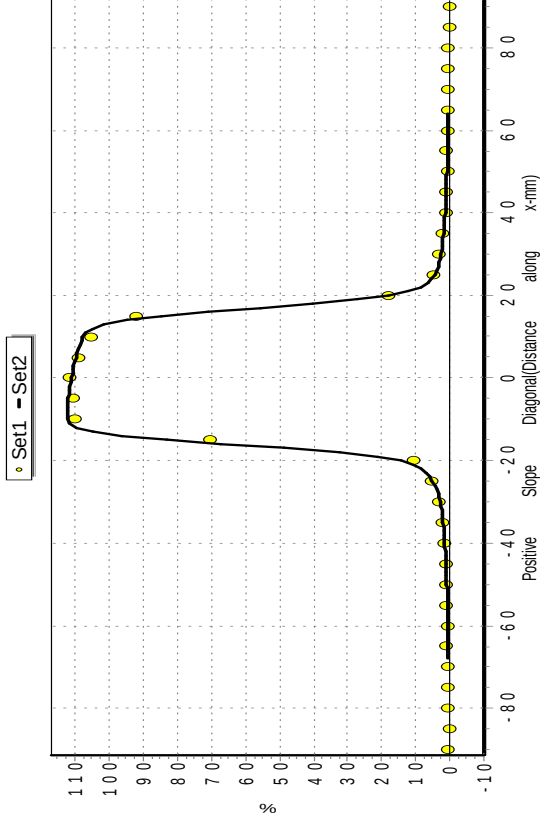
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 6.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

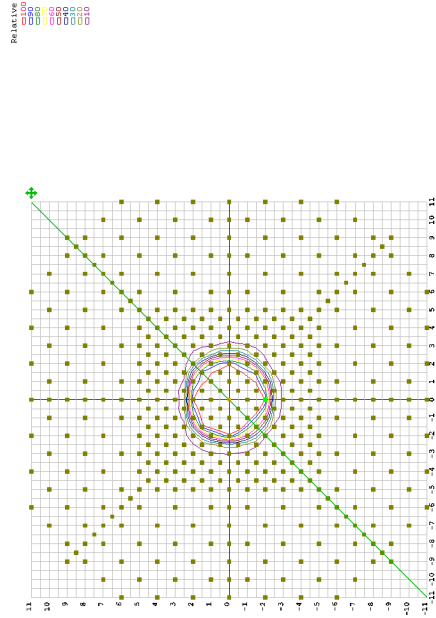
Dose Values in cGy		
	Cax	Picked
Set1	34.20	30.42
Set2	33.44	30.17
Set1-Set2	0.76	0.26
% Diff	2.52	0.85
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 7

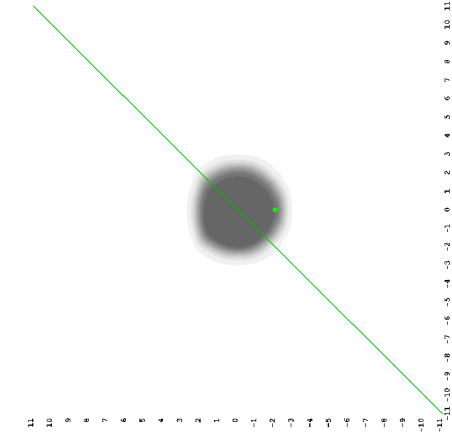
Reviewed By :

Set1

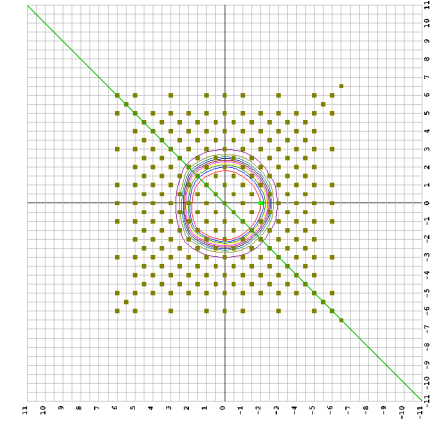


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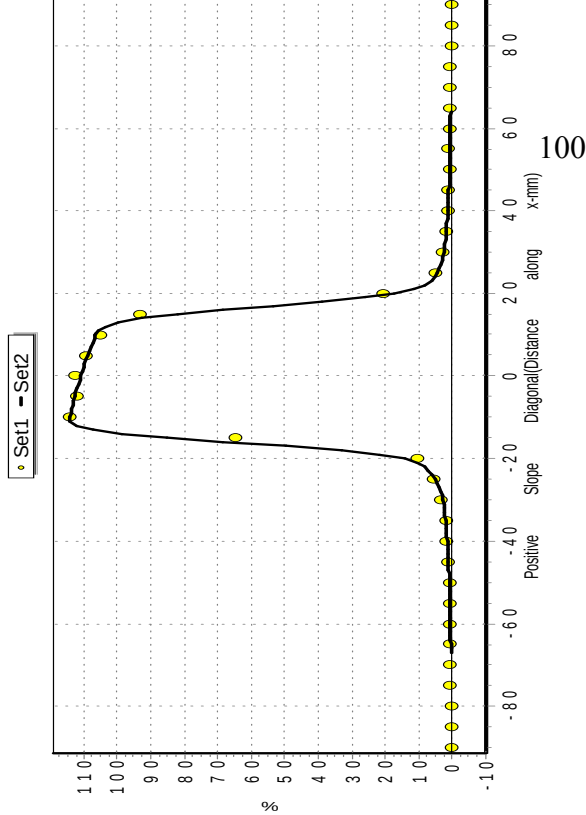
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 7.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

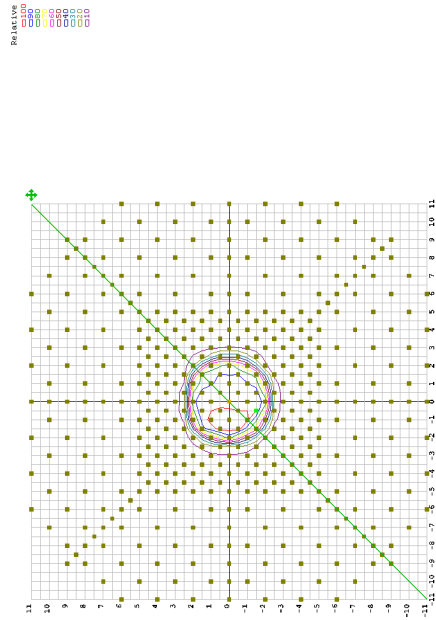
Dose Values in cGy		
	Cax	Picked
Set1	36.56	37.43
Set2	35.55	36.27
Set1-Set2	1.01	1.16
% Diff	2.78	3.21
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Gated Beam 8

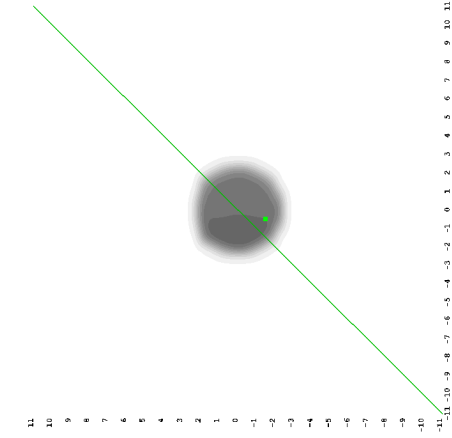
Reviewed By :

Set1

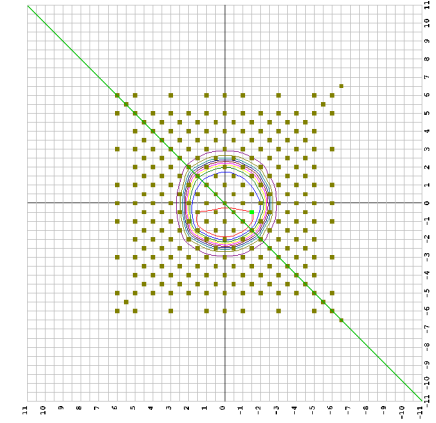


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\12BPM Gated\8.txt

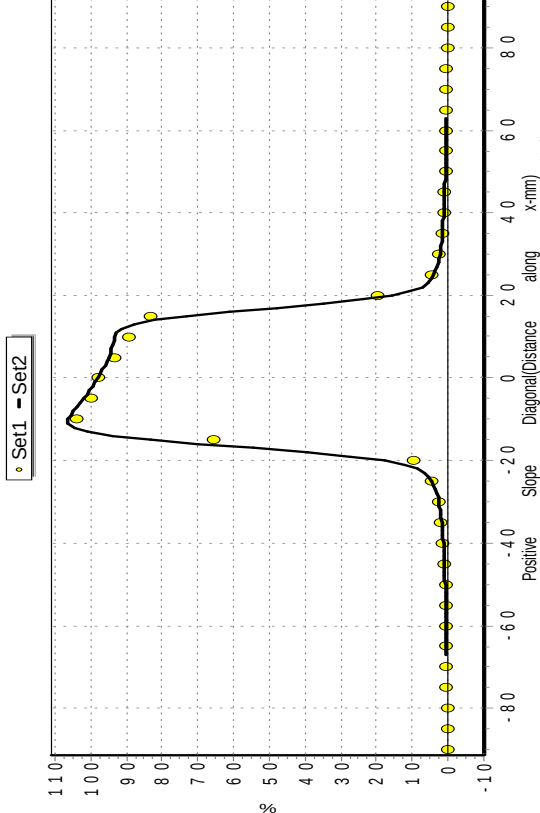
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 8.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

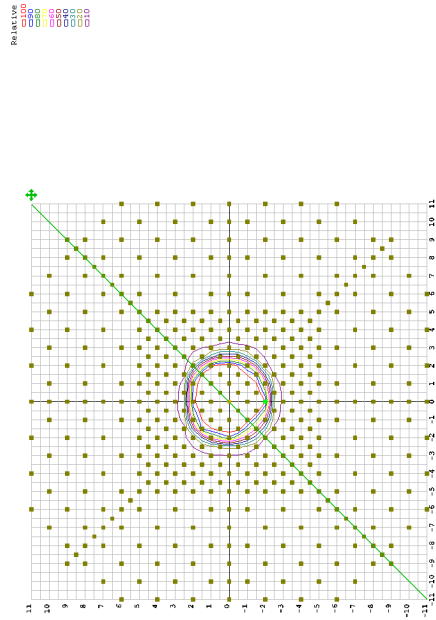
Dose Values in cGy		
	Cax	Picked
Set1	25.96	25.96
Set2	25.64	25.64
Set1-Set2	0.31	0.31
% Diff	1.35	1.35
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 9

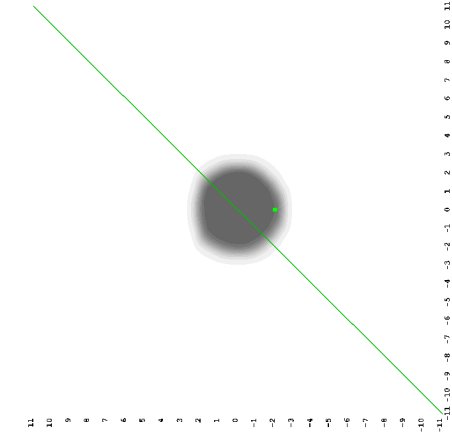
Reviewed By :

Set1

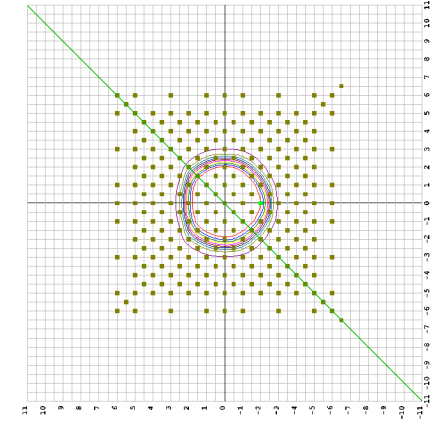


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\12BPM Gated\9.txt

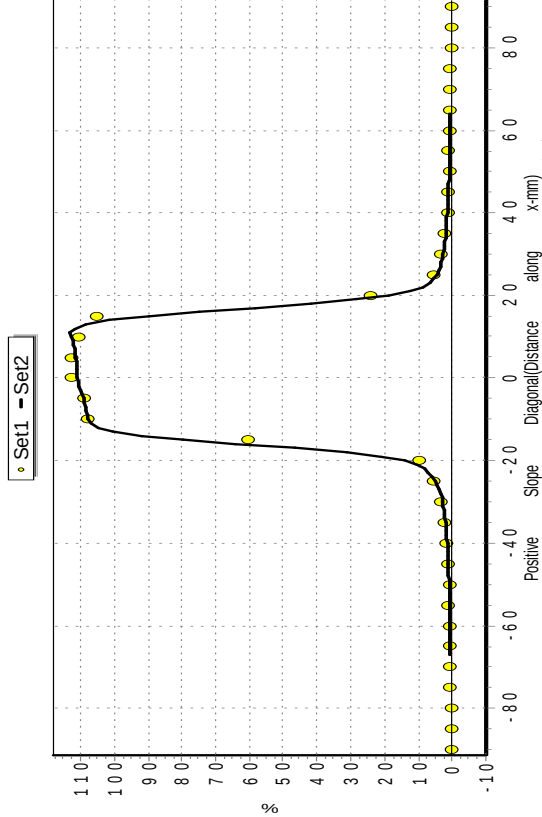
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 9.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

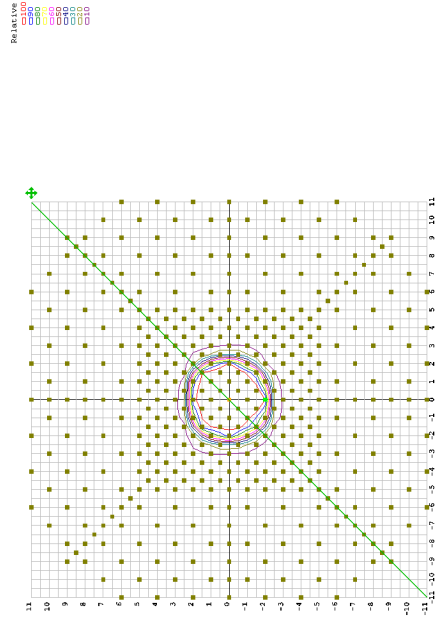
Dose Values in cGy		
	Cax	Picked
Set1	22.15	19.86
Set2	21.92	19.90
Set1-Set2	0.23	-0.04
% Diff	1.16	-0.20
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 1

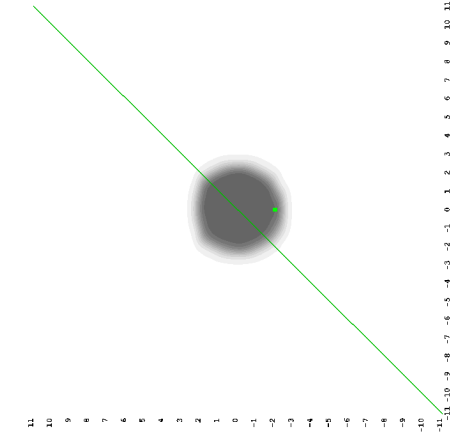
Reviewed By :

Set1

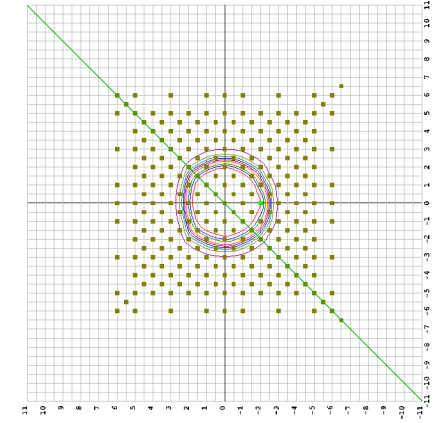


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\1.txt

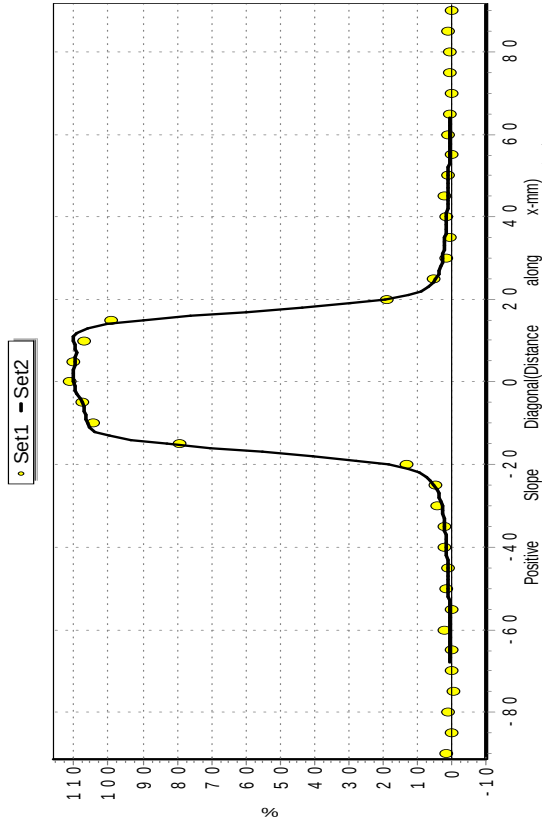
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 1.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

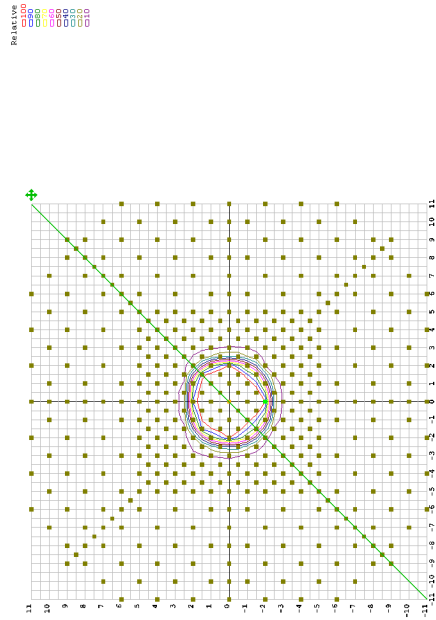
Dose Values in cGy		
	Cax	Picked
Set1	20.15	17.94
Set2	19.80	17.71
Set1-Set2	0.35	0.23
% Diff	1.97	1.29
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 2

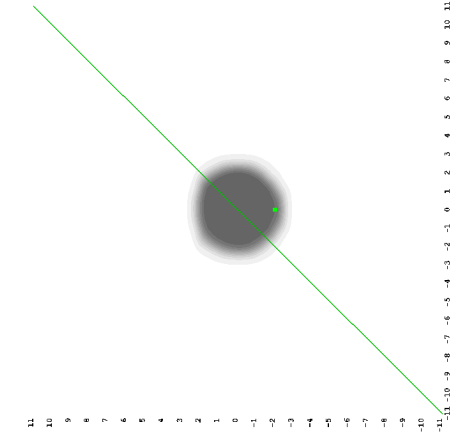
Reviewed By :

Set1

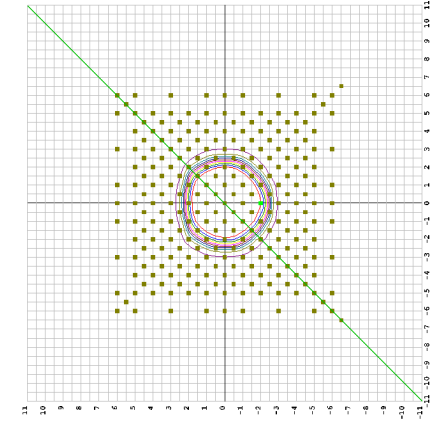


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\2.txt

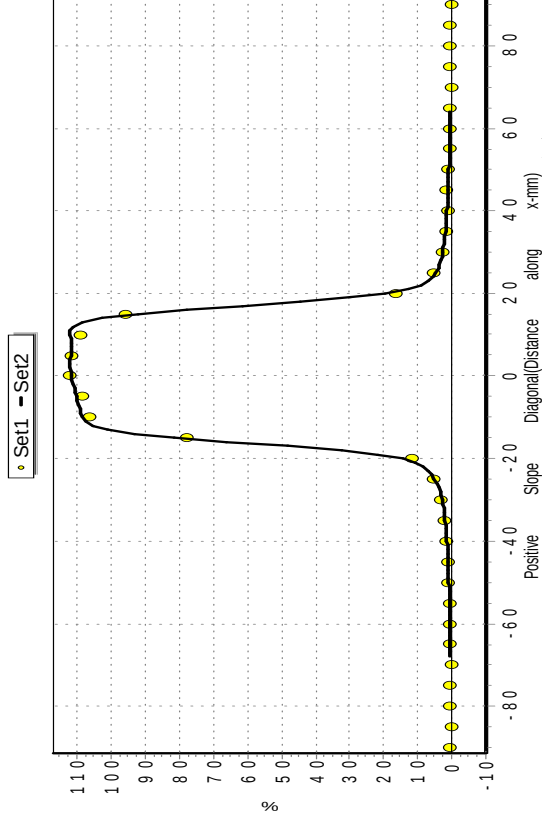
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 2.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

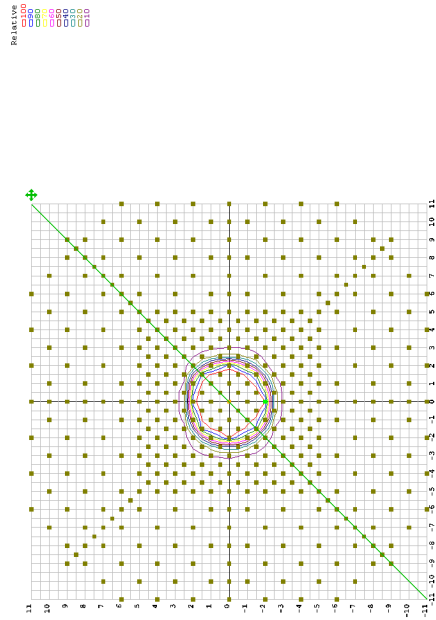
Dose Values in cGy		
	Cax	Picked
Set1	19.32	17.48
Set2	19.24	17.38
Set1-Set2	0.09	0.10
% Diff	0.49	0.55
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 3

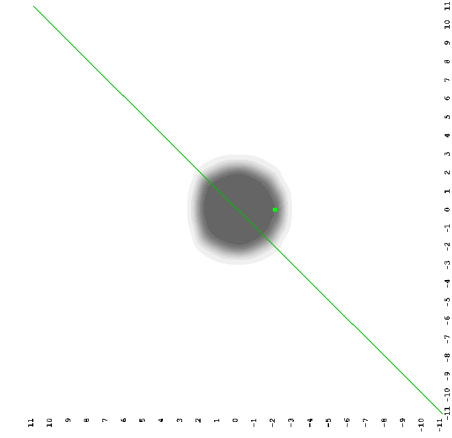
Reviewed By :

Set1

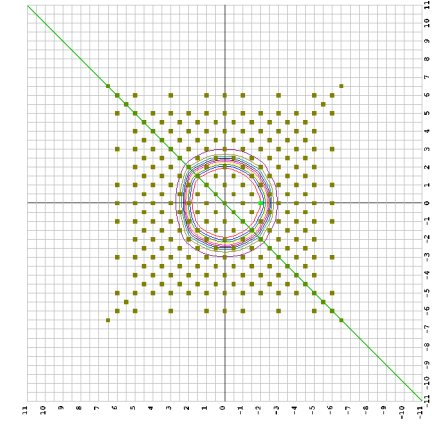


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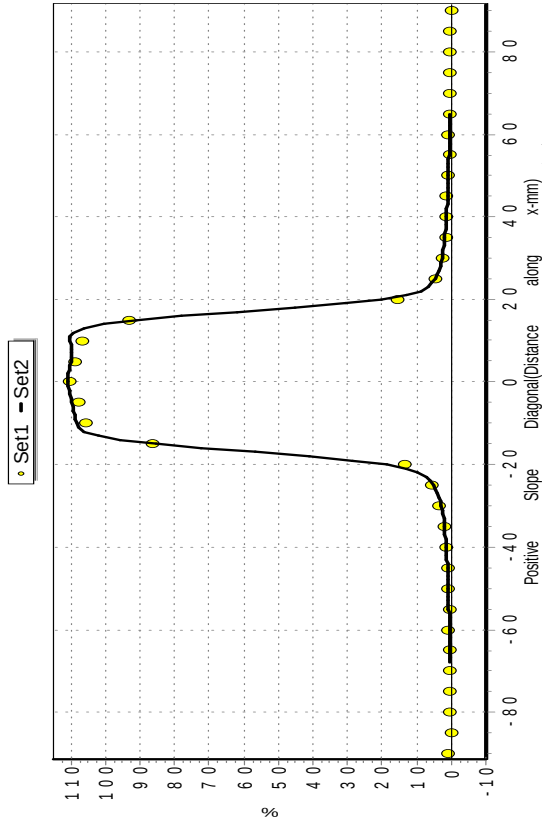
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 3.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

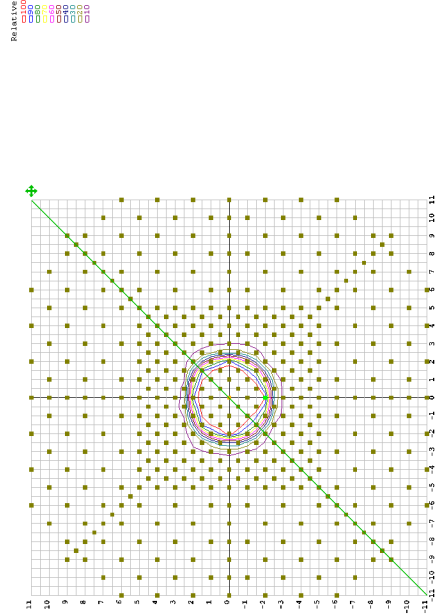
Dose Values in cGy		
	Cax	Picked
Set1	19.69	17.73
Set2	19.33	17.32
Set1-Set2	0.35	0.40
% Diff	2.04	2.33
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 4

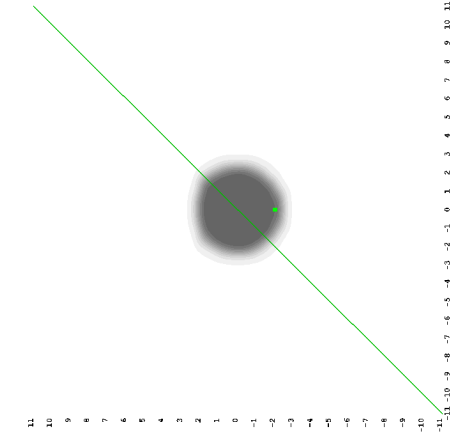
Reviewed By :

Set1

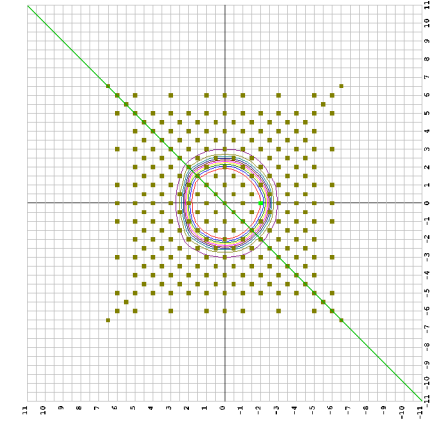


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\4.txt

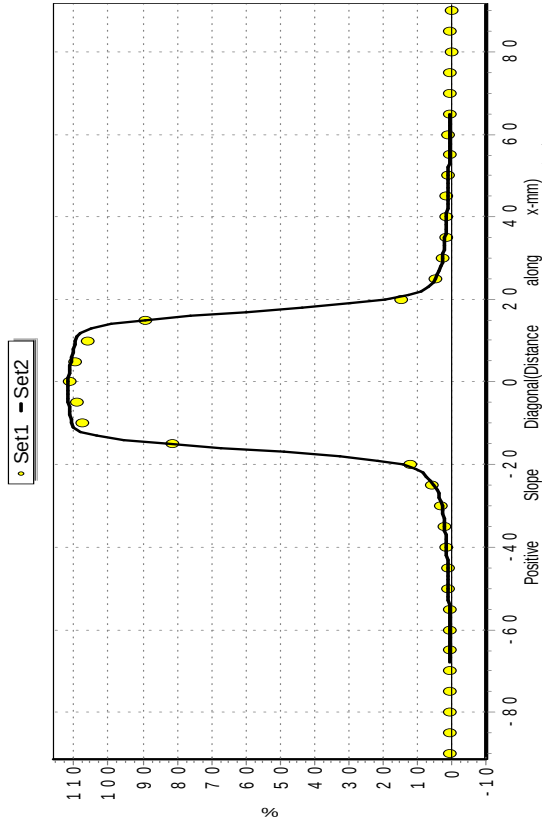
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 4.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

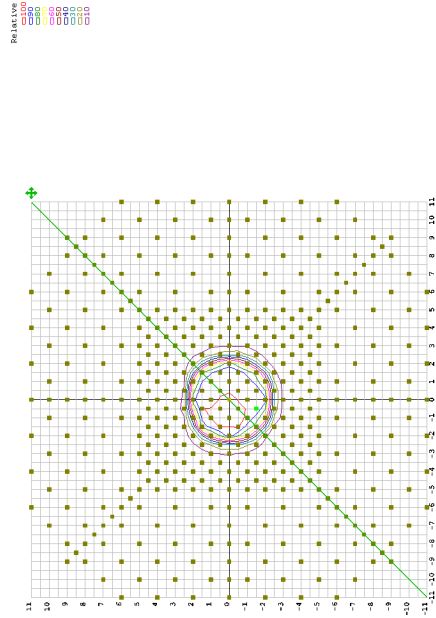
Dose Values in cGy	
Cax	Picked
Set1	20.77
Set2	20.77
Set1-Set2	20.60
% Diff	0.17
DTA(mm)	0.30
Coords (y,x) cm	0.85
	1.47
	0.85
	0.00
	0.00
	-1.5-0.5
	0.0

Notes

Non-gated Beam 5

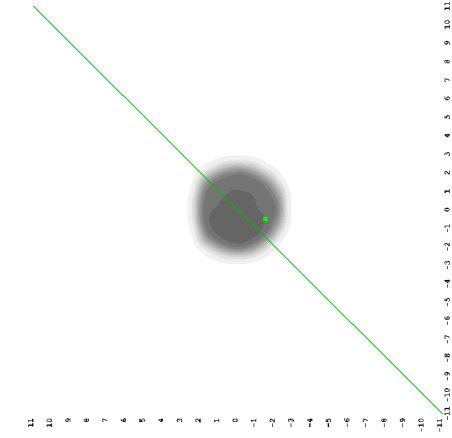
Reviewed By :

Set1

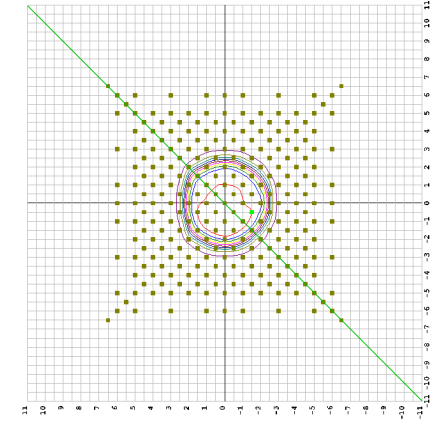


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\5.txt

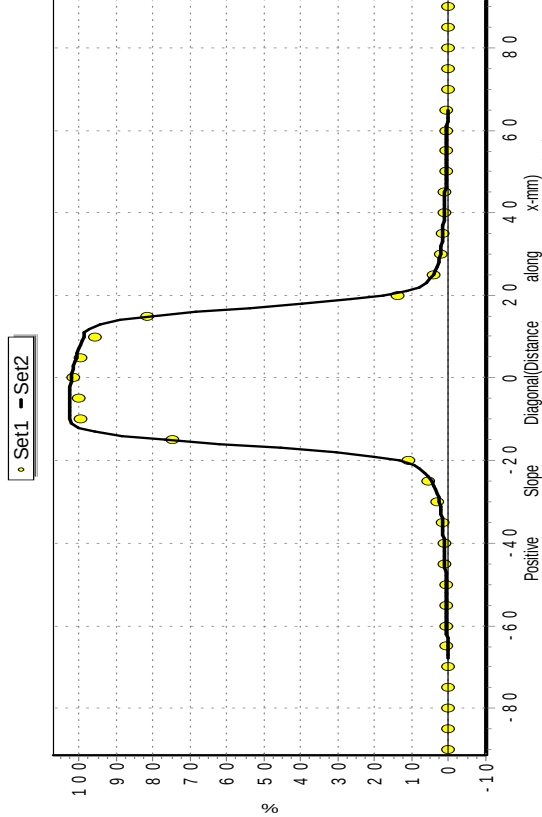
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 5.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

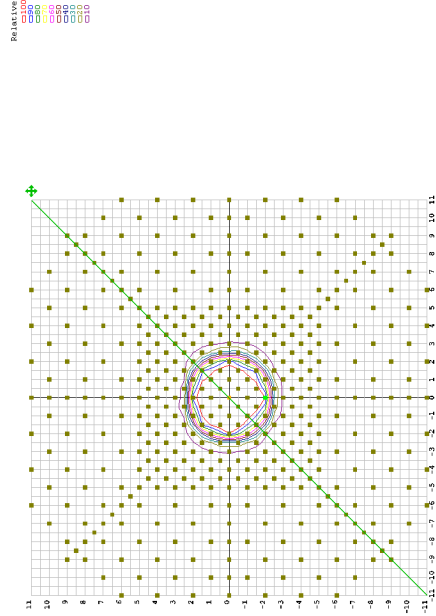
Dose Values in cGy		
	Cax	Picked
Set1	23.50	21.27
Set2	23.17	20.86
Set1-Set2	0.33	0.41
% Diff	1.58	1.98
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 6

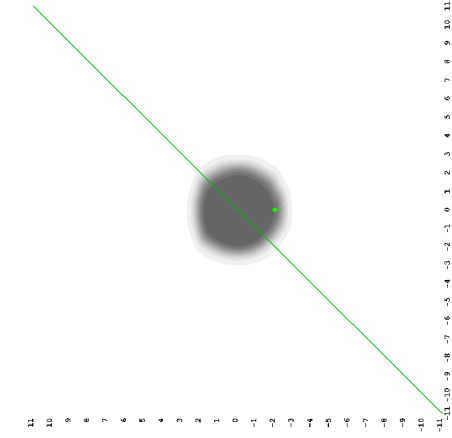
Reviewed By :

Set1

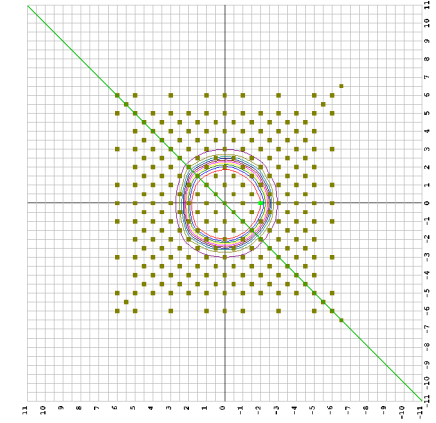


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\6.txt

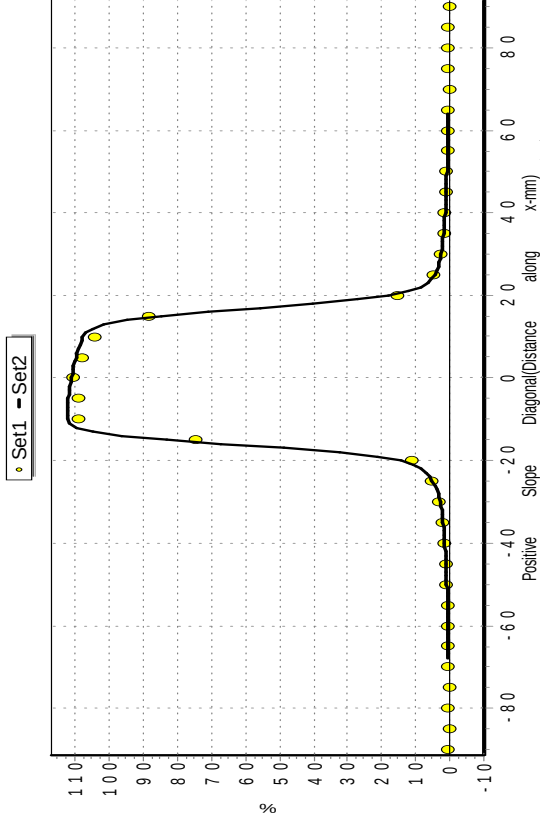
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 6.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

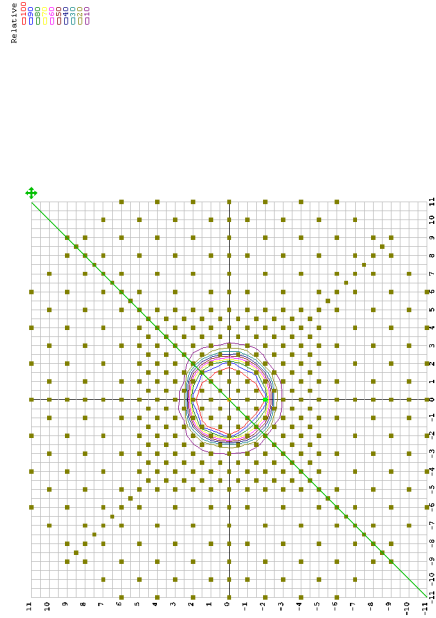
Dose Values in cGy	
Cax	Picked
Normal	
Set1	34.16
Set2	34.16
Set1-Set2	0.00
% Diff	0.00
DTA(mm)	0.00
Coords (y,x) cm	0.0 -2.0

Notes

Non-gated Beam 7

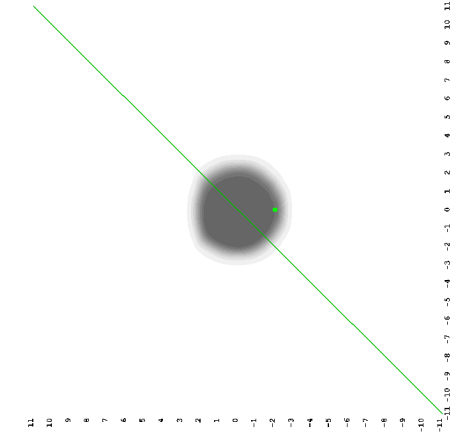
Reviewed By :

Set1

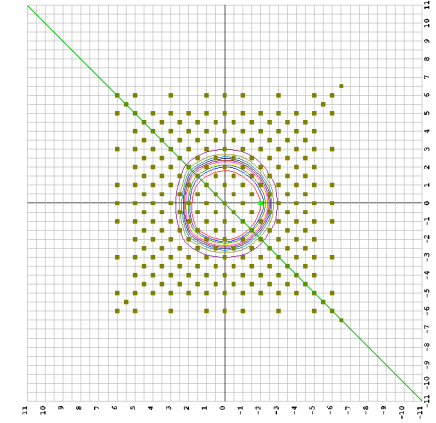


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\7.txt

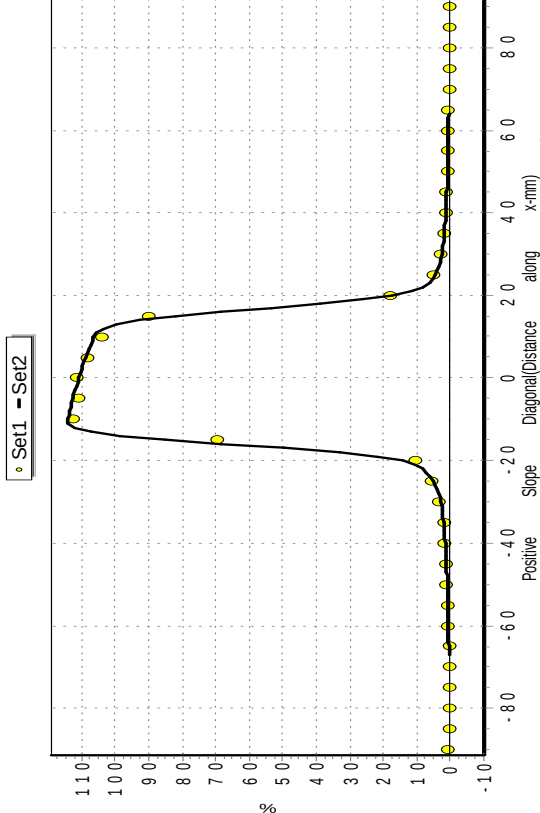
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 7.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary
Total Points : 57
Passed : 57
Failed : 0
% Passed : 100

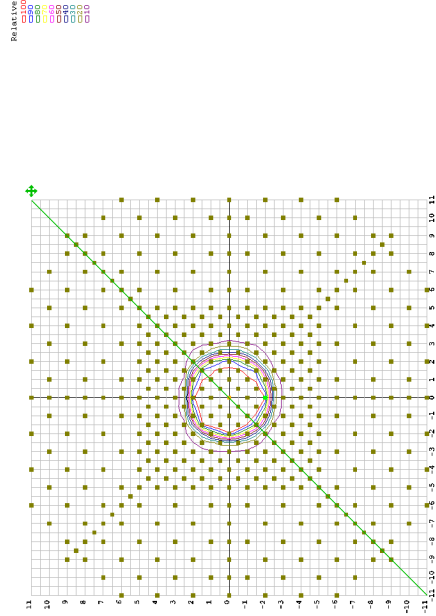
Dose Values in cGy	
Cax	Picked
Normal	
Set1	36.46
Set2	36.46
Set1-Set2	0.00
% Diff	0.00
DTA(mm)	0.00
Coords (y,x) cm	0.0 -2.0

Notes

Non-gated Beam 8

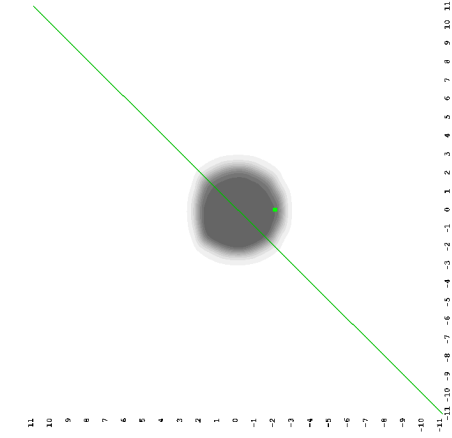
Reviewed By :

Set1

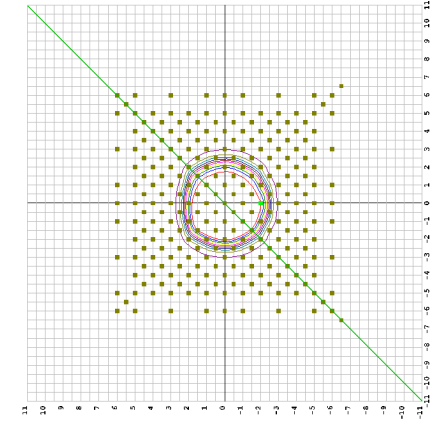


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\12 bpm non gated\8.txt

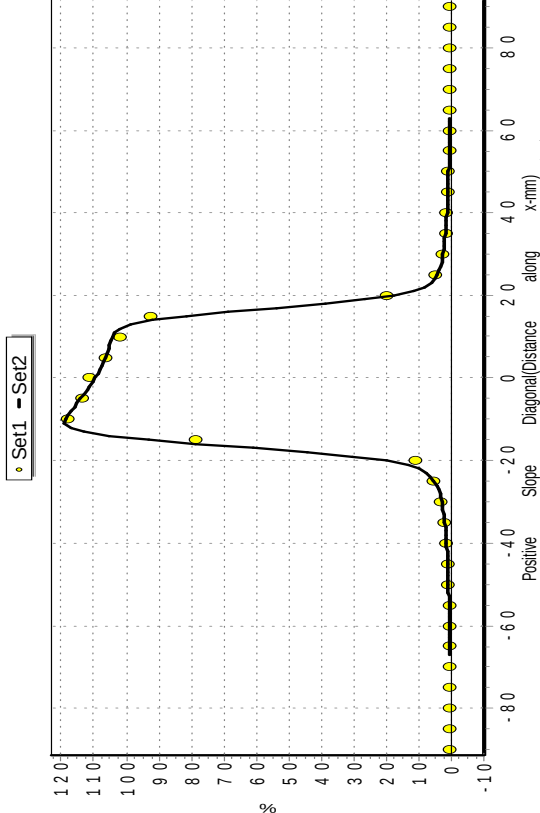
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #2 Eclipse Dose Planes\Beam 8.dcm



QA File Parameter
Patient Name : Phantom Patient #2
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

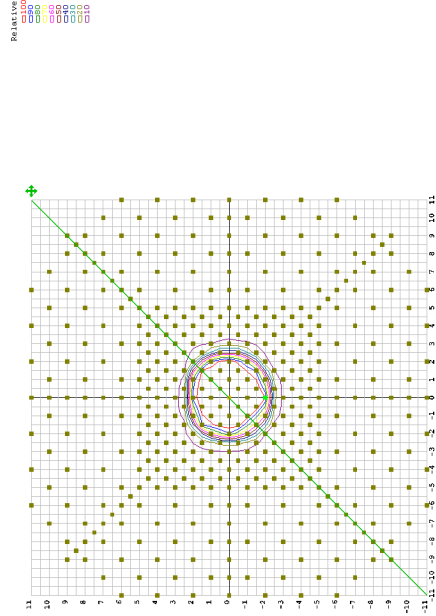
Dose Values in cGy		
	Cax	Picked
Set1	25.86	23.19
Set2	25.64	23.11
Set1-Set2	0.22	0.07
% Diff	0.96	0.31
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 9

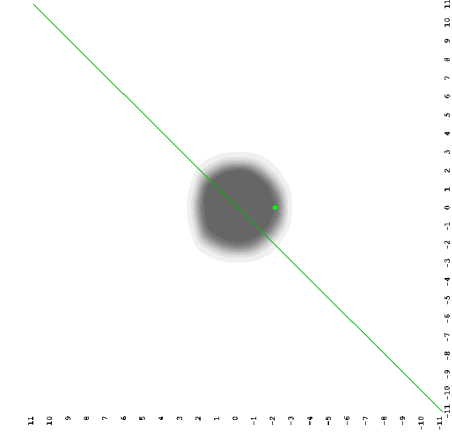
Reviewed By :

Set1

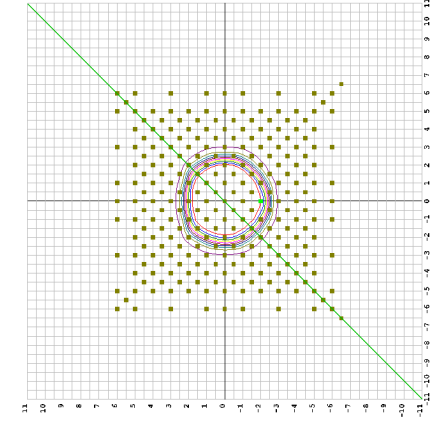


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map
Check Non Gated\12 bpm non gated\9.txt

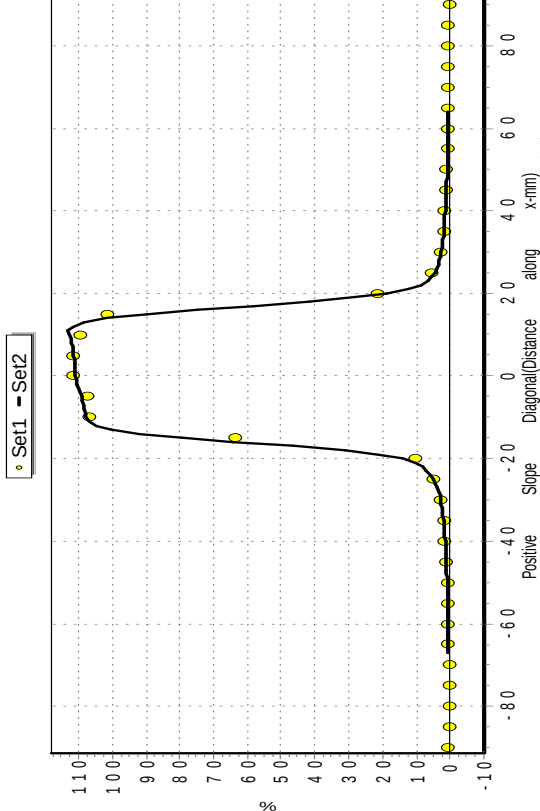
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Pha
ntom Patient #2 Eclipse Dose Planes\Beam 9.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

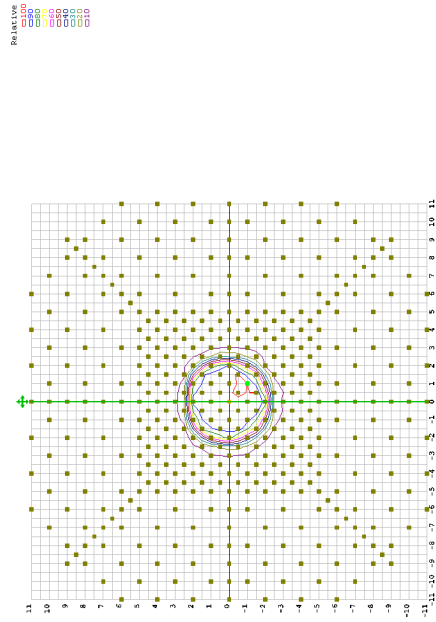
Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

Dose Values in cGy		
	Cax	Picked
Set1	22.24	22.63
Set2	21.65	21.71
Set1-Set2	0.59	0.93
% Diff	2.72	4.27
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1,1

Notes

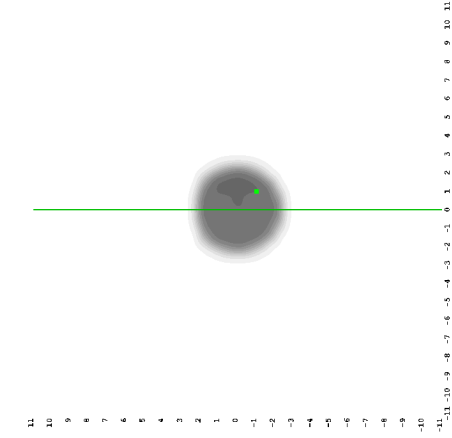
Gated Beam 1

Set1

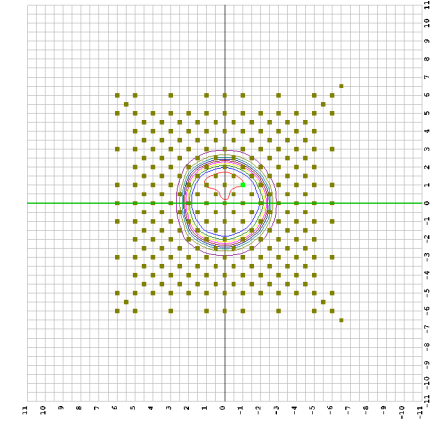


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\1.txt

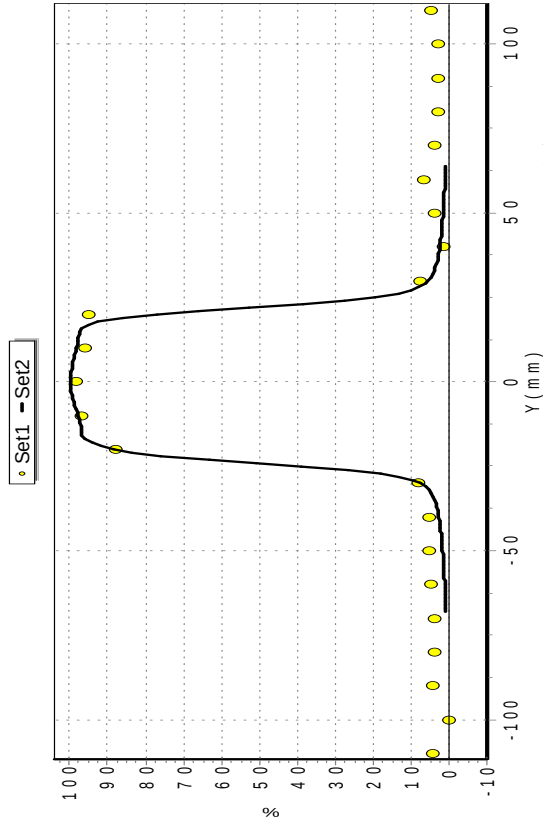
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 1.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

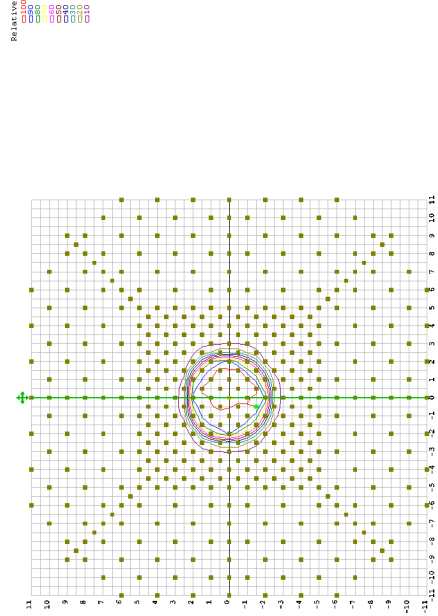
Dose Values in cGy		
	Cax	Picked
Set1	19.78	19.78
Set2	19.58	19.58
Set1-Set2	0.20	0.20
% Diff	1.06	1.06
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Gated Beam 2

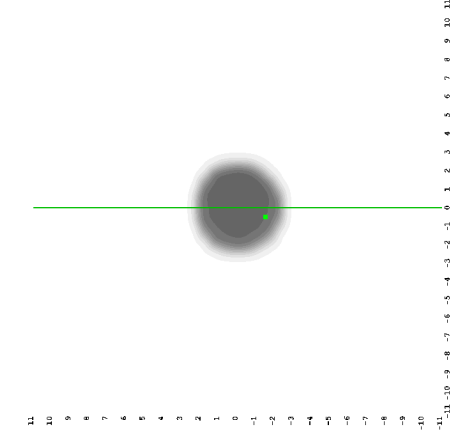
Reviewed By :

Set1

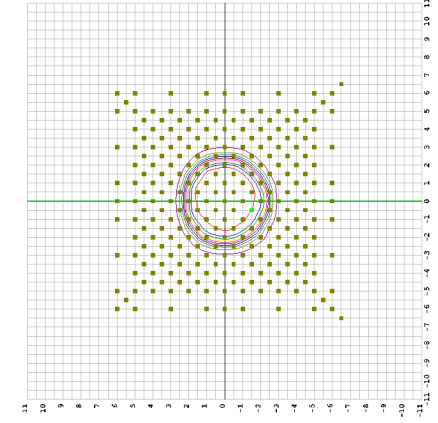


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\2.txt

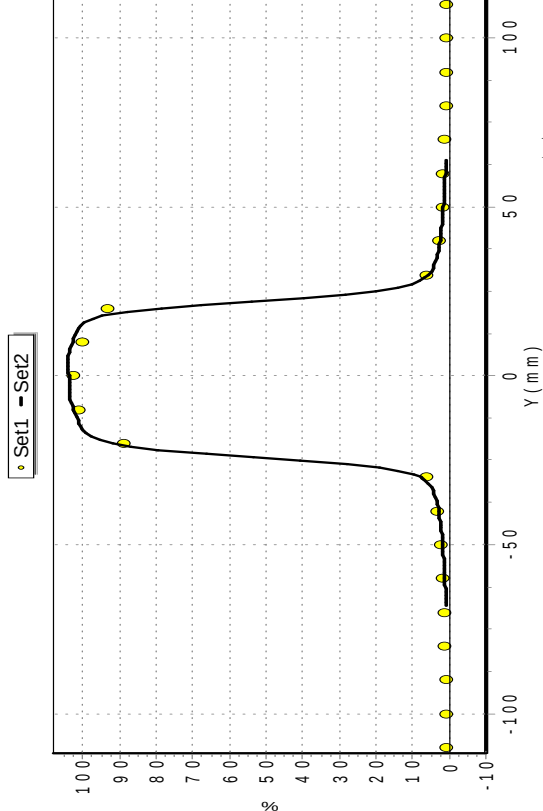
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 2.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

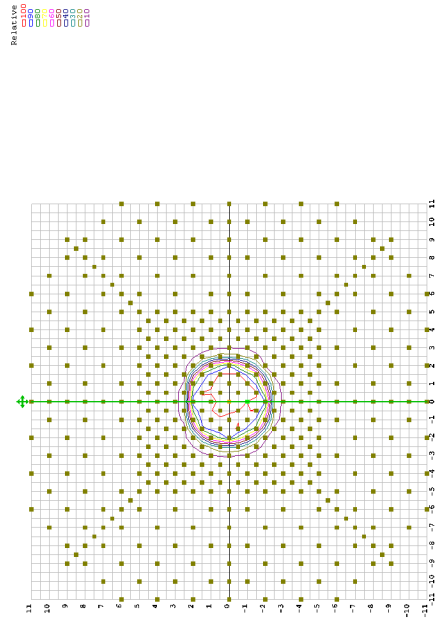
Dose Values in cGy		
	Cax	Picked
Set1	19.37	19.02
Set2	19.01	18.59
Set1-Set2	0.36	0.43
% Diff	1.96	2.29
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1,0

Notes

Gated Beam 3

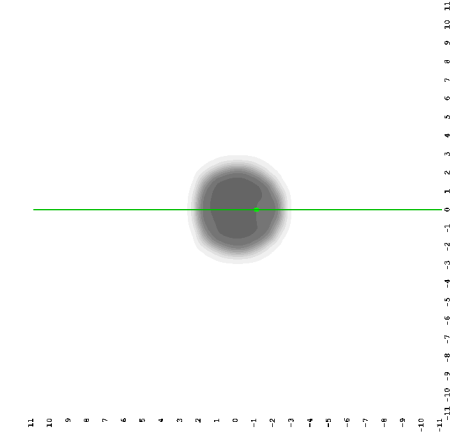
Reviewed By :

Set1

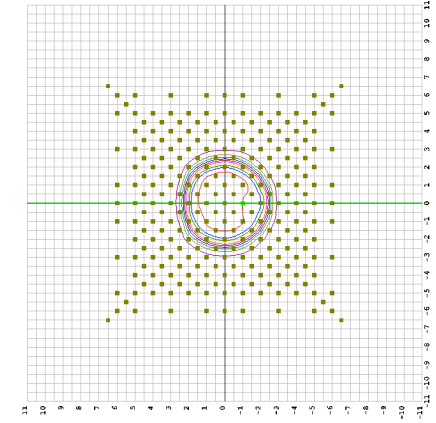


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\3.txt

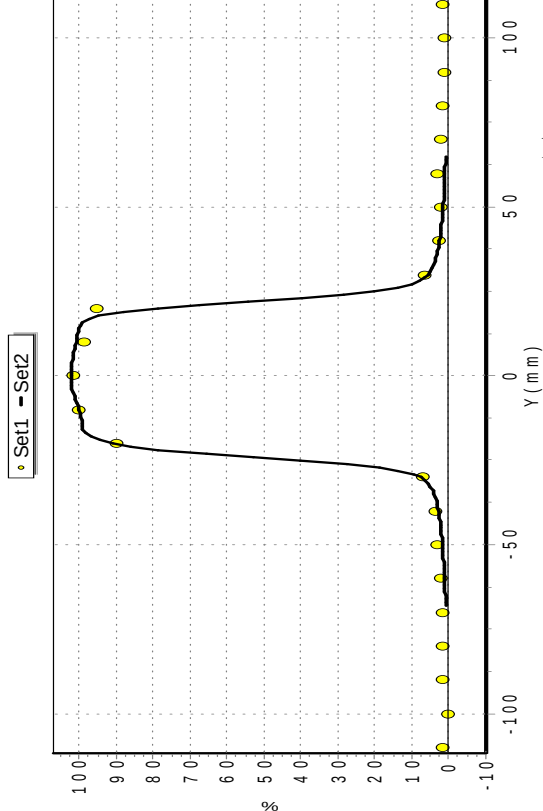
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 3.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

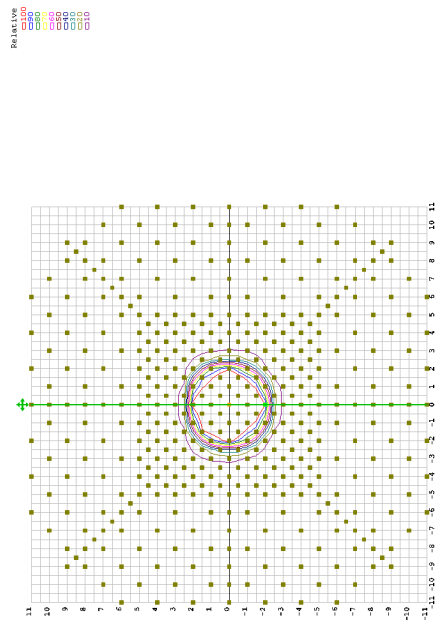
Dose Values in cGy		
	Cax	Picked
Set1	19.39	16.99
Set2	19.08	16.95
Set1-Set2	0.31	0.04
% Diff	1.85	0.26
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 4

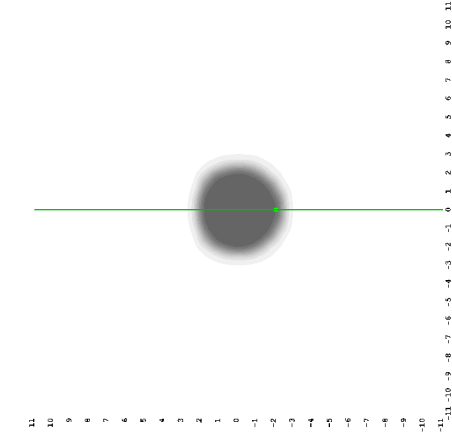
Reviewed By :

Set1

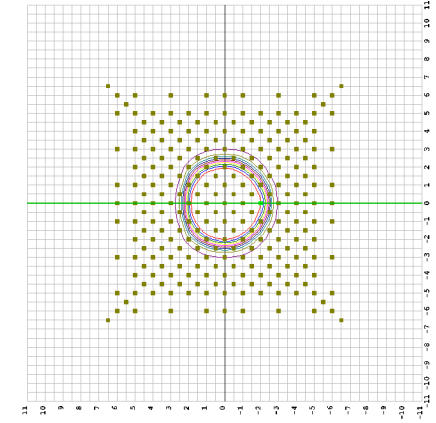


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\4.txt

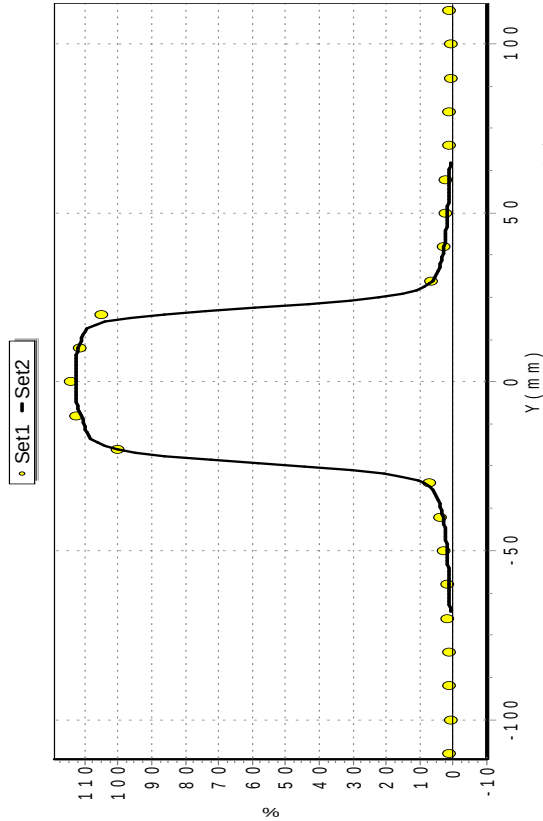
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 4.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

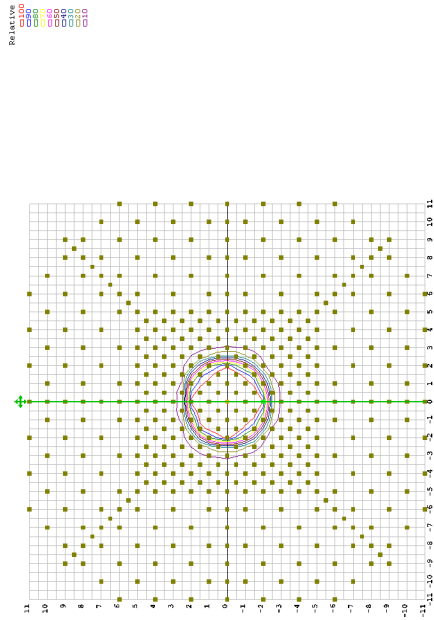
Dose Values in cGy		
	Cax	Picked
Set1	20.54	18.25
Set2	20.37	18.02
Set1-Set2	0.17	0.23
% Diff	0.95	1.26
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 5

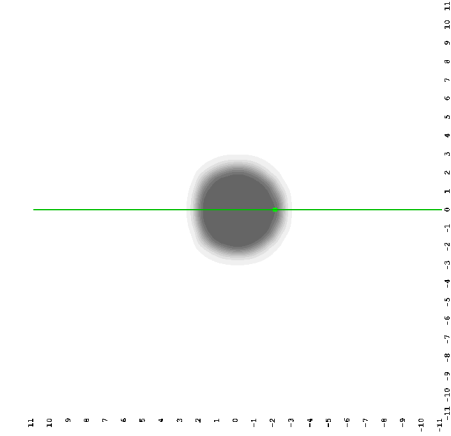
Reviewed By :

Set1

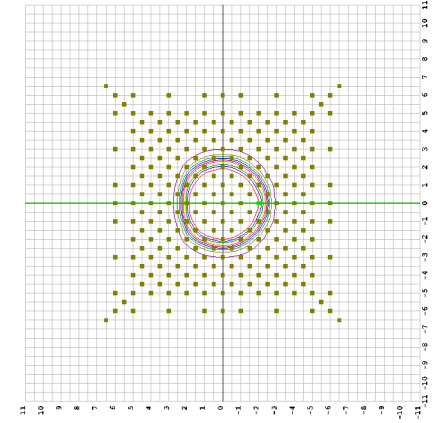


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\5.txt

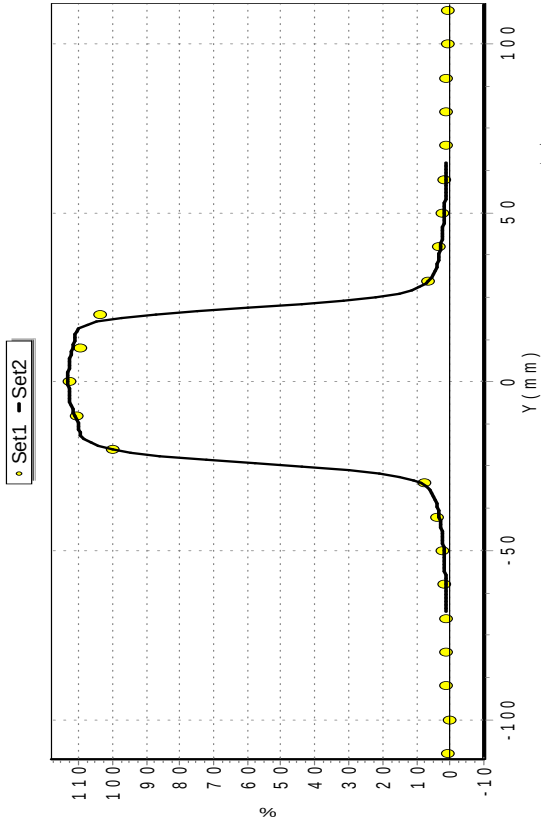
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 5.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

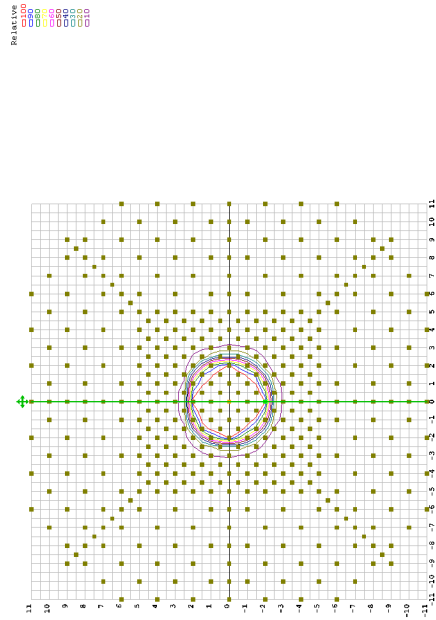
Dose Values in cGy		
	Cax	Picked
Set1	23.17	20.44
Set2	22.87	20.38
Set1-Set2	0.30	0.06
% Diff	1.49	0.30
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Gated Beam 6

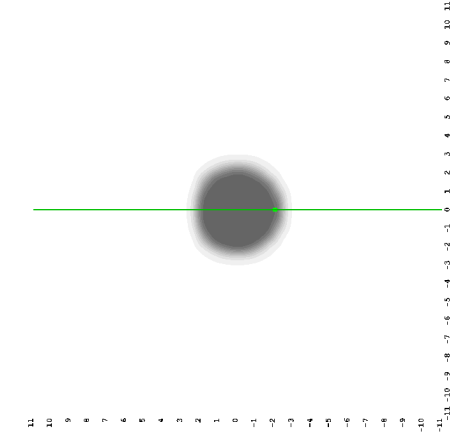
Reviewed By :

Set1

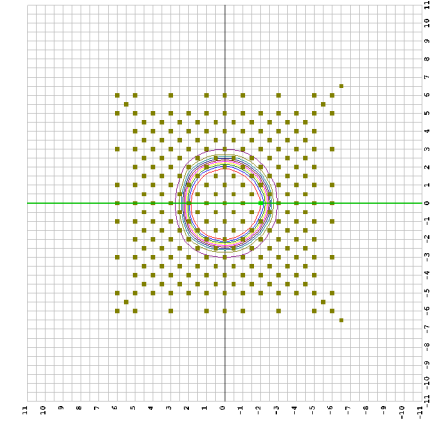


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\6.txt

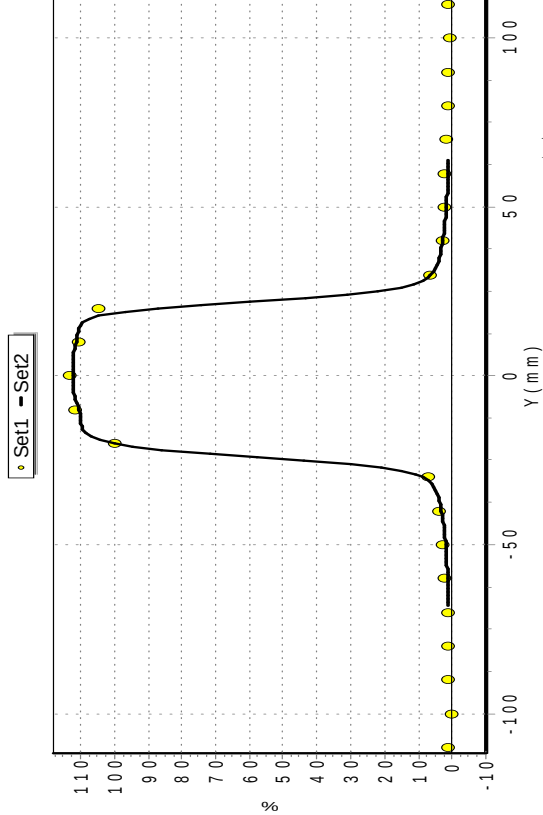
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 6.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

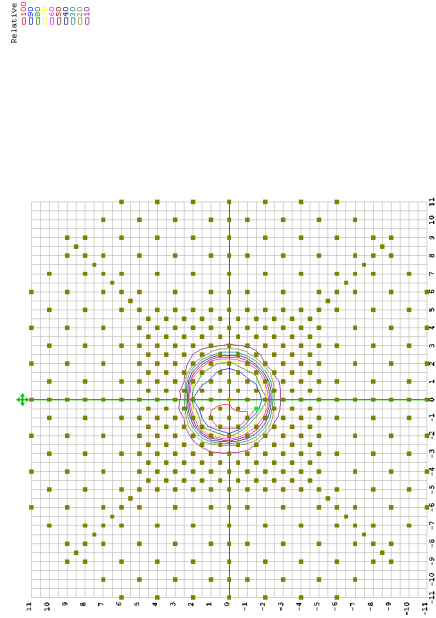
Dose Values in cGy		
	Cax	Picked
Set1	33.93	34.05
Set2	33.03	32.91
Set1-Set2	0.90	1.14
% Diff	2.74	3.47
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Gated Beam 7

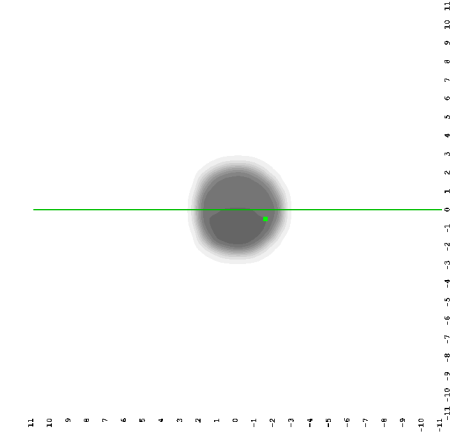
Reviewed By :

Set1

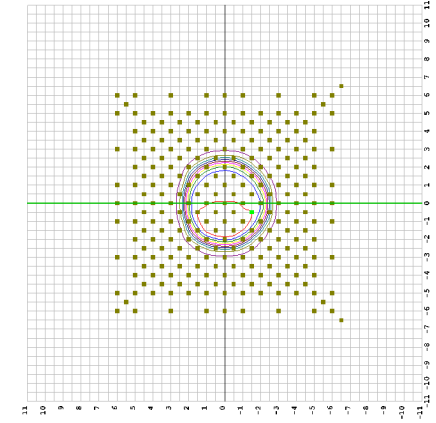


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\7.txt

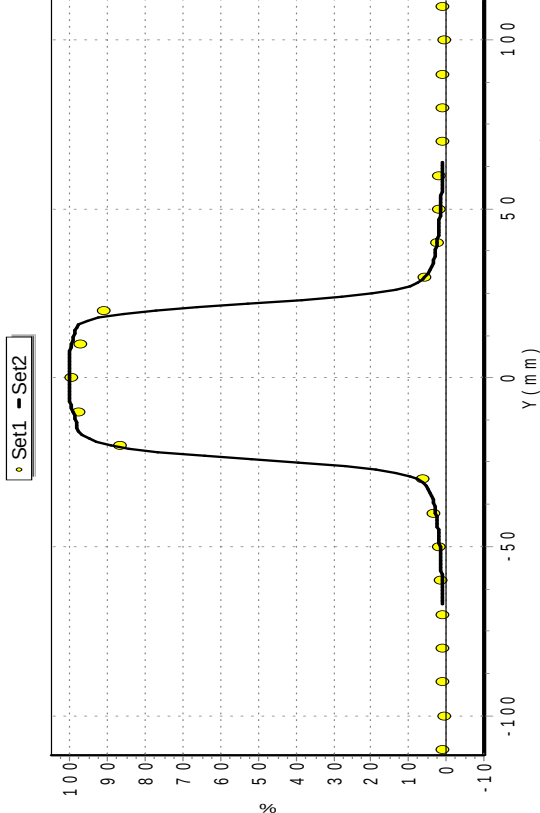
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 7.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

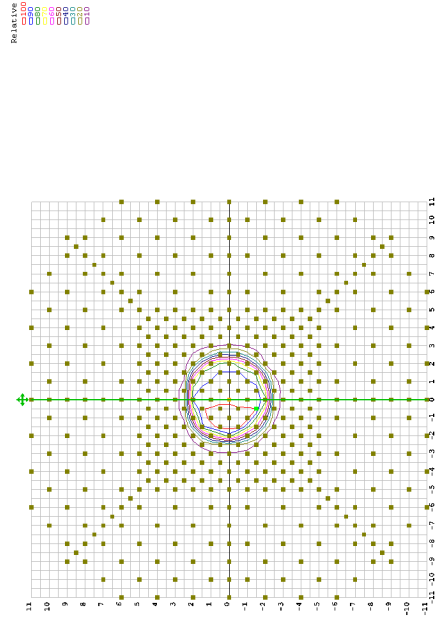
Dose Values in cGy		
	Cax	Picked
Set1	36.39	36.93
Set2	35.05	35.63
Set1-Set2	1.34	1.30
% Diff	3.76	3.66
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Gated Beam 8

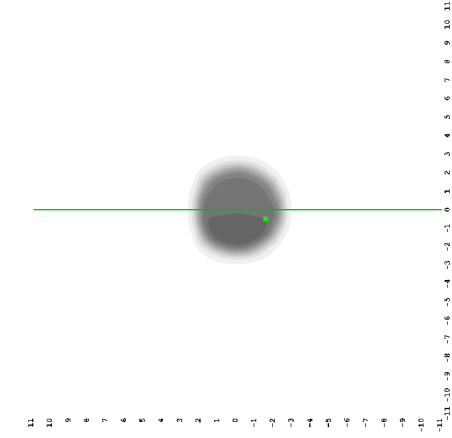
Reviewed By :

Set1

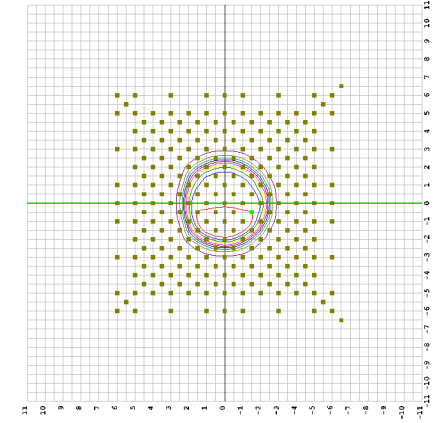


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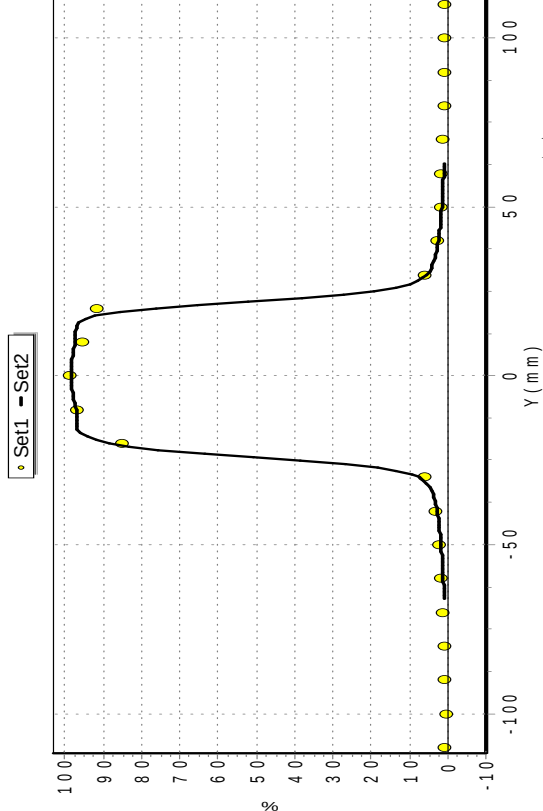
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 8.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

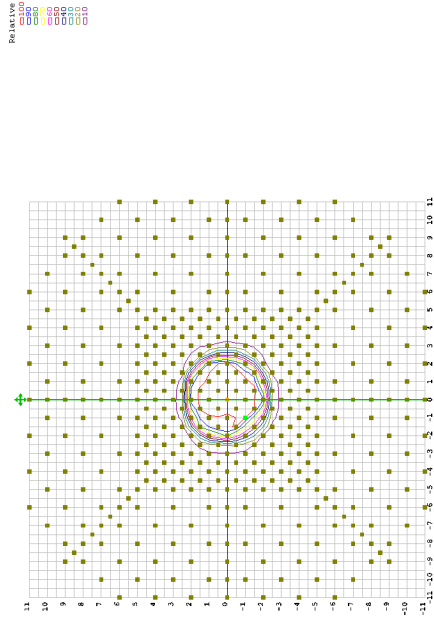
Dose Values in cGy		
	Cax	Normal
Set1	25.59	24.62
Set2	25.34	24.58
Set1-Set2	0.25	0.05
% Diff	1.02	0.19
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1,-1

Notes

Gated Beam 9

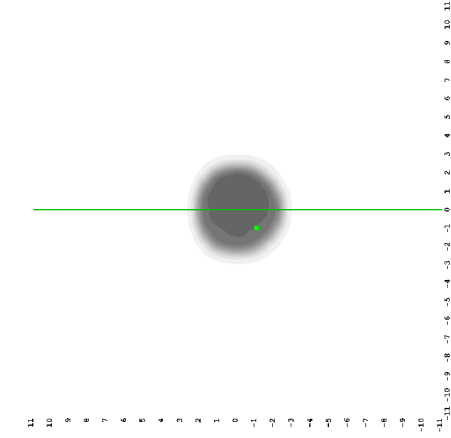
Reviewed By :

Set1

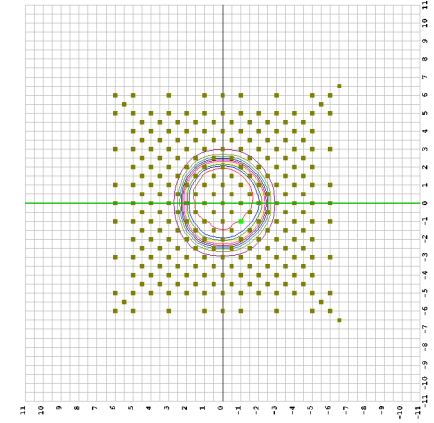


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Gated\14BPM Gated\9.txt

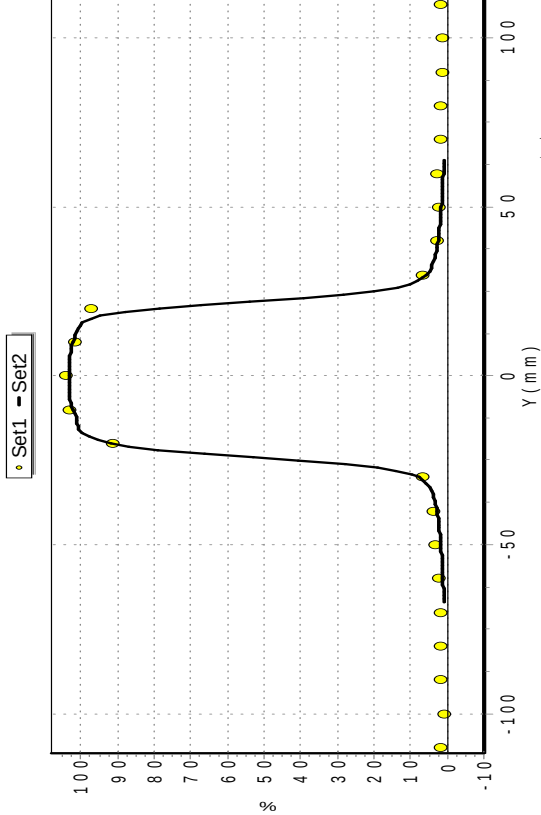
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 9.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

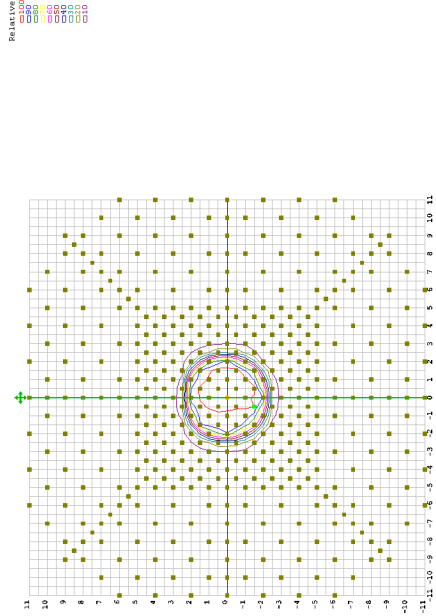
Dose Values in cGy		
	Cax	Picked
Set1	22.07	21.12
Set2	21.65	20.63
Set1-Set2	0.42	0.49
% Diff	2.04	2.38
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Non-gated Beam 1

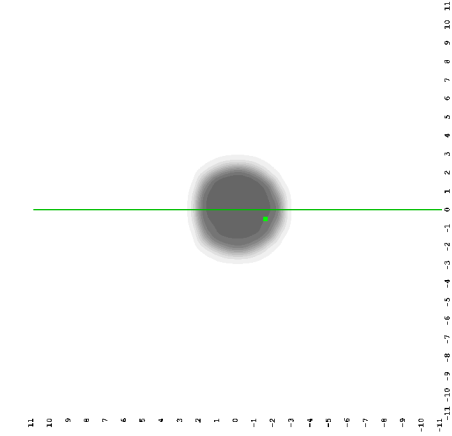
Reviewed By :

Set1

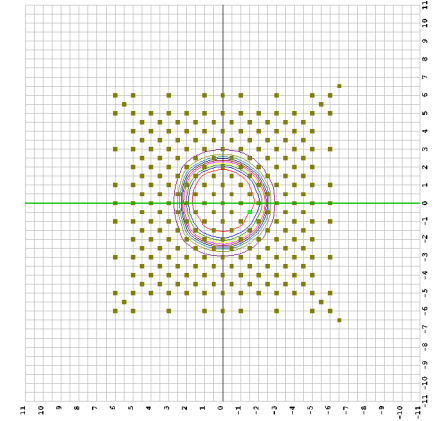


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\1.txt

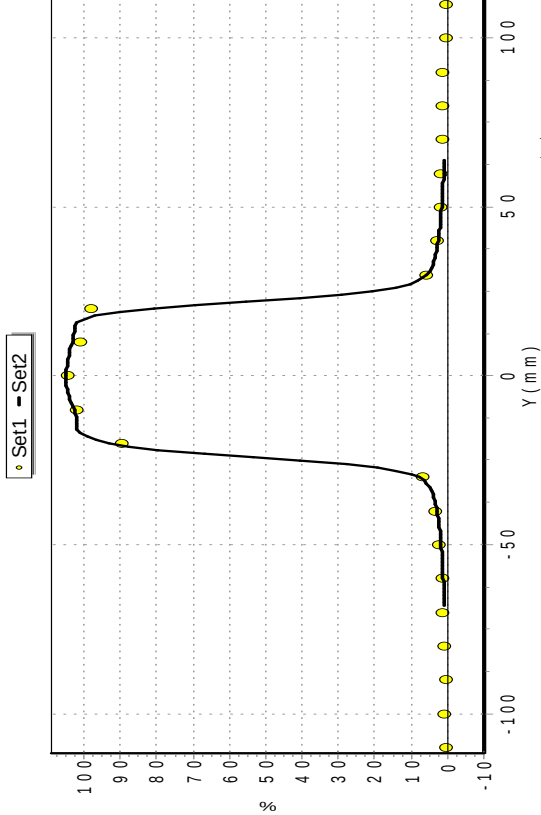
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 1.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

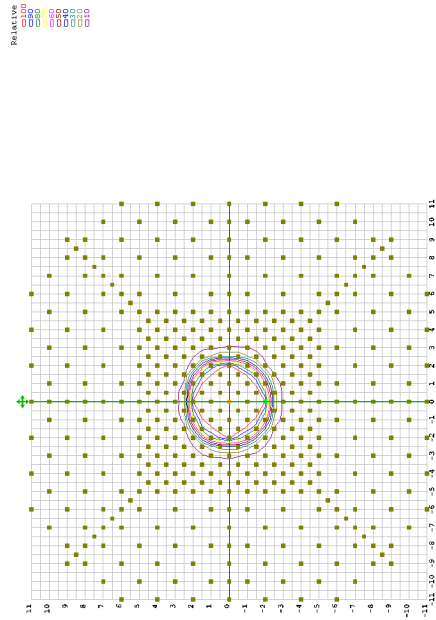
Dose Values in cGy		
	Cax	Picked
Set1	19.70	17.29
Set2	19.58	17.33
Set1-Set2	0.12	-0.04
% Diff	0.71	-0.25
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 2

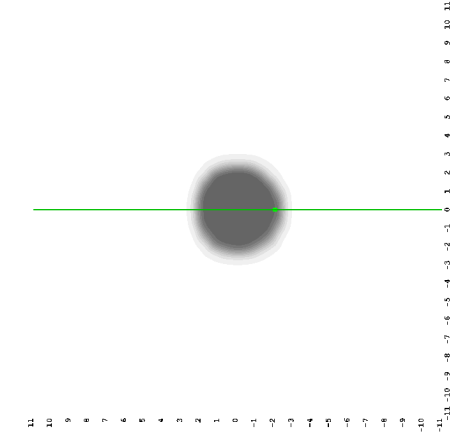
Reviewed By :

Set1

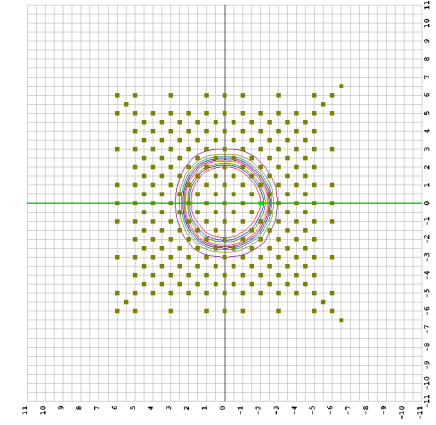


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\2.txt

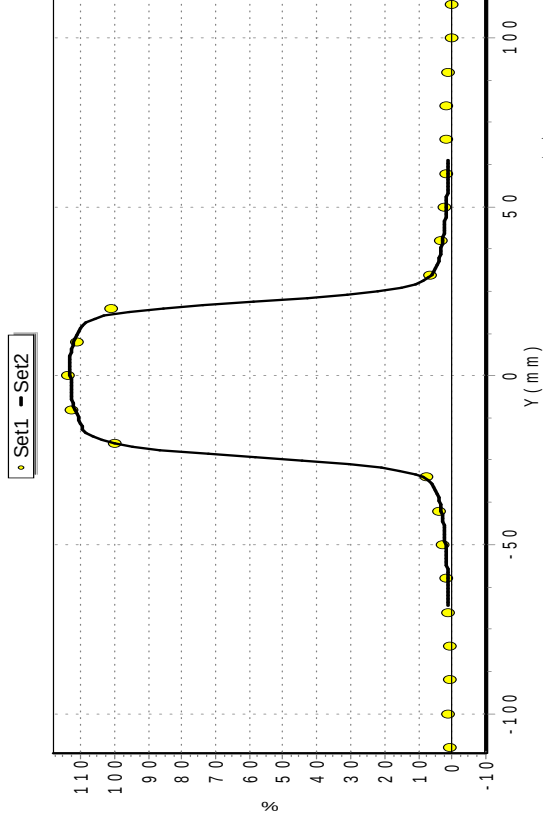
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 2.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

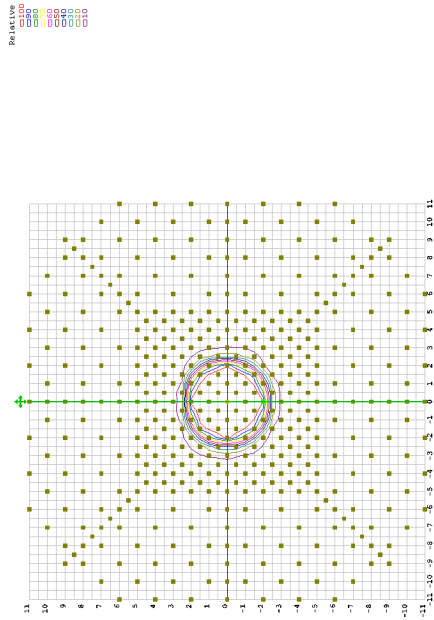
Dose Values in cGy		
	Cax	Picked
Set1	19.35	16.88
Set2	19.01	16.93
Set1-Set2	0.35	-0.05
% Diff	2.04	-0.28
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 3

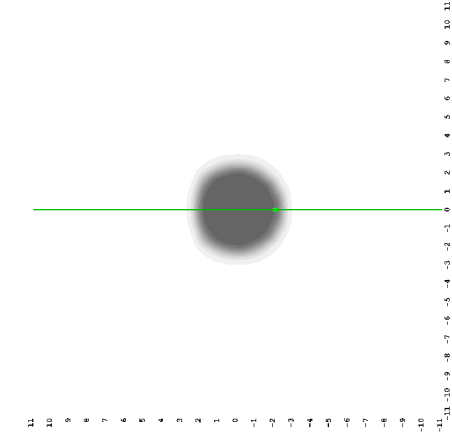
Reviewed By :

Set1

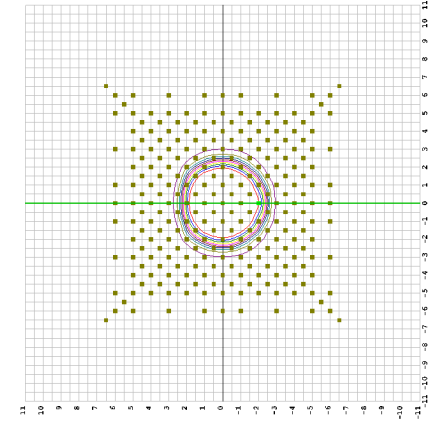


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\3.txt

Set1-Set2

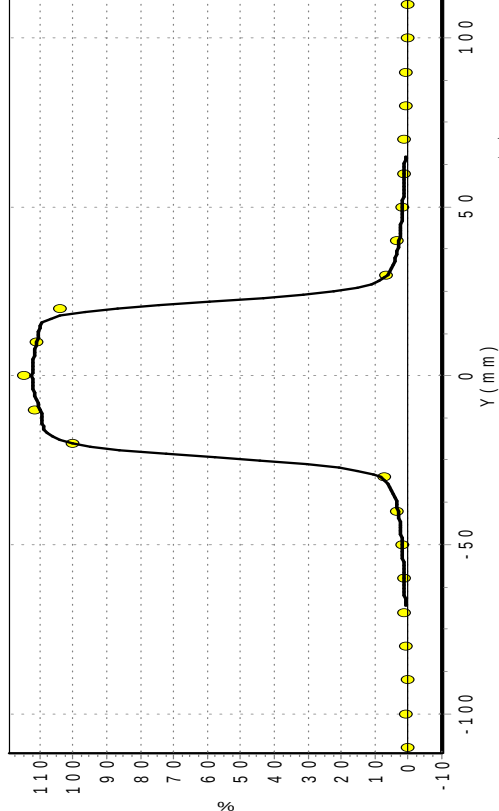


Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 3.dcm

Set1 - Set2



QA File Parameter
Patient Name : Phantom Patient #4
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

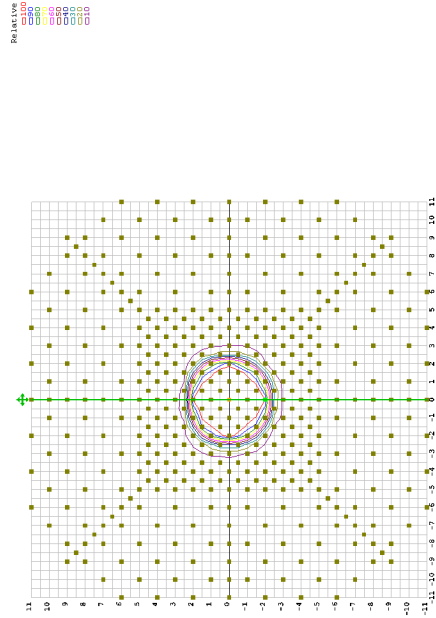
Dose Values in cGy		
	Cax	Picked
Set1	19.20	17.04
Set2	19.08	16.95
Set1-Set2	0.13	0.09
% Diff	0.74	0.56
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 4

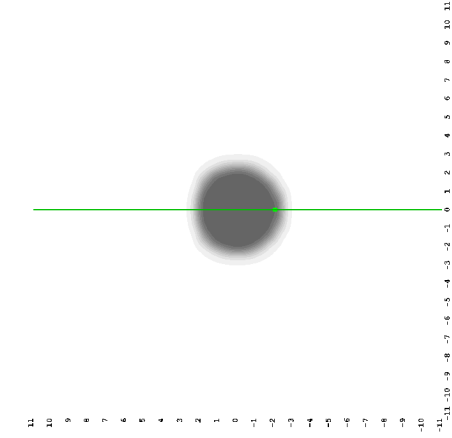
Reviewed By :

Set1

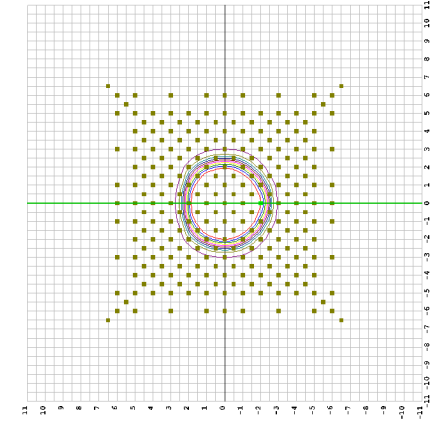


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\4.txt

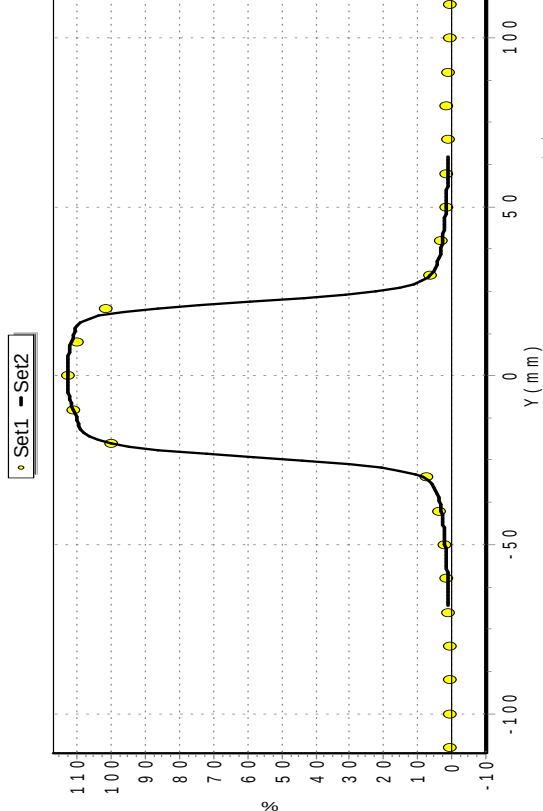
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 4.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

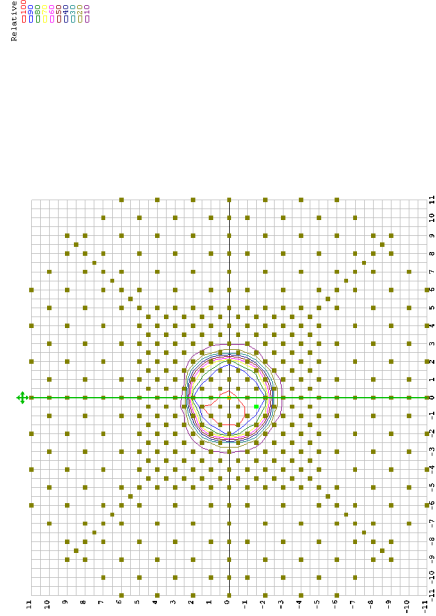
Dose Values in cGy		
	Cax	Picked
Set1	20.40	20.13
Set2	20.37	19.88
Set1-Set2	0.03	0.25
% Diff	0.17	1.26
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Non-gated Beam 5

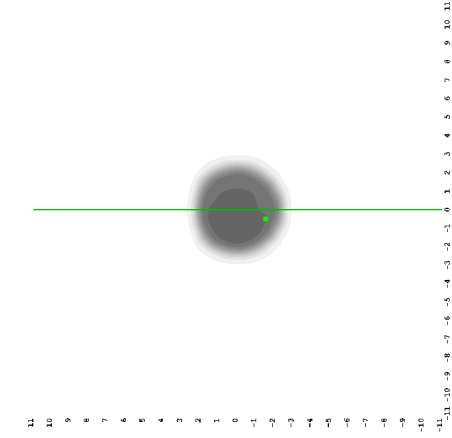
Reviewed By :

Set1

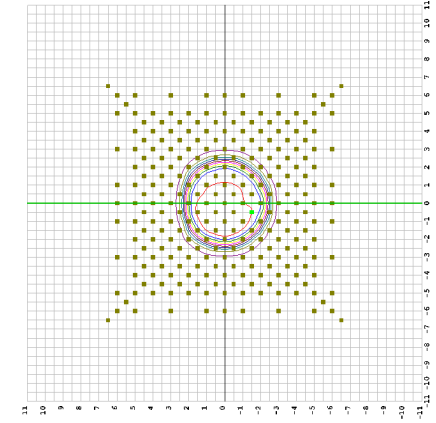


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\5.txt

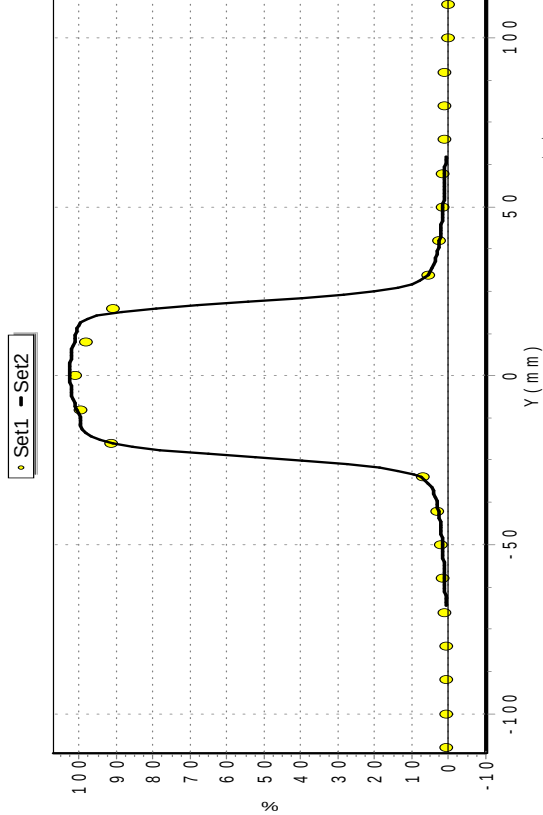
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 5.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 55
Passed : 55
Failed : 0
% Passed : 100

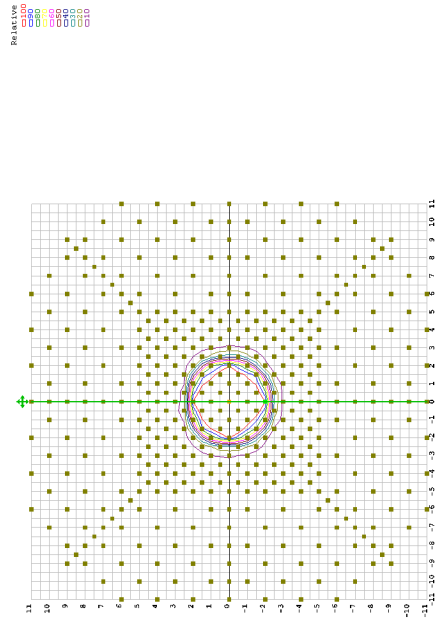
Dose Values in cGy		
	Cax	Picked
Set1	22.97	20.45
Set2	22.87	20.38
Set1-Set2	0.10	0.08
% Diff	0.50	0.37
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 6

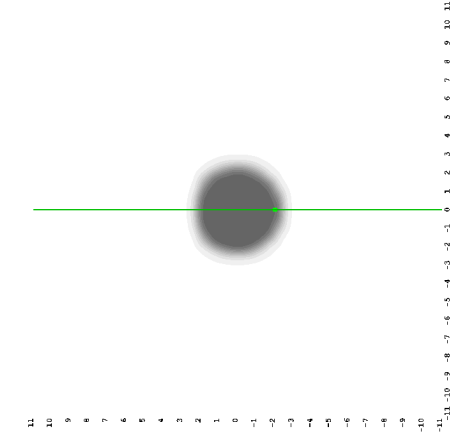
Reviewed By :

Set1

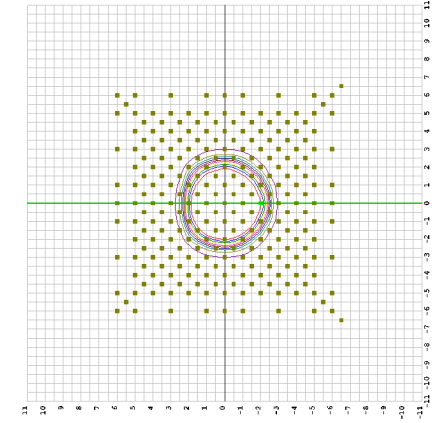


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\6.txt

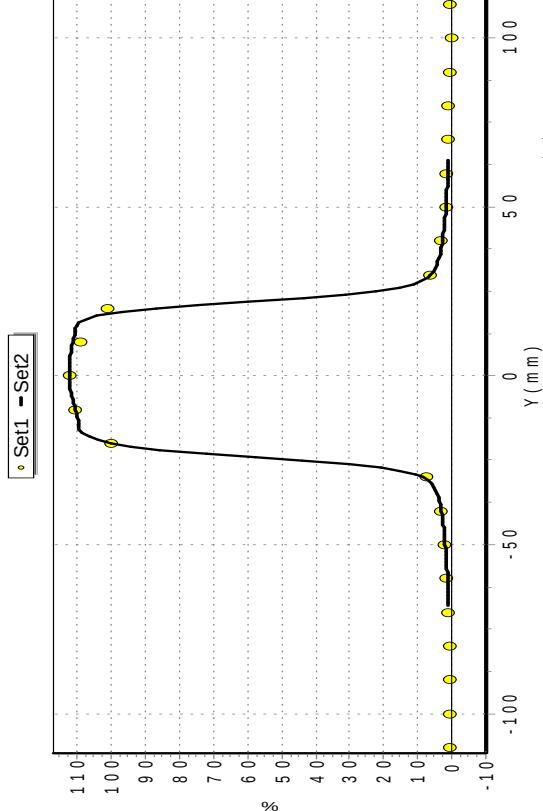
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 6.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

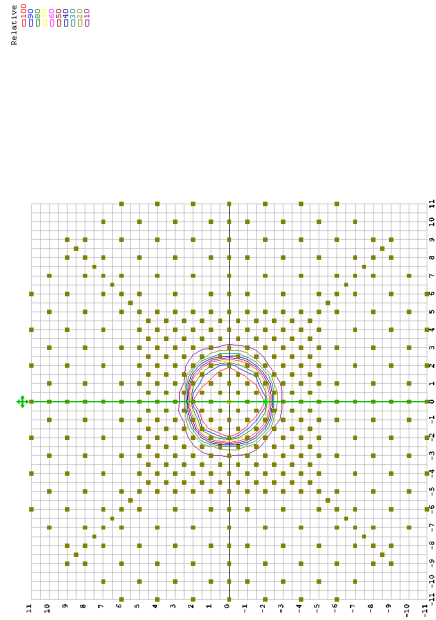
Dose Values in cGy		
	Cax	Picked
Set1	33.67	33.67
Set2	33.03	33.03
Set1-Set2	0.64	0.64
% Diff	2.17	2.17
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 7

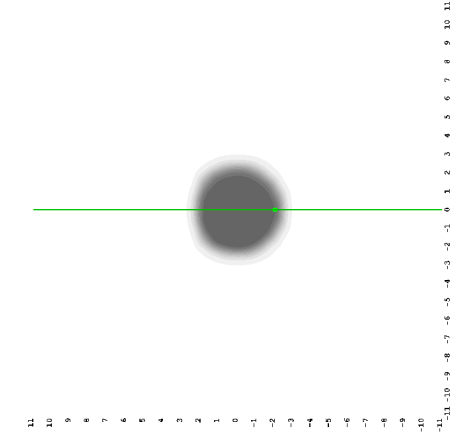
Reviewed By :

Set1

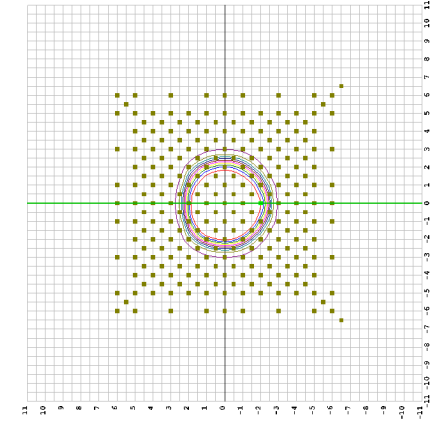


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\7.txt

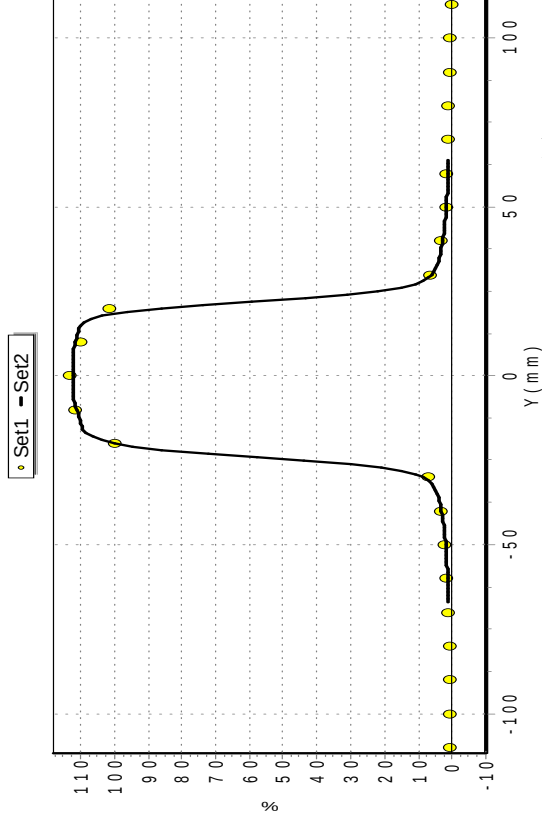
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 7.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 54
Passed : 54
Failed : 0
% Passed : 100

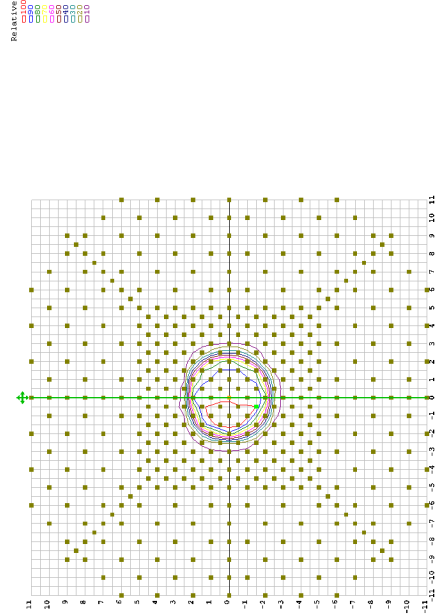
Dose Values in cGy		
	Cax	Picked
Set1	36.05	36.49
Set2	35.05	35.63
Set1-Set2	1.00	0.86
% Diff	2.79	2.42
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-1.5,-0.5

Notes

Non-gated Beam 8

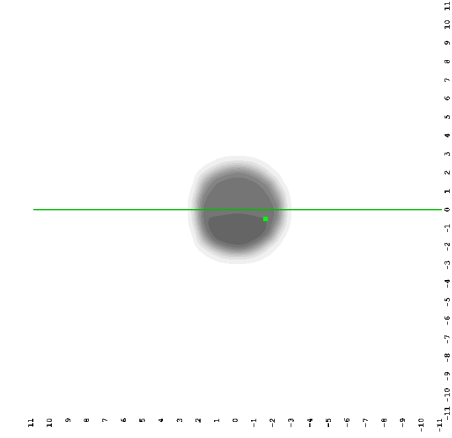
Reviewed By :

Set1

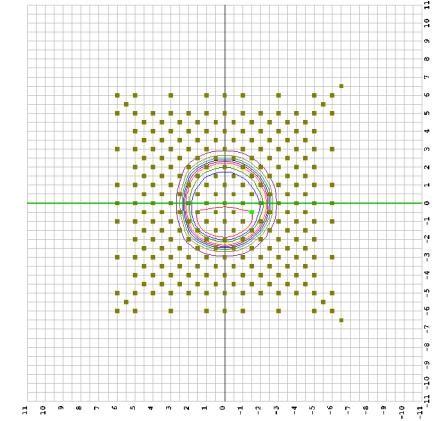


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\8.txt

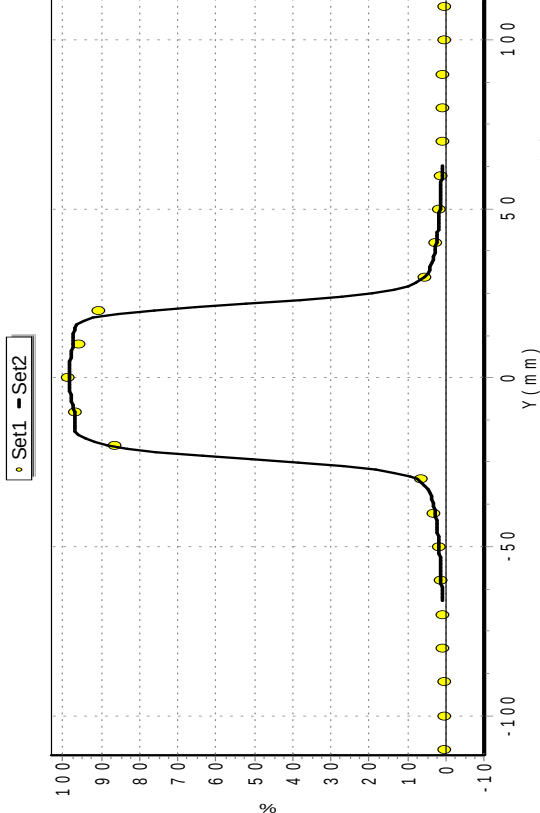
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 8.dcm



QA File Parameter
Patient Name : Phantom Patient #3
Patient ID : 11111
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3
D to A (mm) : 3
Threshold : 10
Rotation Angle : 0.0 Degr
Meas Uncertainty : Yes

Summary
Total Points : 56
Passed : 56
Failed : 0
% Passed : 100

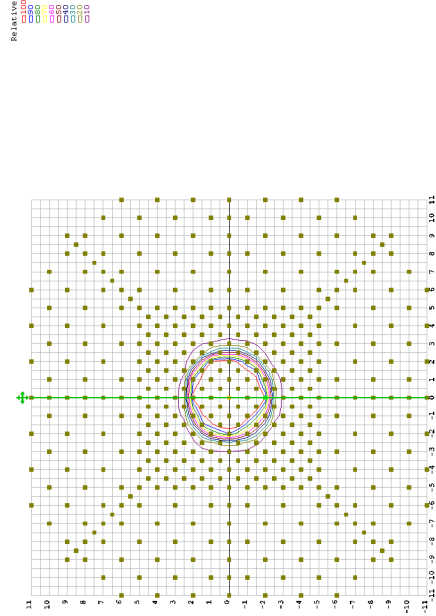
Dose Values in cGy		
	Cax	Normal
Set1	25.48	22.35
Set2	25.34	22.57
Set1-Set2	0.14	-0.22
% Diff	0.63	-0.97
DTA(mm)	0.00	0.00
Coords (y,x) cm	0,0	-2,0

Notes

Non-gated Beam 9

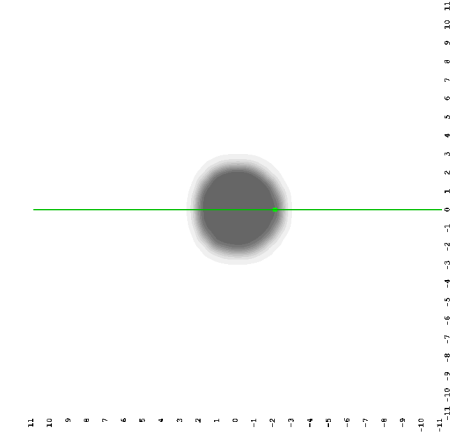
Reviewed By :

Set1

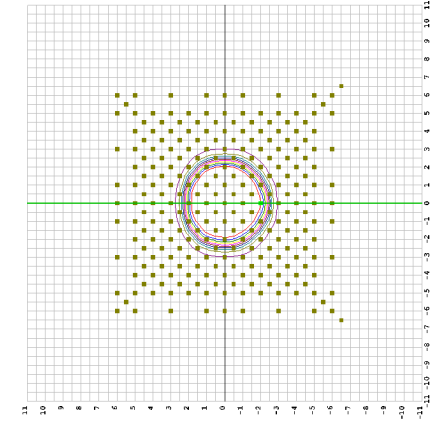


C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Map Check Non Gated\14 bpm non gated\9.txt

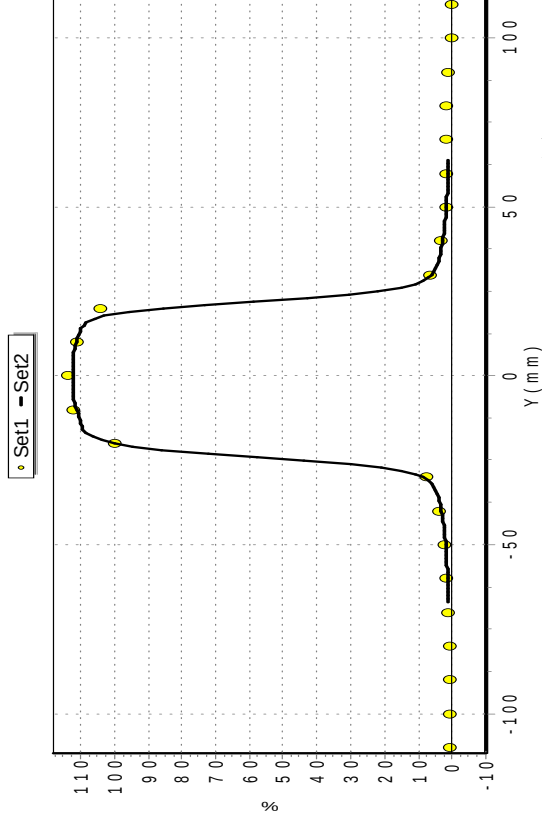
Set1-Set2



Set2



C:\Documents and Settings\Lindsey\Desktop\Thesis\Measurements\Phantom Patient #3 Eclipse Dose Planes\Beam 9.dcm



Appendix B – RGRT Patients MapCHECK Results

QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 113
Passed : 103
Failed : 10
% Passed : 91.2

Dose Values in cGy

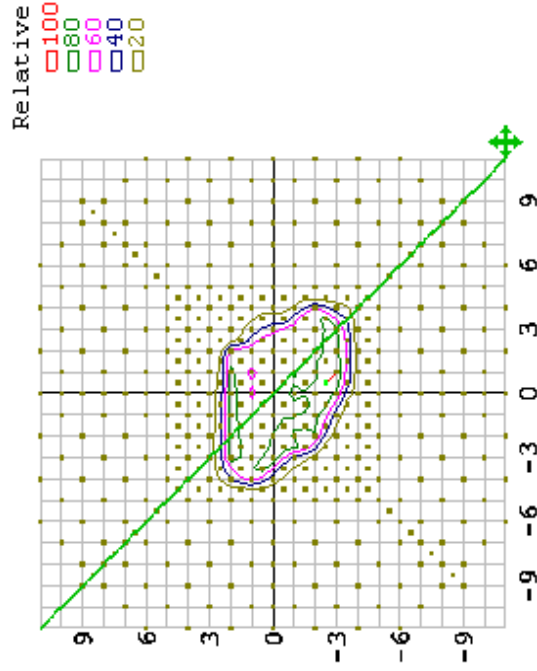
	Cax	Normal	Picked
Set1	22.65	31.58	22.65
Set2	22.61	31.87	22.61
Set1-Set2	0.04	-0.29	0.04
% Diff	0.14	-0.91	0.14
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2.5,0.5	0.0

Notes

Beam 1

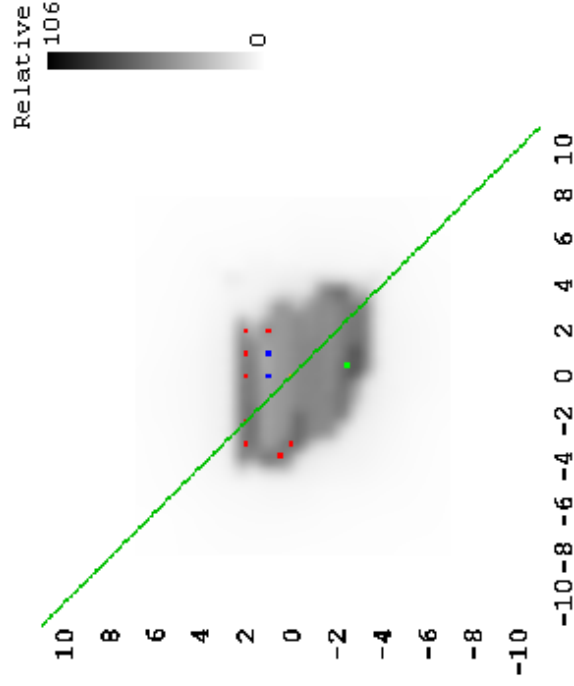
Reviewed By :

Set1



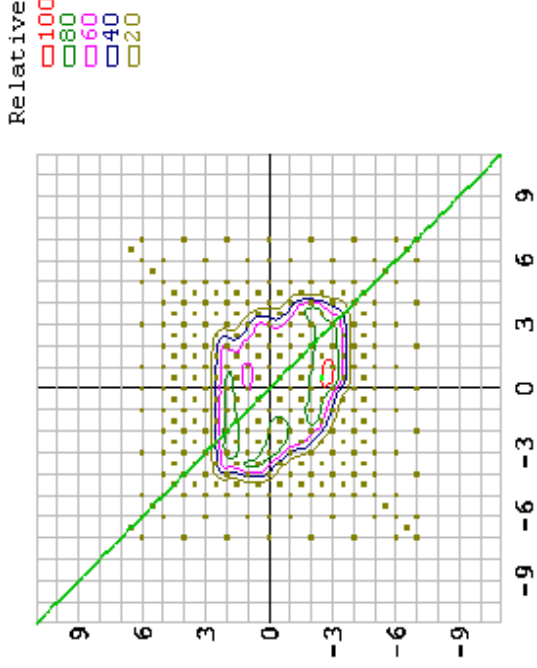
I:\Special Med Phy reports\SFH IMRT Reports...\1.txt

Set1-Set2

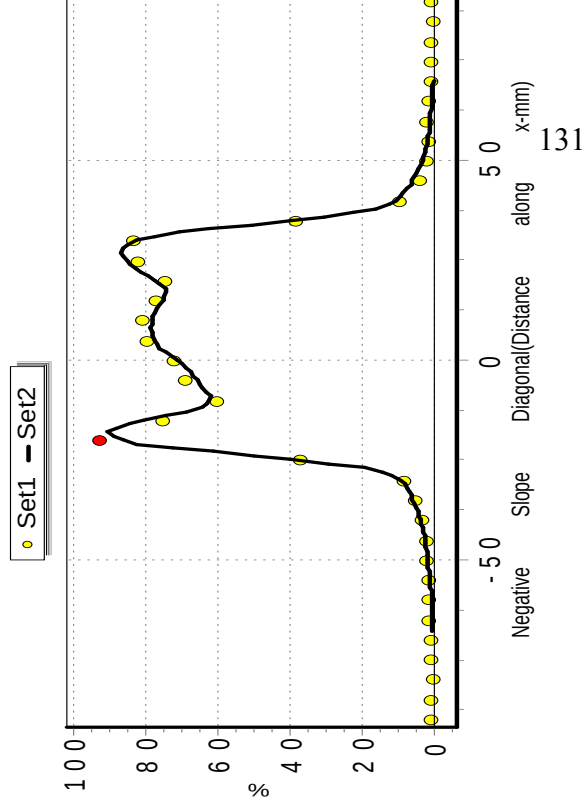


Set2

CAX Offset X=0 Y=1



I:\Special Med...\bm01_TGRa1DosePlanes10703276



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :
:

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 126
Passed : 119
Failed : 7
% Passed : 94.4

Dose Values in cGy

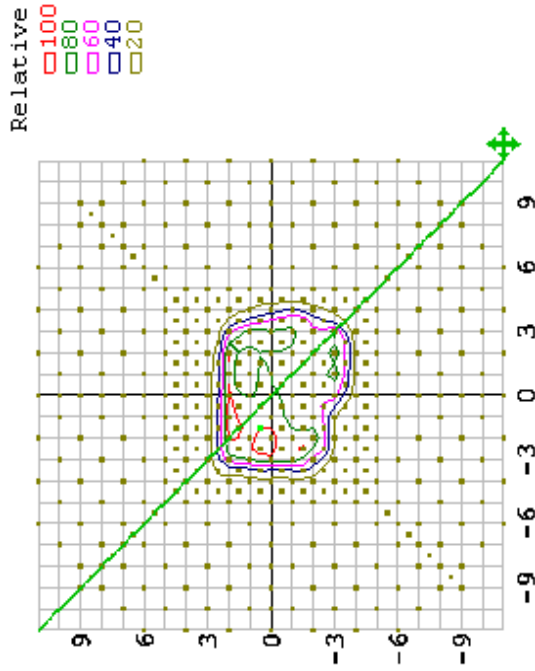
	Cax	Normal	Picked
Set1	30.05	35.93	30.05
Set2	29.62	35.50	29.62
Set1-Set2	0.43	0.43	0.43
% Diff	1.22	1.21	1.22
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	0.5,-1.5	0.0

Notes

Beam 2

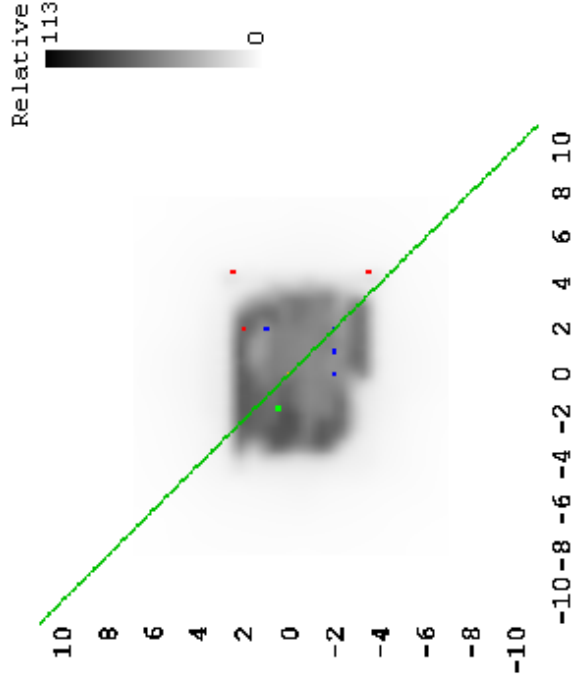
Reviewed By :

Set1



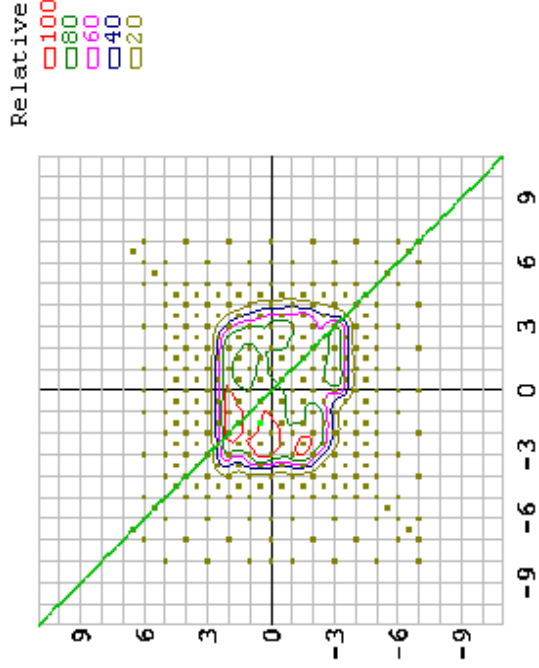
I:\Special Med Phy reports\SFH IMRT Reports...12.txt

Set1-Set2

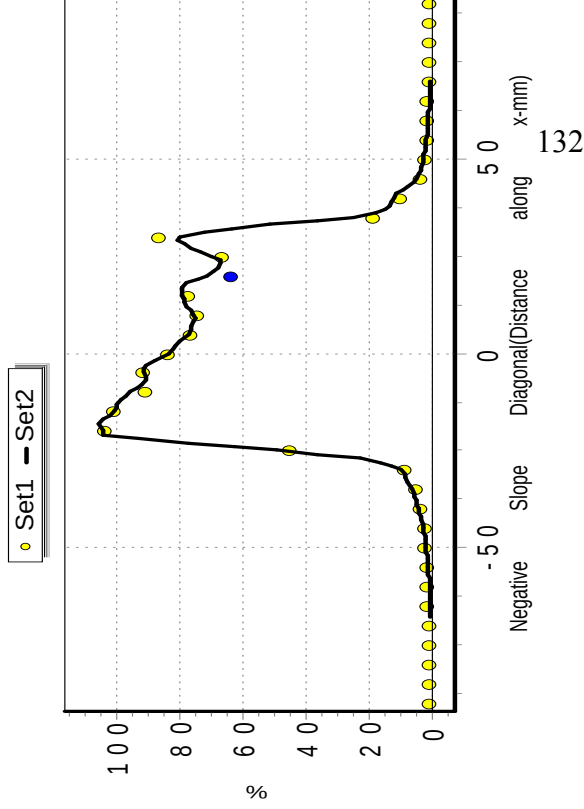


Set2

CAX Offset X=1 Y=1



I:\Special Med...lbm02_TGRa1DosePlanes10703276



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 112
Passed : 108
Failed : 4
% Passed : 96.4

Dose Values in cGy

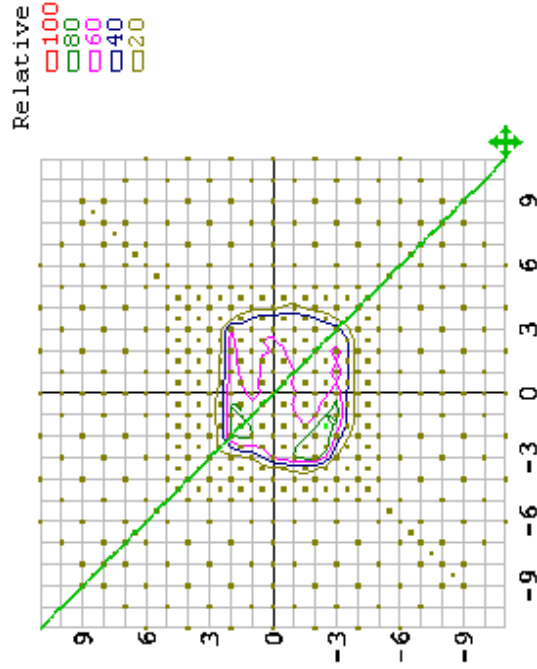
	Cax	Normal	Picked
Set1	16.28	25.89	16.28
Set2	15.78	25.84	15.78
Set1-Set2	0.51	0.05	0.51
% Diff	1.97	0.19	1.97
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0,0	-2.5,-1.5	0,0

Notes

Beam 3

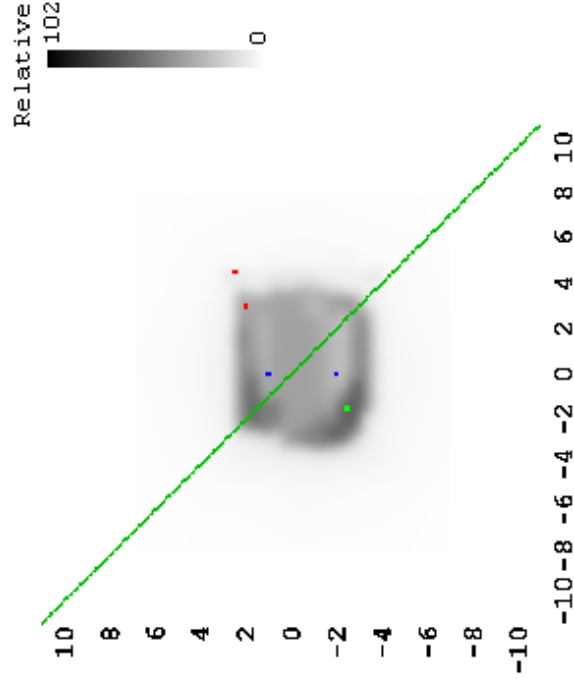
Reviewed By :

Set1



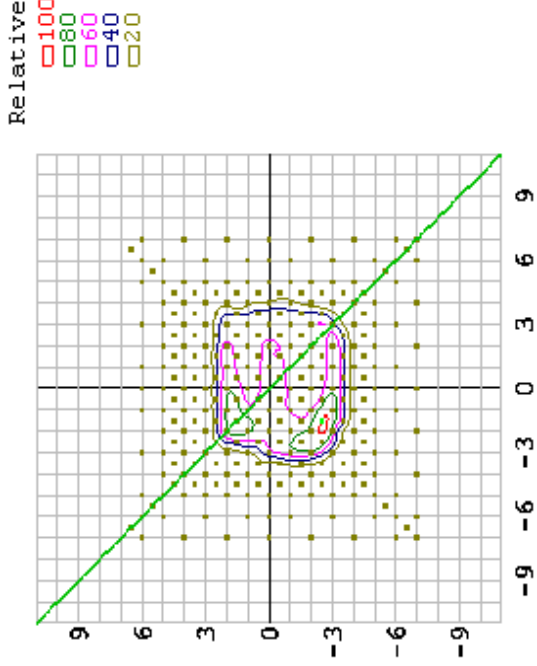
I:\Special Med Phy reports\SFH IMRT Reports...\3.txt

Set1-Set2

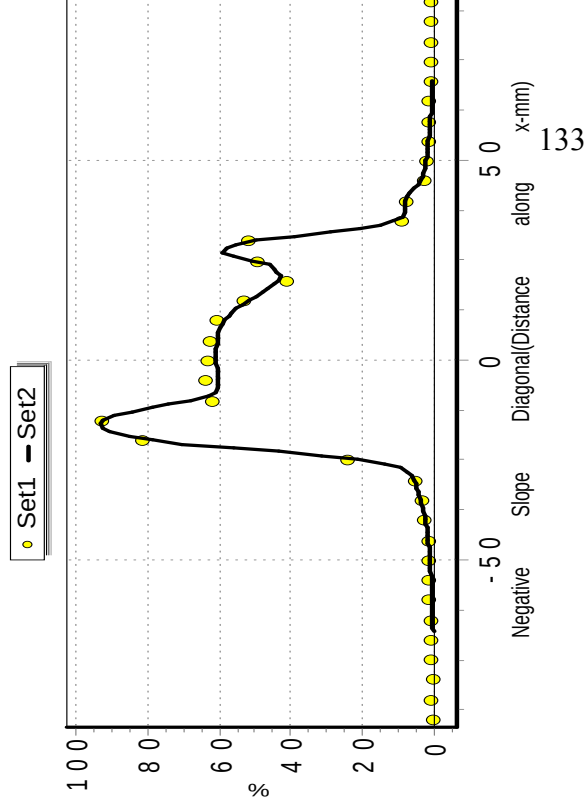


Set2

CAX Offset X=0 Y=1



I:\Special Med...\bm03_TGRa1DosePlanes10703276



QA File Parameter

Patient Name :
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison

% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)

Total Points : 115
Passed : 114
Failed : 1
% Passed : 99.1

Dose Values in cGy

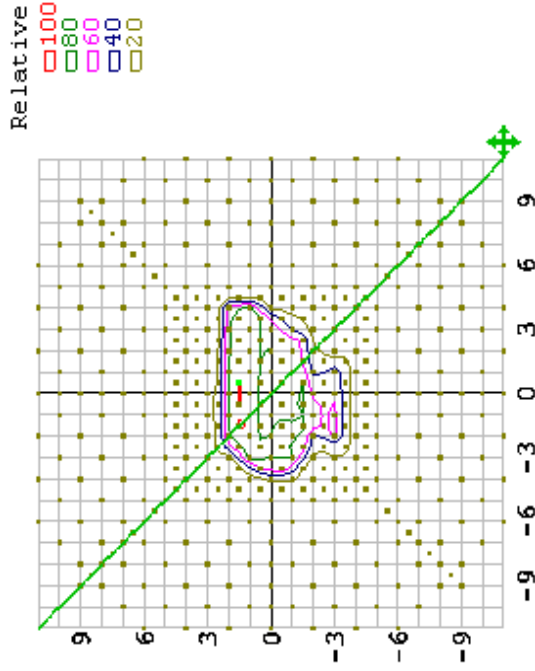
	Cax	Normal	Picked
Set1	13.23	17.89	13.23
Set2	12.79	17.38	12.79
Set1-Set2	0.44	0.52	0.44
% Diff	2.54	2.97	2.54
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0,0	1.5,0.5	0,0

Notes

Beam 4

Reviewed By :

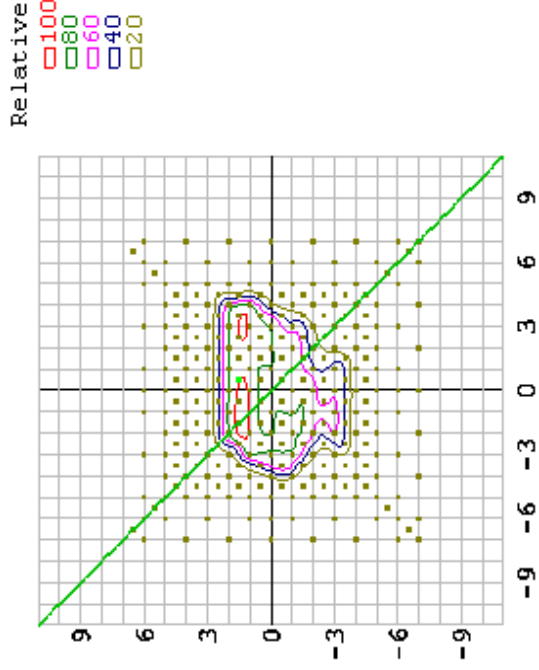
Set1



I:\Special Med Phy reports\SFH IMRT Reports...V4.txt

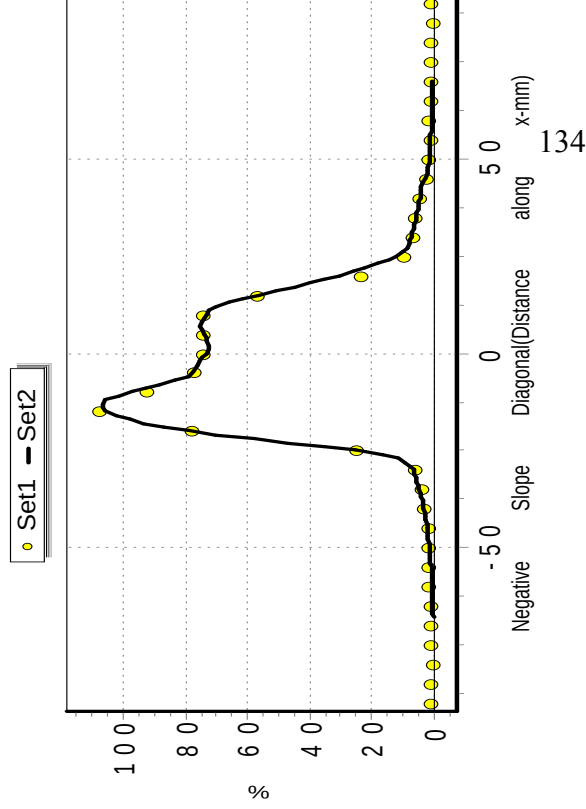
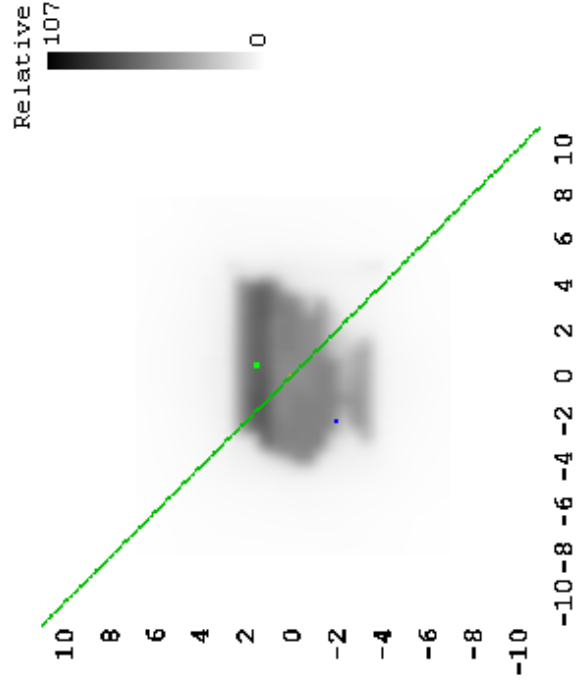
Set2

CAX Offset X=0 Y=1



I:\Special Med...lbm04_TGRa1DosePlanes10703276

Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 137
Passed : 131
Failed : 6
% Passed : 95.6

Dose Values in cGy

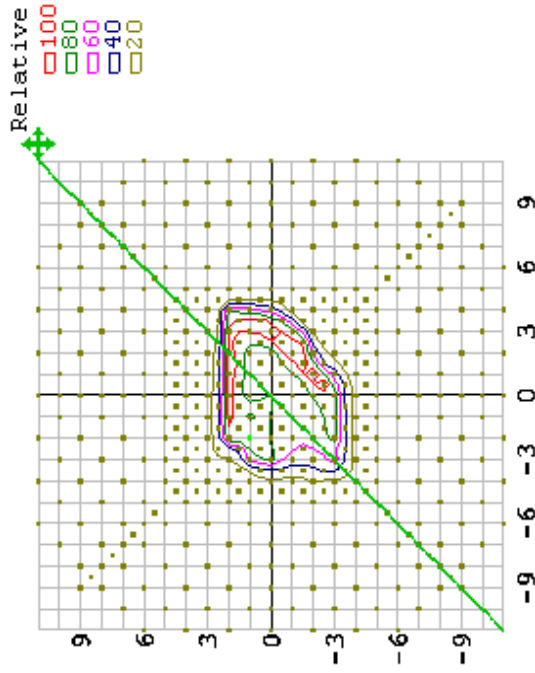
	Cax	Normal	Picked
Set1	16.64	20.67	16.64
Set2	16.94	19.89	16.94
Set1-Set2	-0.31	0.77	-0.31
% Diff	-1.55	3.90	-1.55
DTA(mm)	2.00	0.00	2.00
Coords (y,x) cm	0,0	1,-2	0,0

Notes

Beam 5

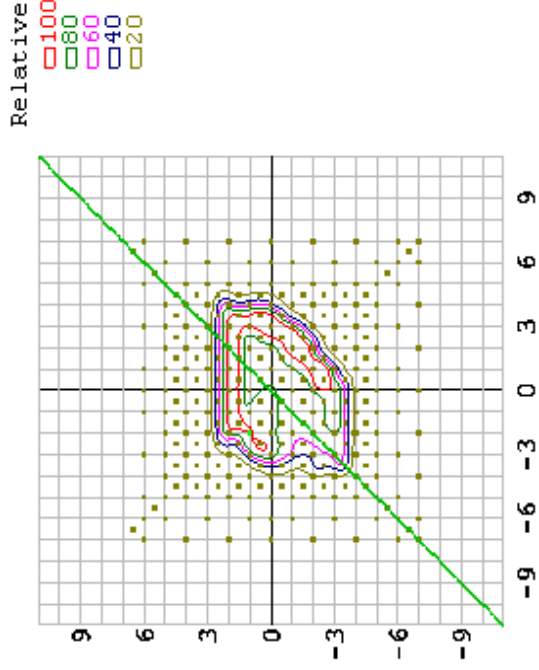
Reviewed By :

Set1



Set2

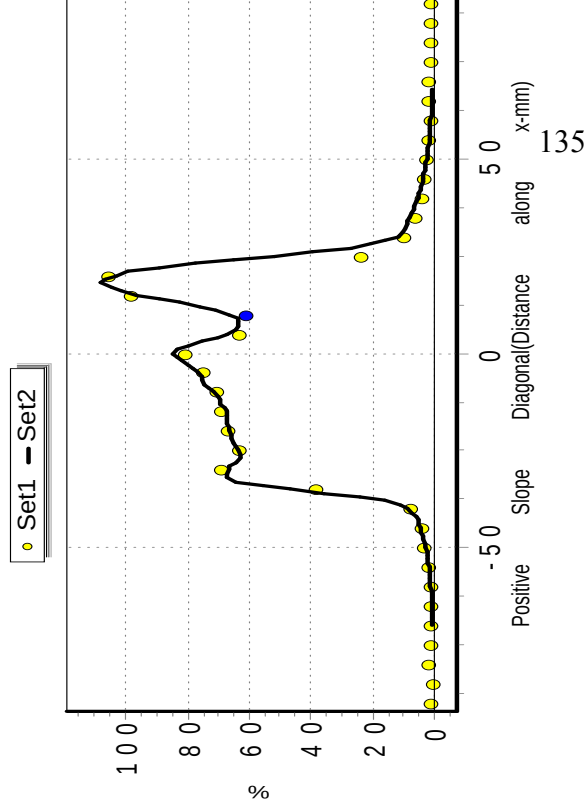
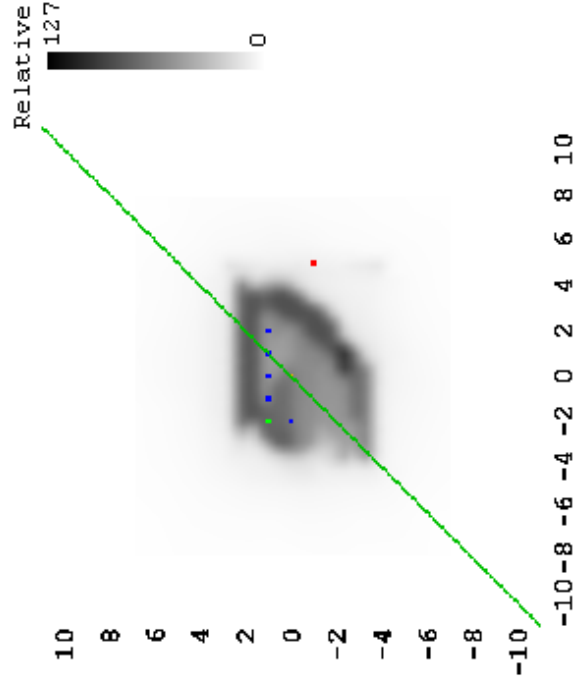
CAX Offset X=0 Y=1



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Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 109
Passed : 107
Failed : 2
% Passed : 98.2

Dose Values in cGy

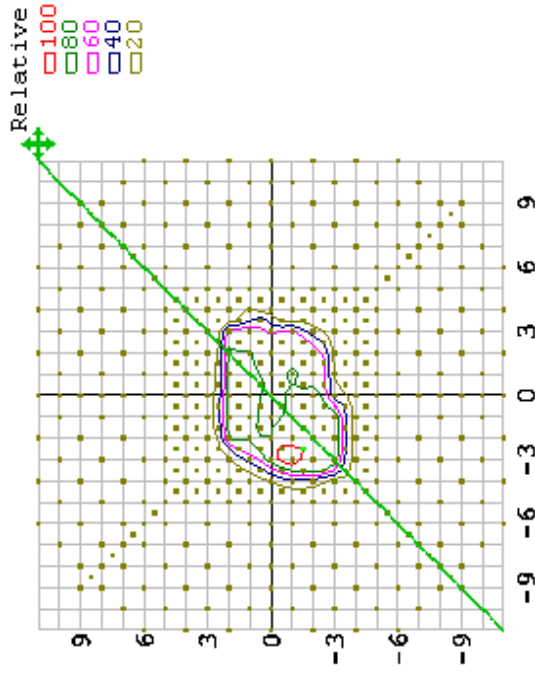
	Cax	Normal	Picked
Set1	21.45	29.11	21.45
Set2	21.17	28.58	21.22
Set1-Set2	0.28	0.53	0.23
% Diff	0.99	1.85	0.79
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,-2.5	0.0

Notes

Beam 6

Reviewed By :

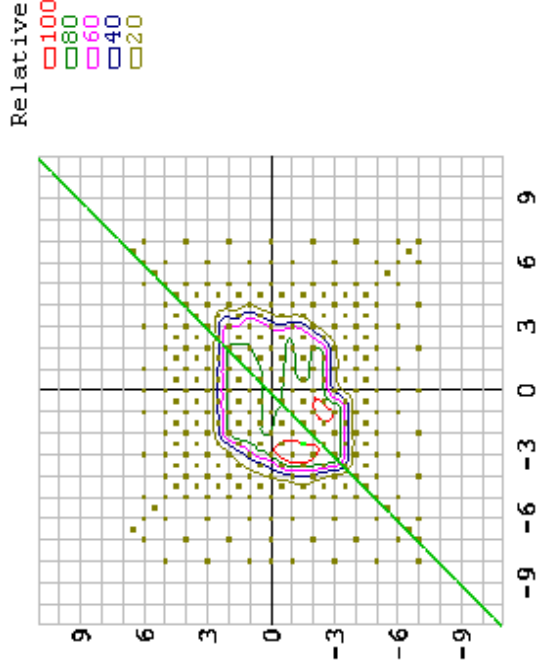
Set1



I:\Special Med Phy reports\SFH IMRT Reports...\6.txt

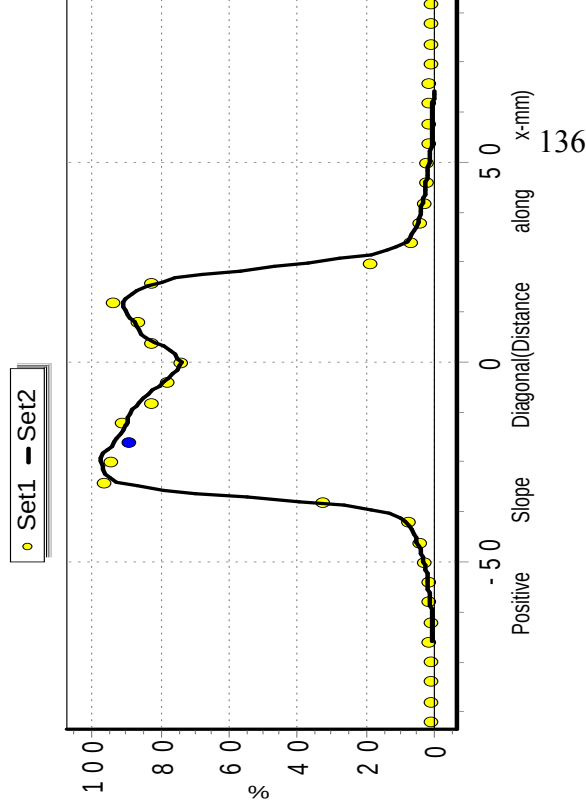
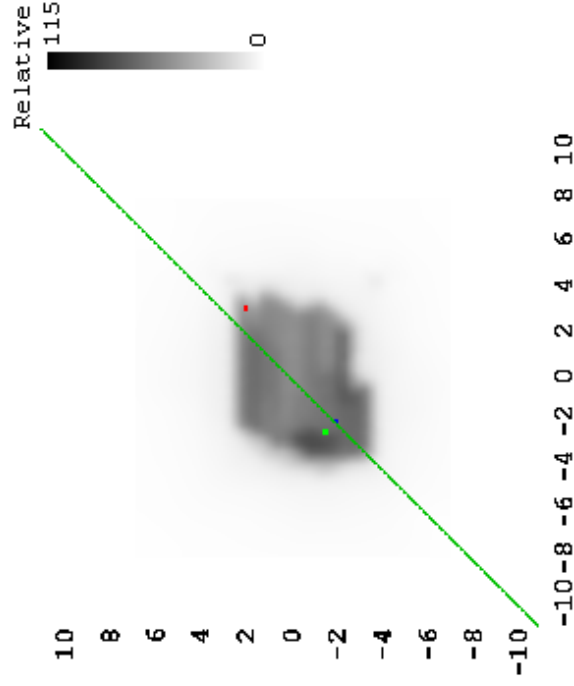
Set2

CAX Offset X=1 Y=1



I:\Special Med...bm06_TGRa1DosePlanes10703276

Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 115
Passed : 113
Failed : 2
% Passed : 98.3

Dose Values in cGy

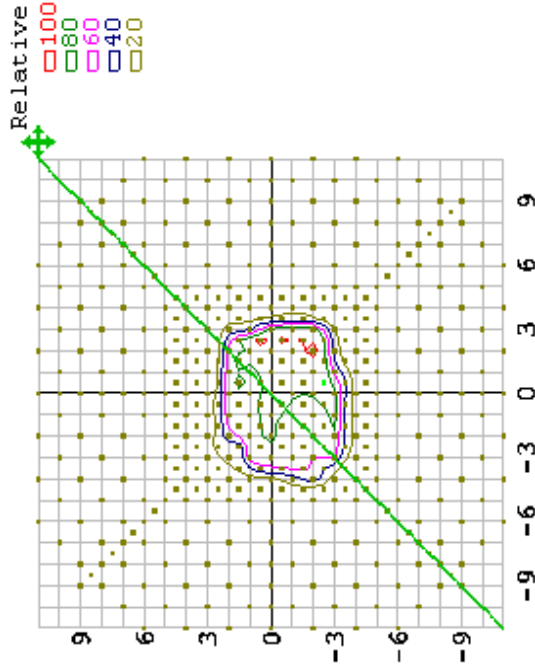
	Cax	Normal	Picked
Set1	28.55	31.38	28.55
Set2	27.14	31.15	27.14
Set1-Set2	1.41	0.23	1.41
% Diff	4.53	0.74	4.53
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2.5,0.5	0.0

Notes

Beam 7

Reviewed By :

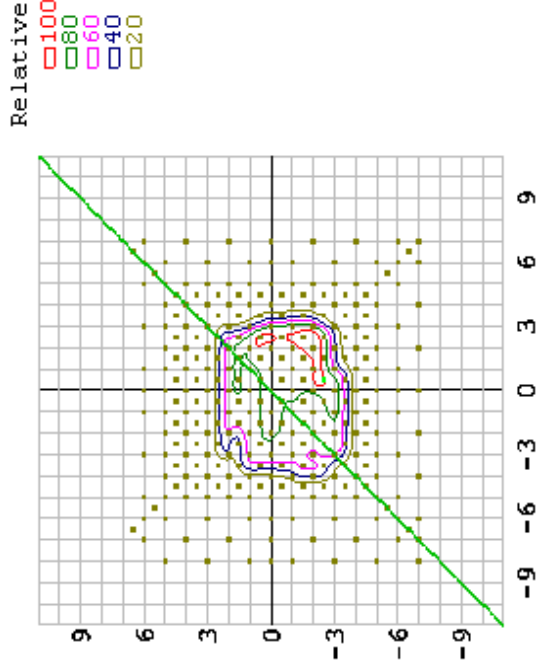
Set1



I:\Special Med Phy reports\SFH IMRT Reports...17.txt

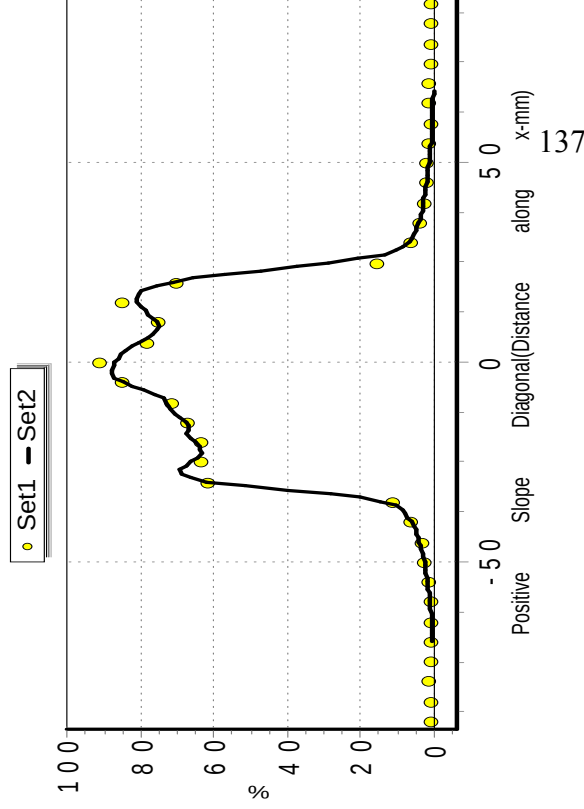
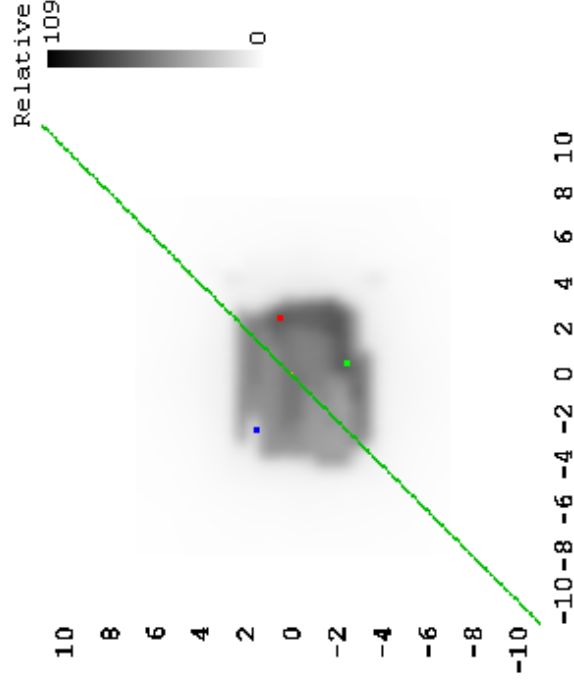
Set2

CAX Offset X=1 Y=1



I:\Special Med...lbm07_TGRa1DosePlanes10703276

Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 128
Passed : 125
Failed : 3
% Passed : 97.7

Dose Values in cGy

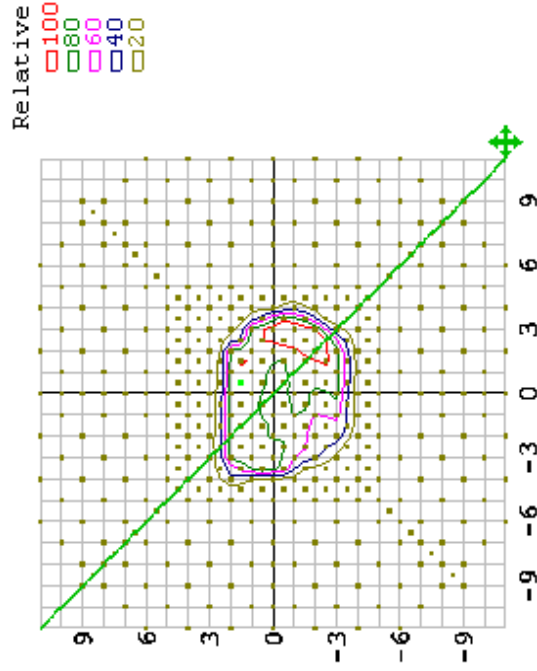
	Cax	Normal	Picked
Set1	21.45	28.52	21.45
Set2	20.93	28.41	20.93
Set1-Set2	0.52	0.11	0.52
% Diff	1.85	0.40	1.85
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	15.0.5	0.0

Notes

Beam 8

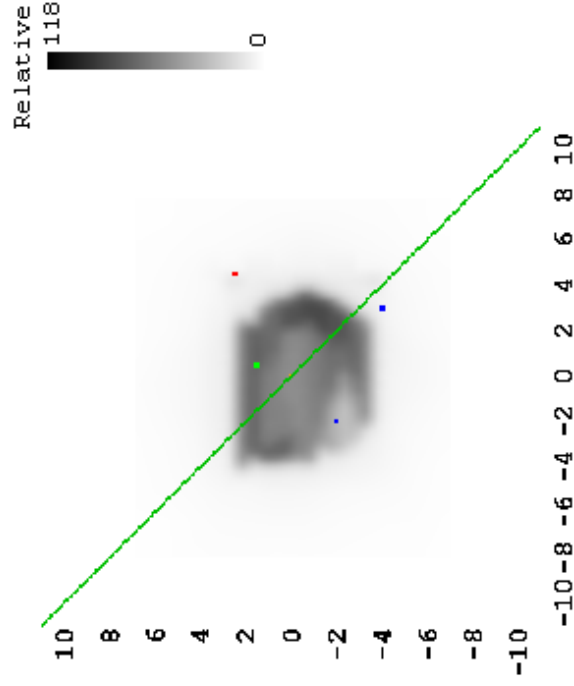
Reviewed By :

Set1



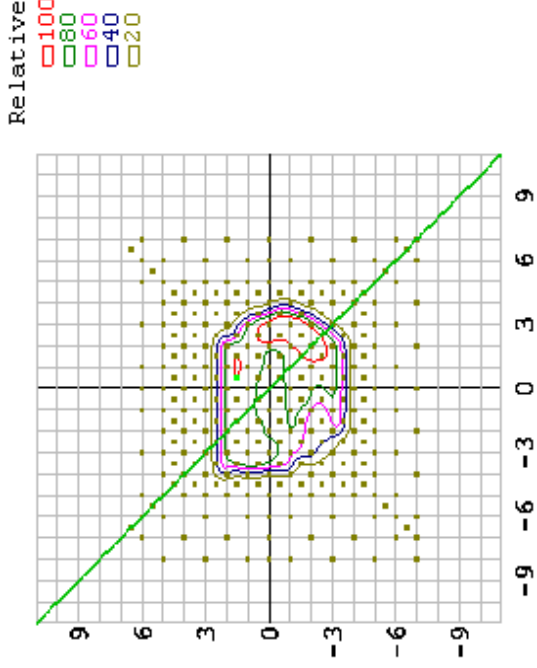
I:\Special Med Phy reports\SFH IMRT Reports...18.txt

Set1-Set2

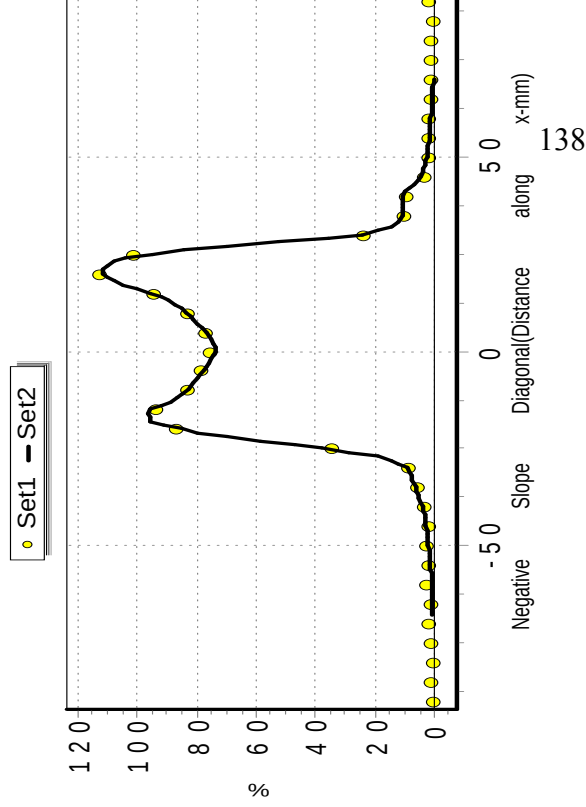


Set2

CAX Offset X=1 Y=1



I:\Special Med...lbm08_TGRa1DosePlanes10703276



QA File Parameter
Patient Name : RGRT Patient #1
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10.0
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 109
Passed : 109
Failed : 0
% Passed : 100

Dose Values in cGy

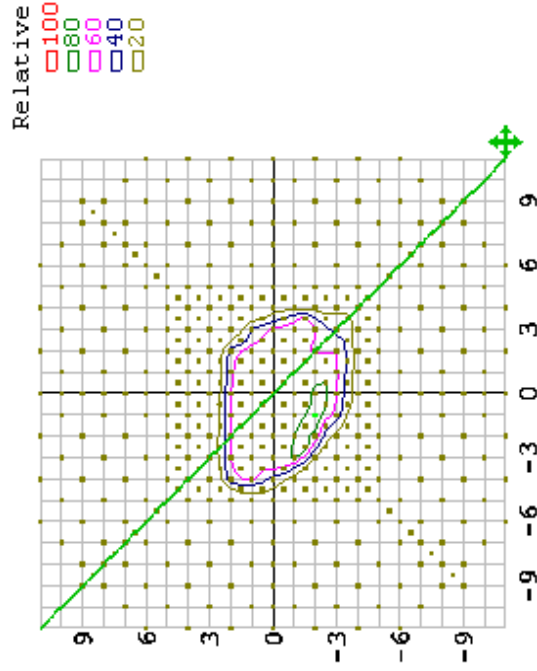
	Cax	Normal	Picked
Set1	25.76	39.14	25.76
Set2	25.25	37.48	25.25
Set1-Set2	0.51	1.66	0.51
% Diff	1.36	4.43	1.36
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0,0	-2,-1	0,0

Notes

Beam 9

Reviewed By :

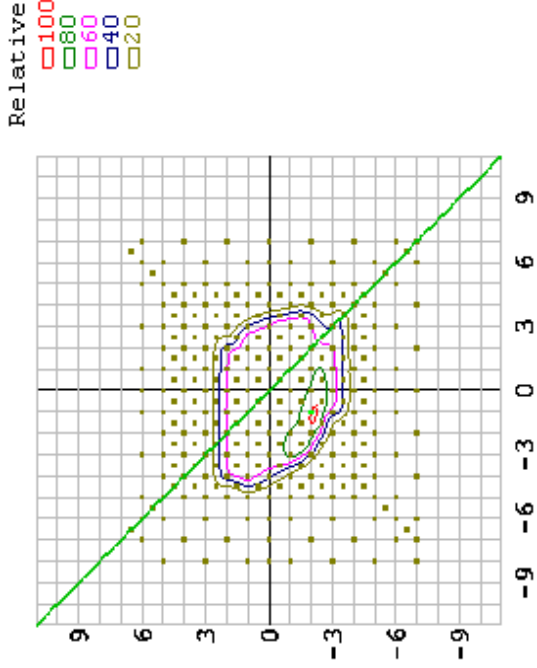
Set1



I:\Special Med Phy reports\SFH IMRT Reports...\9.txt

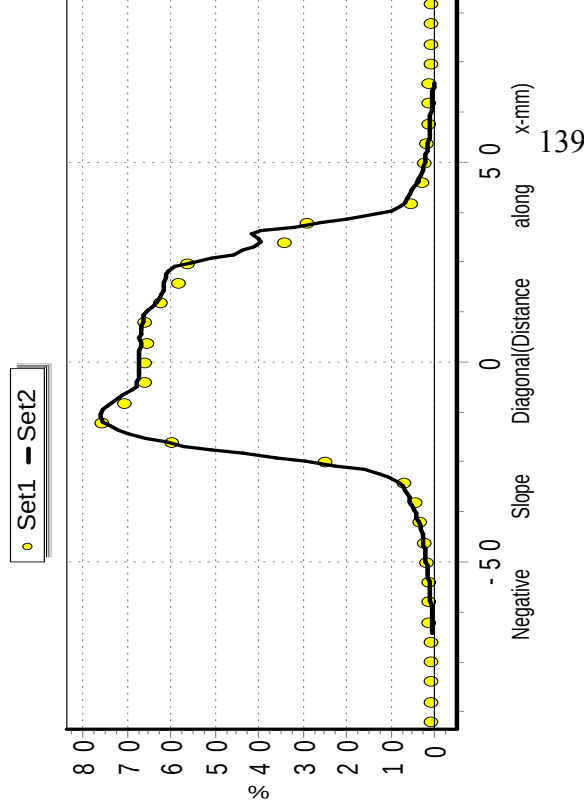
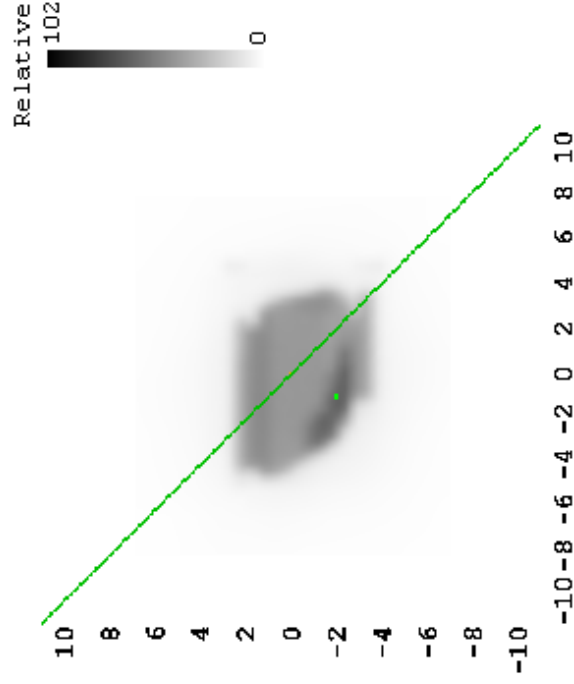
Set2

CAX Offset X=1 Y=1



I:\Special Med...lbm09_TGRa1DosePlanes10703276

Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 150
Passed : 149
Failed : 1
% Passed : 99.3

Dose Values in cGy

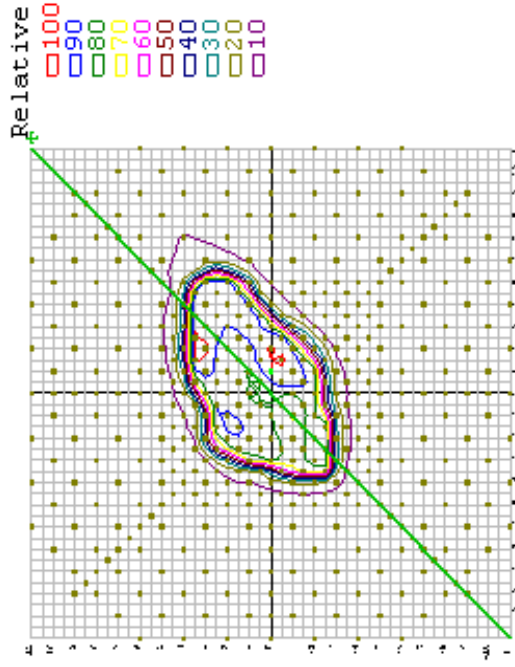
	Cax	Normal	Picked
Set1	23.87	28.74	23.87
Set2	23.84	28.46	23.84
Set1-Set2	0.03	0.28	0.03
% Diff	0.09	0.97	0.09
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	0.1	0.0

Notes

Beam 1

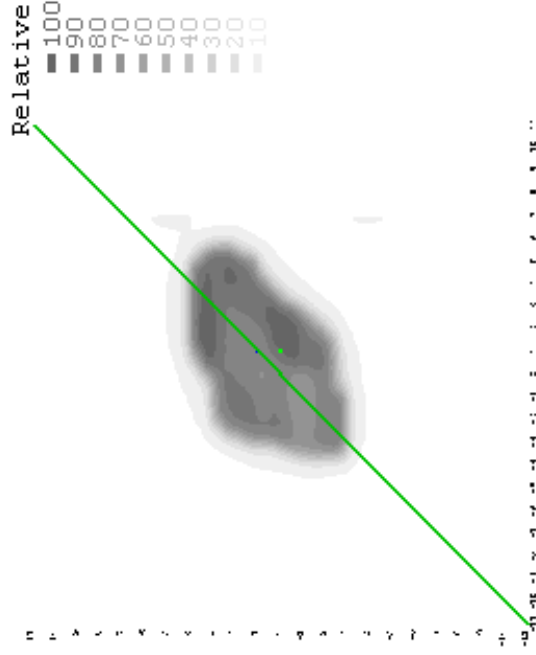
Reviewed By :

Set1

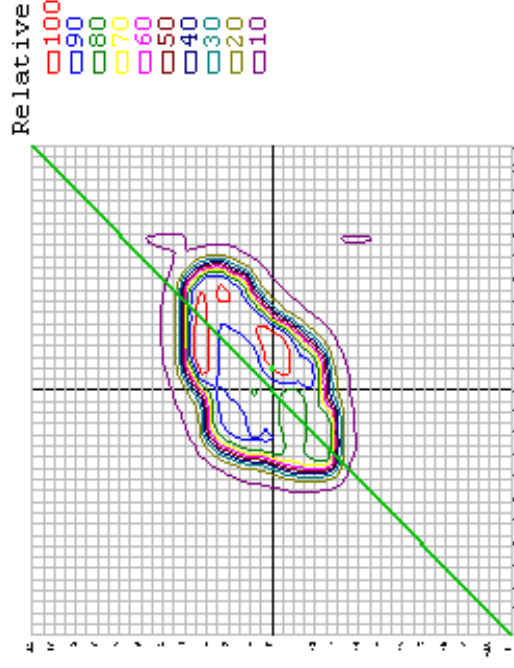


I:\Special Med Phy reports\SFH IMRT Reports...\1.txt

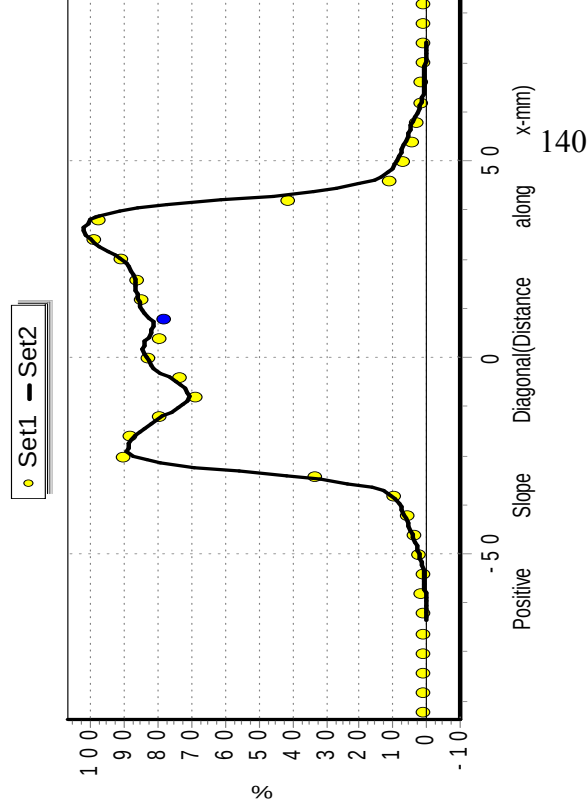
Set1-Set2



Set2



I:\Special Med Ph...\01PA0WB\Jdoseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 137
Passed : 135
Failed : 2
% Passed : 98.5

Dose Values in cGy

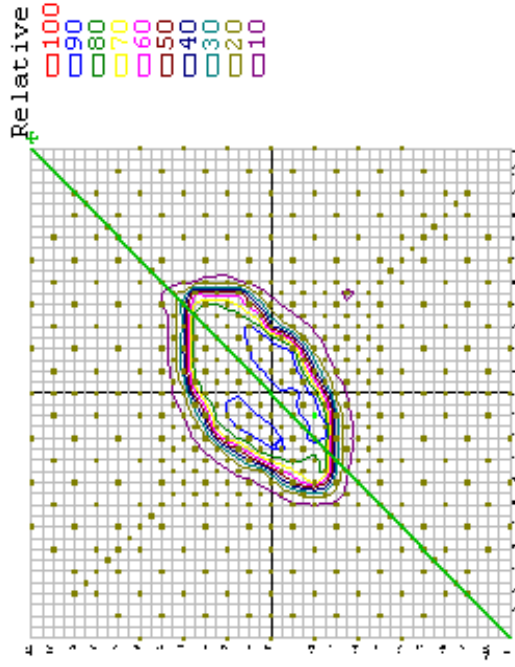
	Cax	Normal	Picked
Set1	16.90	19.28	16.90
Set2	16.84	19.07	16.84
Set1-Set2	0.05	0.20	0.05
% Diff	0.27	1.07	0.27
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2,-1	0.0

Notes

Beam 2

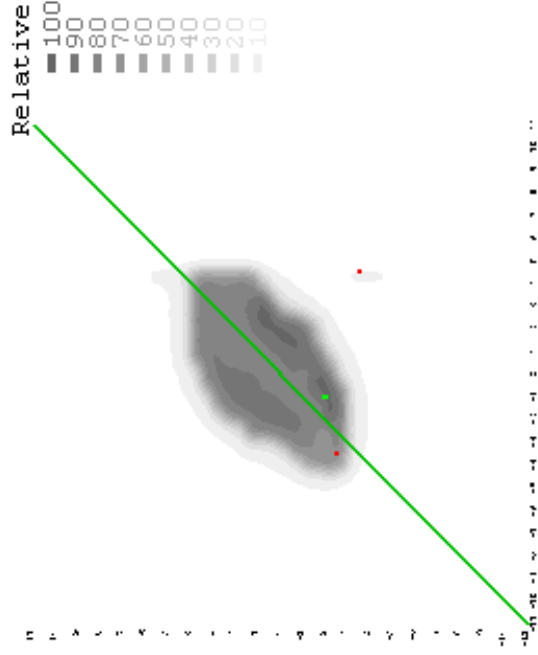
Reviewed By :

Set1

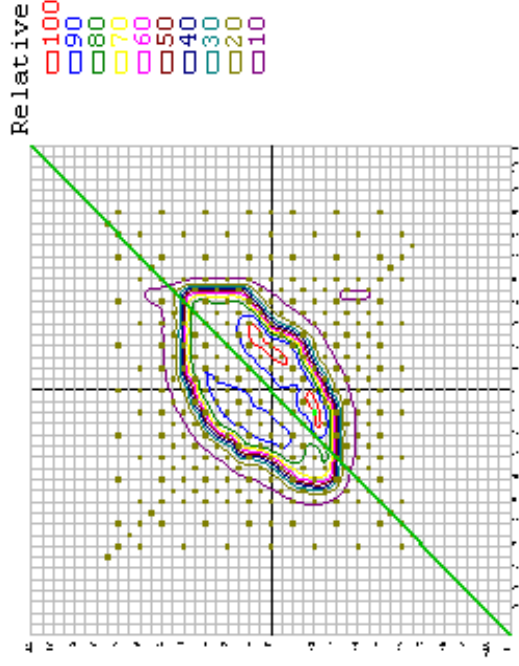


I:\Special Med Phy reports\SFH IMRT Reports...\2.txt

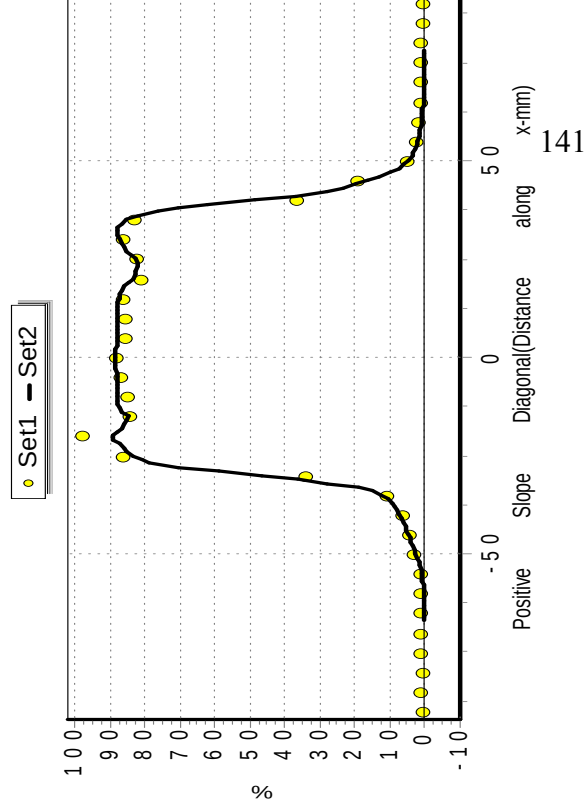
Set1-Set2



Set2



I:\Special Med ...\02LPO40WB\Joseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 146
Passed : 144
Failed : 2
% Passed : 98.6

Dose Values in cGy

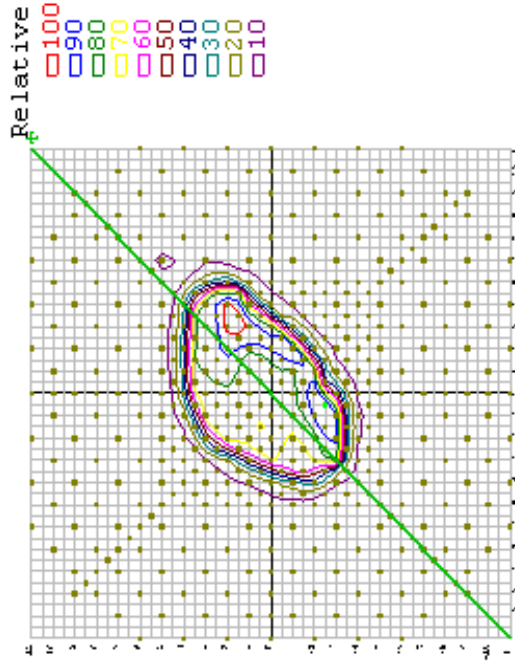
	Cax	Normal	Picked
Set1	20.01	27.41	20.01
Set2	20.34	27.29	20.34
Set1-Set2	-0.33	0.13	-0.33
% Diff	-1.22	0.47	-1.22
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2.5,-0.5	0.0

Notes

Beam 3

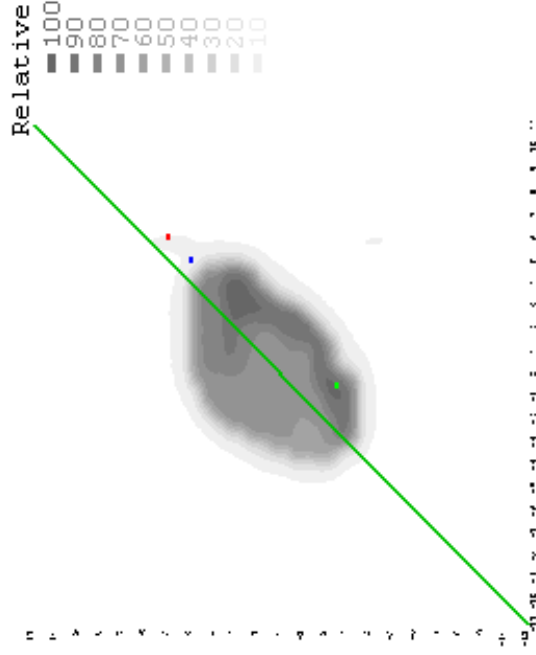
Reviewed By :

Set1

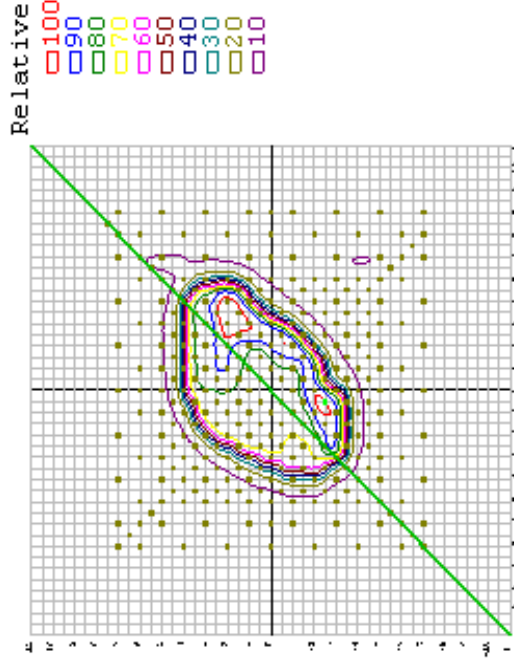


I:\Special Med Phy reports\SFH IMRT Reports...\3.txt

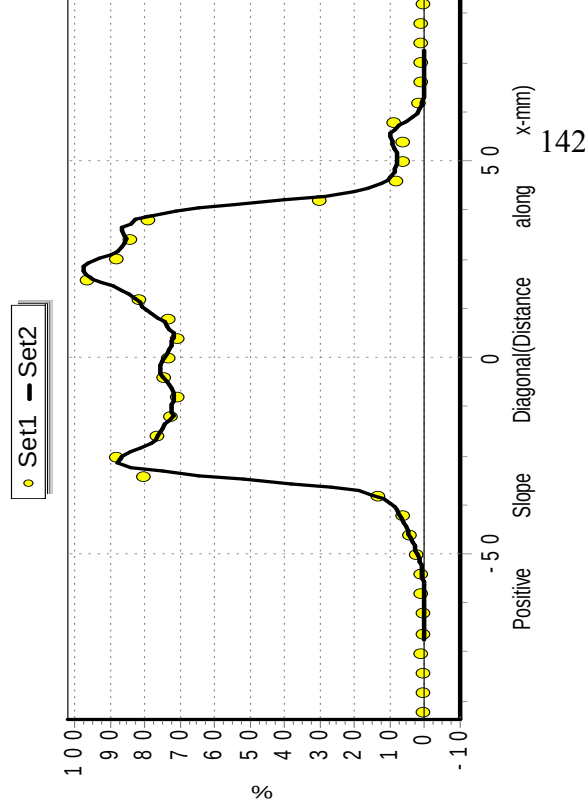
Set1-Set2



Set2



I:\Special Med ...\03LPO80WB\Joseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 135
Passed : 133
Failed : 2
% Passed : 98.5

Dose Values in cGy

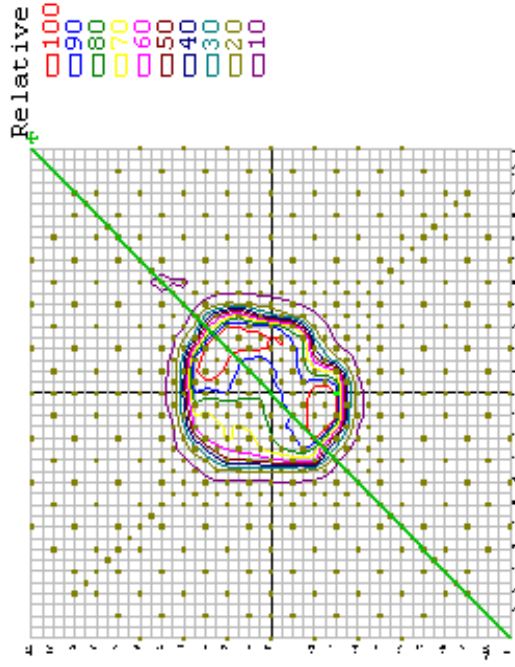
	Cax	Normal	Picked
Set1	28.58	34.04	28.58
Set2	29.18	34.48	29.18
Set1-Set2	-0.60	-0.44	-0.60
% Diff	-1.74	-1.27	-1.74
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-3.0	0.0

Notes

Beam 4

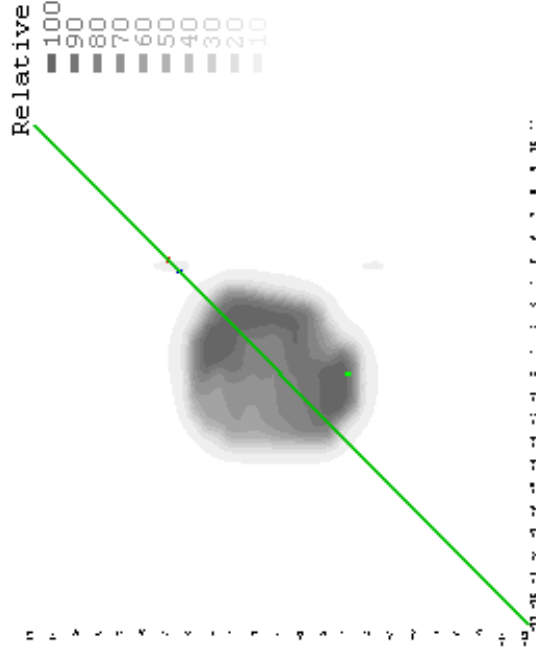
Reviewed By :

Set1

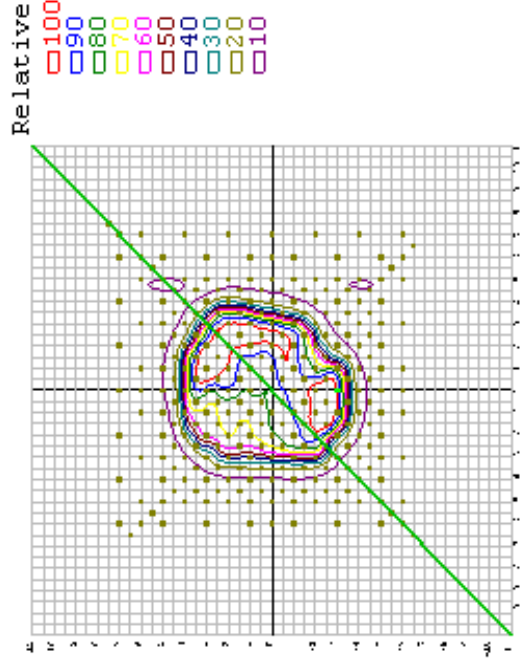


I:\Special Med Phy reports\SFH IMRT Reports...V4.txt

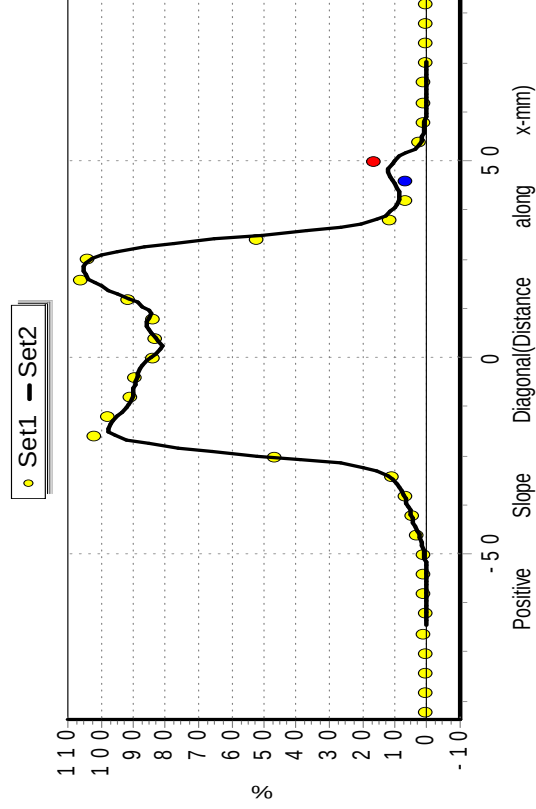
Set1-Set2



Set2



I:\Special Me...I04LAO120WB.Jdoseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 152
Passed : 151
Failed : 1
% Passed : 99.3

Dose Values in cGy

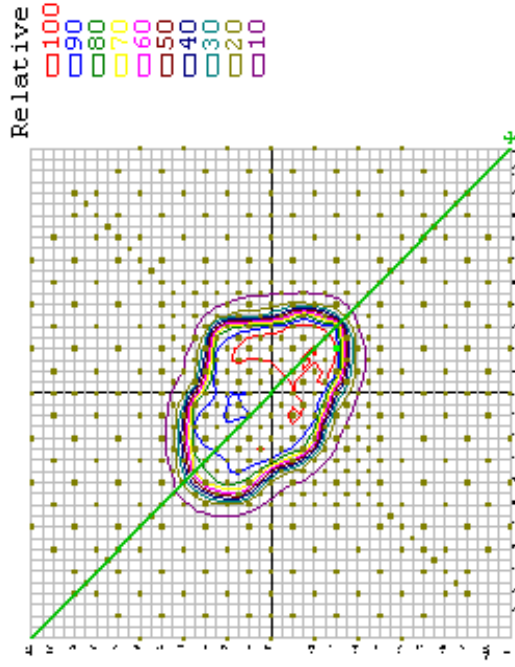
	Cax	Normal	Picked
Set1	31.79	33.23	31.79
Set2	31.86	33.36	31.86
Set1-Set2	-0.07	-0.13	-0.07
% Diff	-0.20	-0.39	-0.20
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-3.2	0.0

Notes

Beam 5

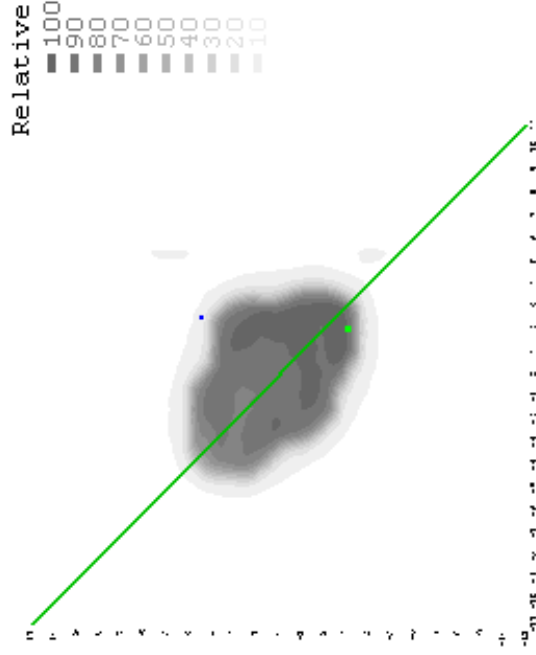
Reviewed By :

Set1

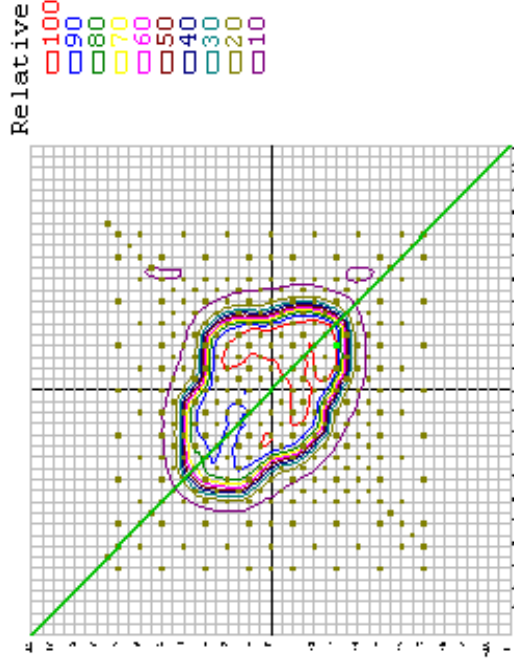


I:\Special Med Phy reports\SFH IMRT Reports...15.txt

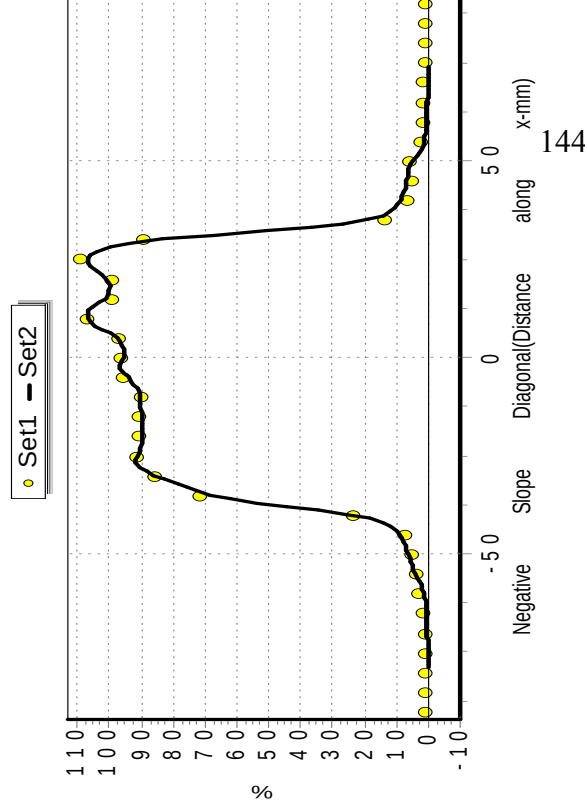
Set1-Set2



Set2



I:\Special Me...105LAO160WB.Jdoseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 143
Passed : 140
Failed : 3
% Passed : 97.9

Dose Values in cGy

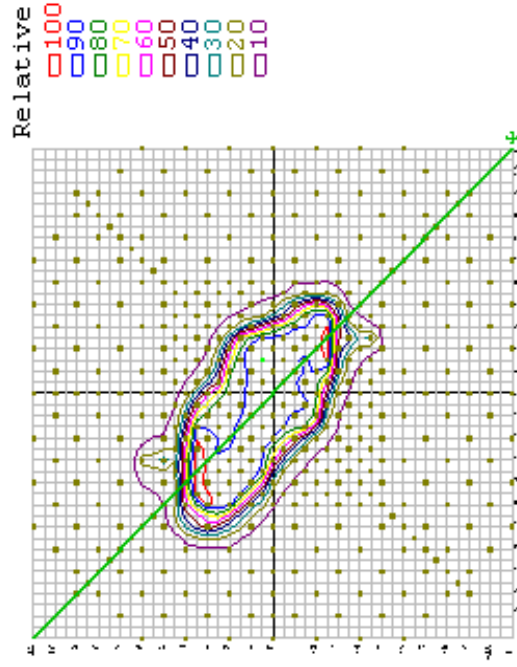
	Cax	Normal	Picked
Set1	21.49	23.83	21.49
Set2	21.38	23.80	21.38
Set1-Set2	0.11	0.03	0.11
% Diff	0.46	0.12	0.46
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	0.5,1.5	0.0

Notes

Beam 6

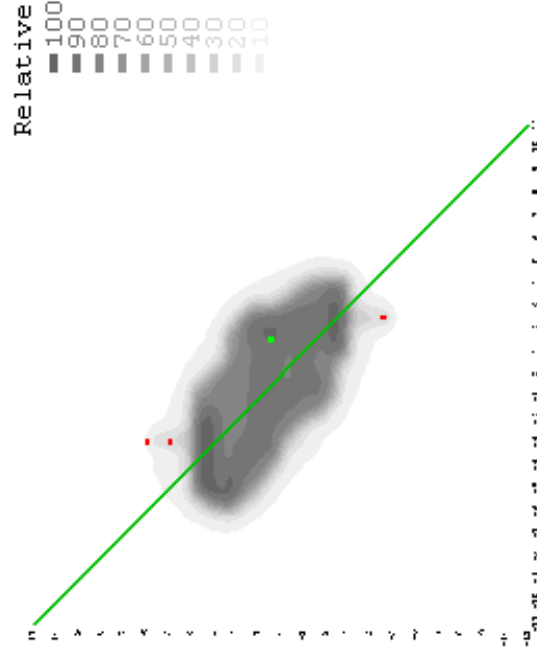
Reviewed By :

Set1

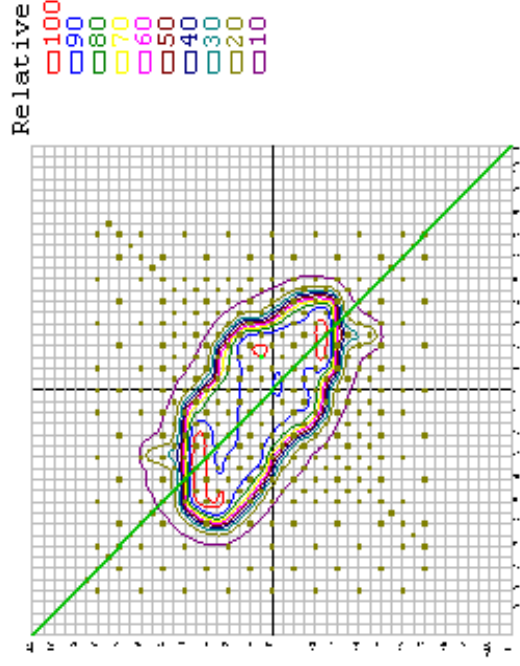


I:\Special Med Phy reports\SFH IMRT Reports...\6.txt

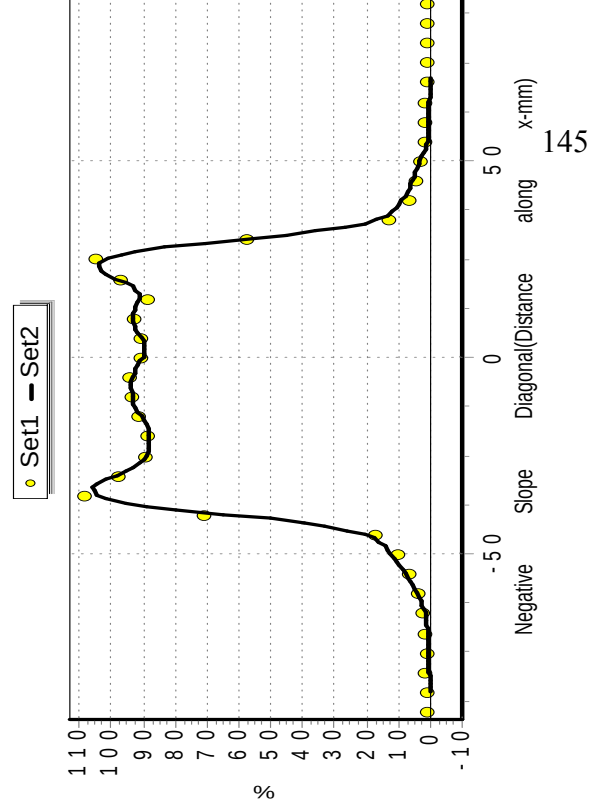
Set1-Set2



Set2



I:\Special Me...\06RAO200WB\Joseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 140
Passed : 140
Failed : 0
% Passed : 100

Dose Values in cGy

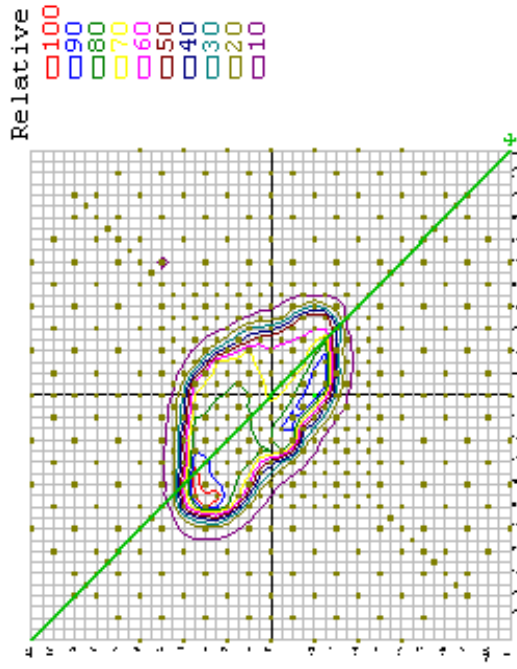
	Cax	Normal	Picked
Set1	20.96	30.96	20.96
Set2	21.25	31.00	21.25
Set1-Set2	-0.29	-0.04	-0.29
% Diff	-0.94	-0.14	-0.94
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2.0	0.0

Notes

Beam 7

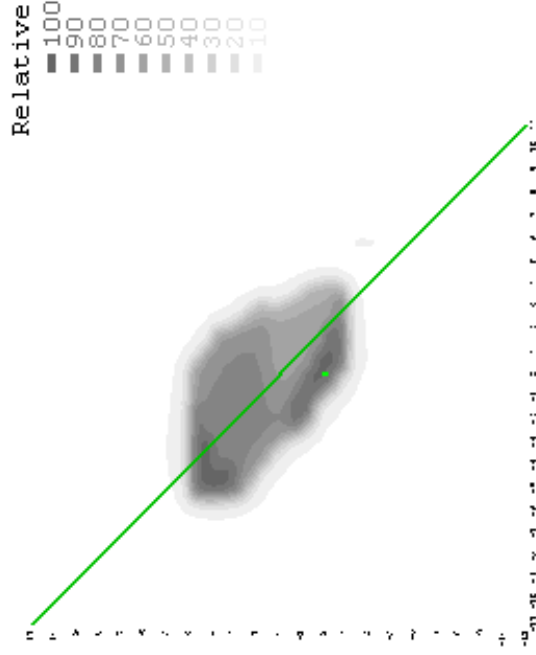
Reviewed By :

Set1

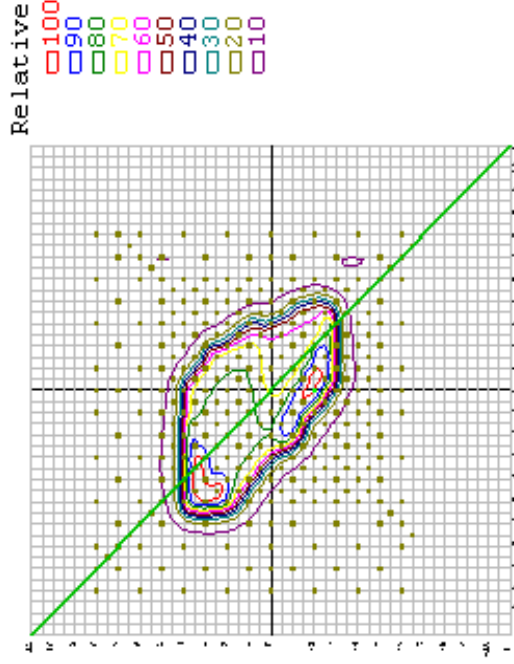


I:\Special Med Phy reports\SFH IMRT Reports...17.txt

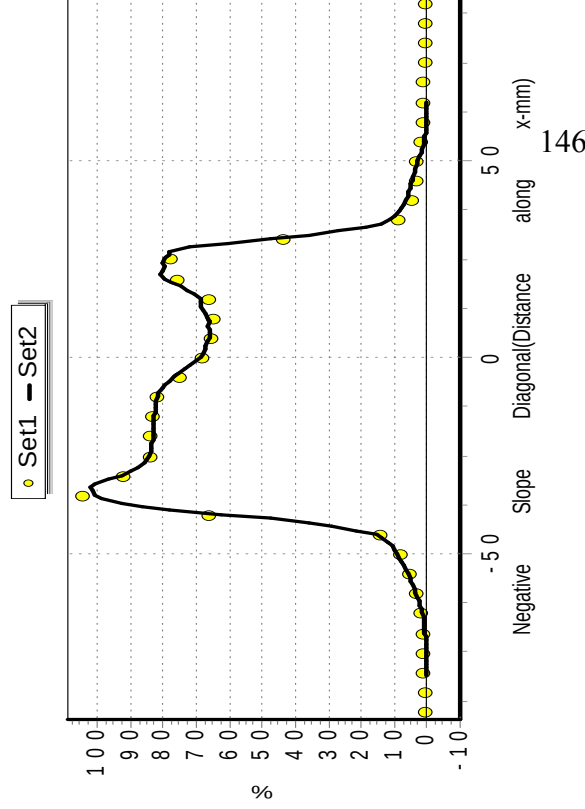
Set1-Set2



Set2



I:\Special Me...107RAO240WBJoseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 149
Passed : 149
Failed : 0
% Passed : 100

Dose Values in cGy

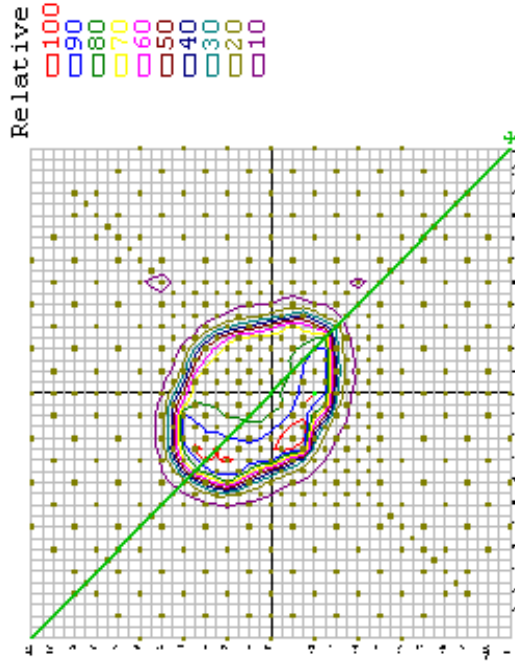
	Cax	Normal	Picked
Set1	26.72	33.88	26.72
Set2	26.81	33.77	26.81
Set1-Set2	-0.09	0.12	-0.09
% Diff	-0.26	0.35	-0.26
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-2.0	0.0

Notes

Beam 8

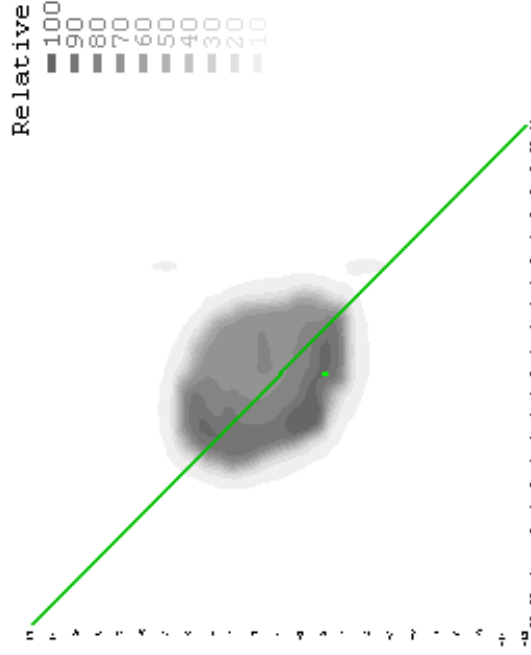
Reviewed By :

Set1

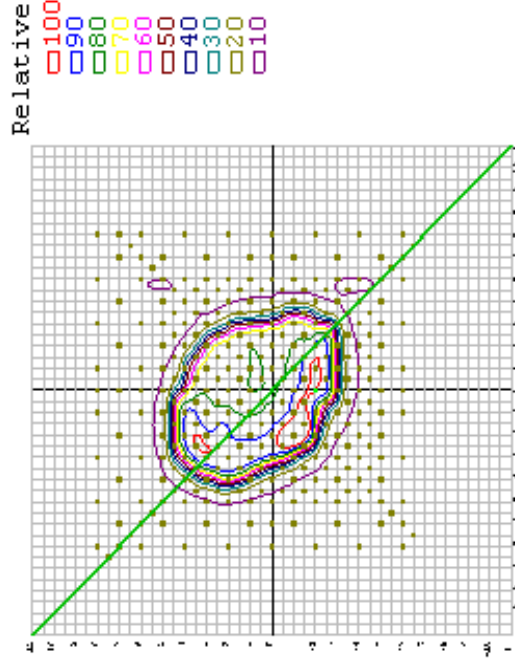


I:\Special Med Phy reports\SFH IMRT Reports...18.txt

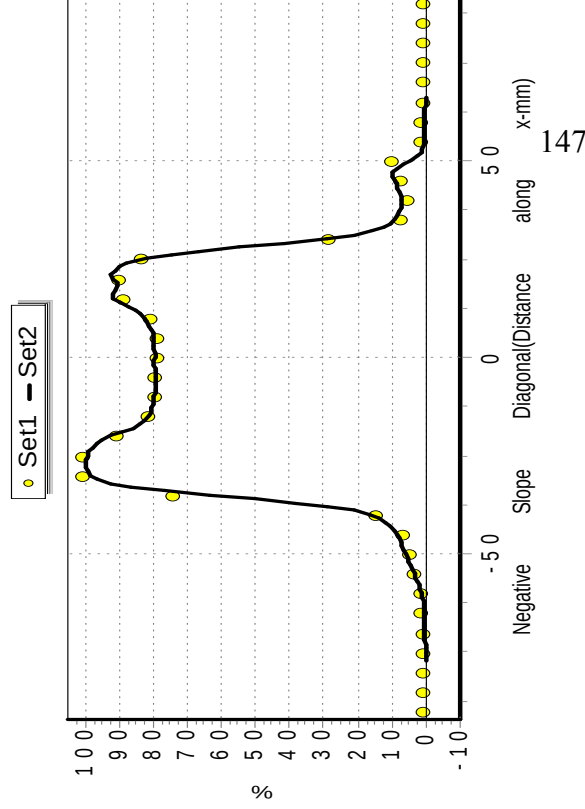
Set1-Set2



Set2



I:\Special Me...108RPO280WBJoseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #2
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 147
Passed : 147
Failed : 0
% Passed : 100

Dose Values in cGy

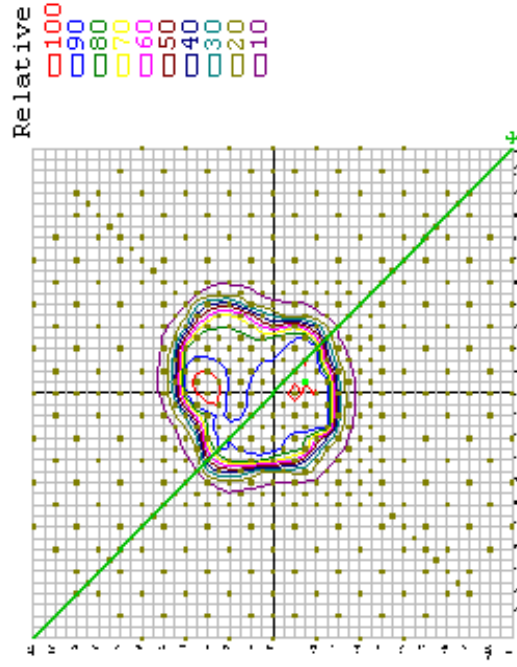
	Cax	Normal	Picked
Set1	37.88	39.07	37.88
Set2	38.55	39.30	38.55
Set1-Set2	-0.67	-0.23	-0.67
% Diff	-1.69	-0.58	-1.69
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,0.5	0.0

Notes

Beam 9

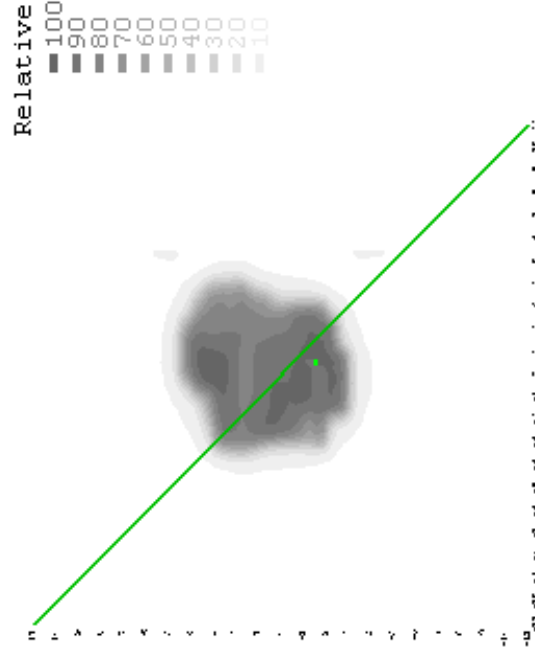
Reviewed By :

Set1

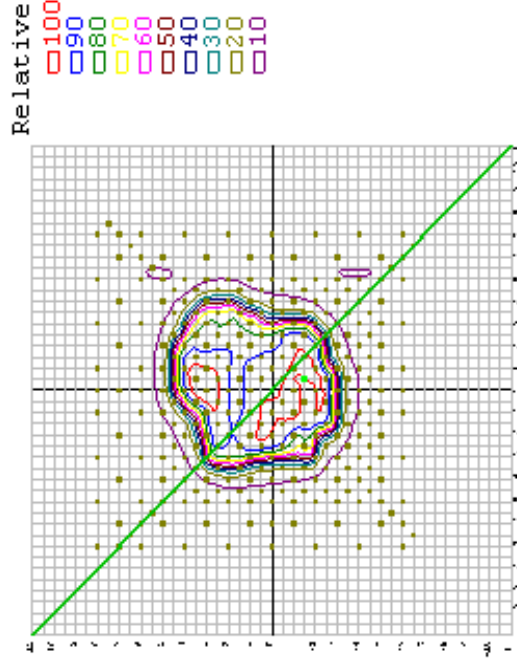


I:\Special Med Phy reports\SFH IMRT Reports...\9.txt

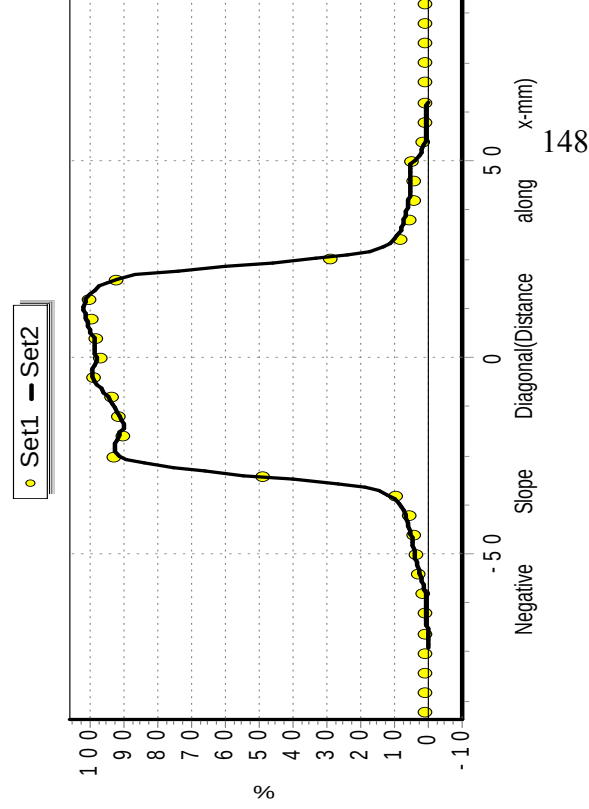
Set1-Set2



Set2



I:\Special Me...\09RPO320WB\Joseplanes09410694



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 149
Passed : 142
Failed : 7
% Passed : 95.3

Dose Values in cGy

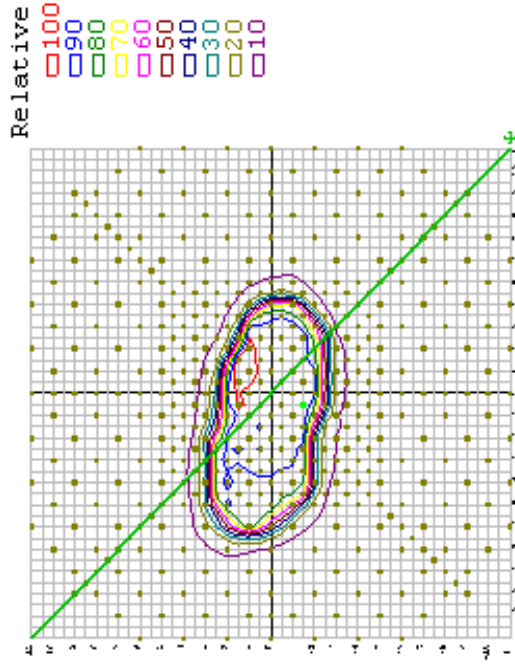
	Cax	Normal	Picked
Set1	27.27	28.42	27.27
Set2	27.23	28.96	27.23
Set1-Set2	0.03	-0.54	0.03
% Diff	0.12	-1.87	0.12
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,-0.5	0.0

Notes

Beam 1

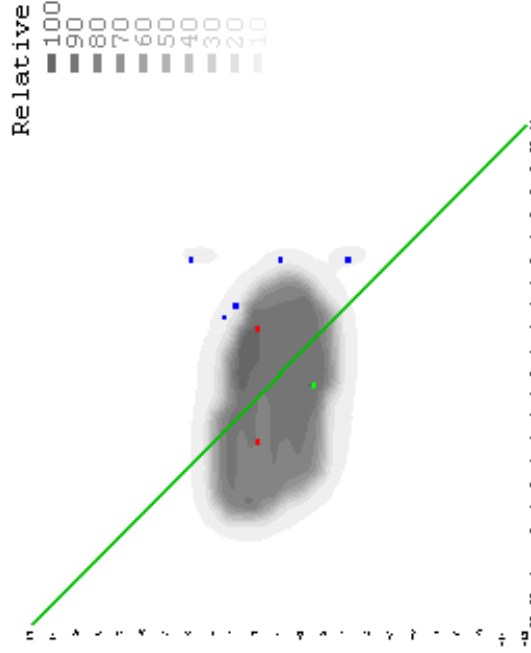
Reviewed By :

Set1

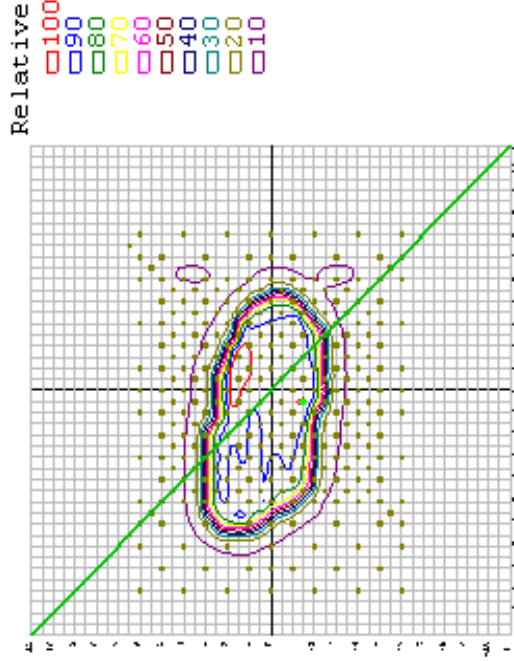


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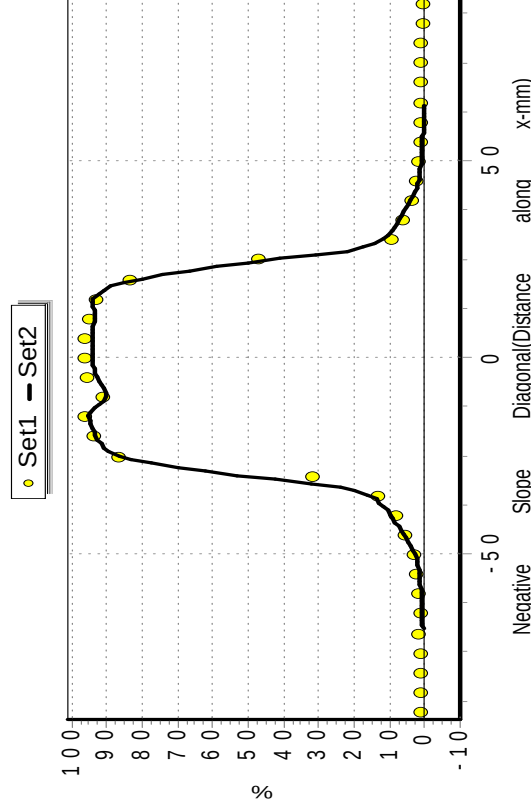
Set1-Set2



Set2



I:\Special Med ...\01PA0WSa1doseplanes25597145



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 114
Passed : 109
Failed : 5
% Passed : 95.6

Dose Values in cGy

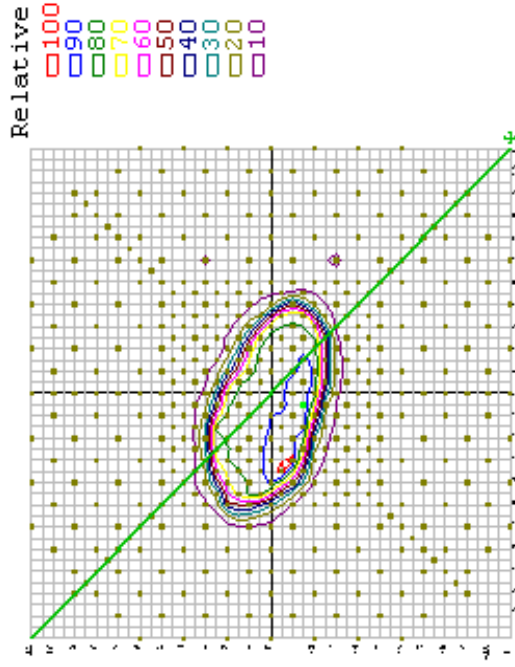
	Cax	Normal	Picked
Set1	19.23	21.93	19.23
Set2	19.27	22.01	19.27
Set1-Set2	-0.04	-0.07	-0.04
% Diff	-0.18	-0.33	-0.18
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,-0.5	0.0

Notes

Beam 2

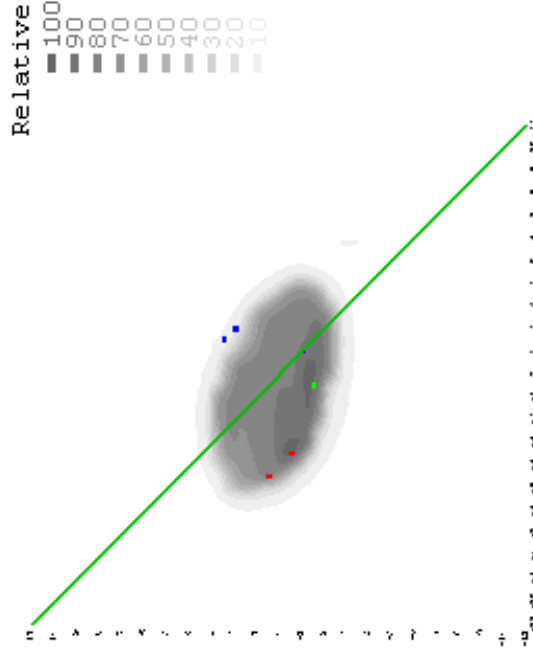
Reviewed By :

Set1

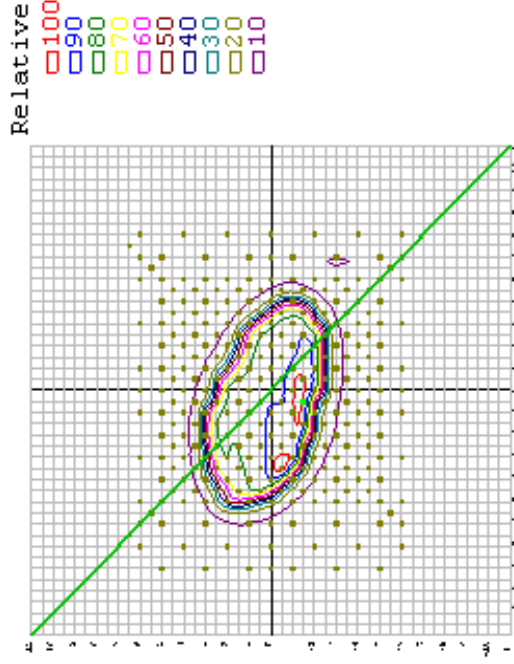


I:\Special Med Phy reports\SFH IMRT Reports...12.txt

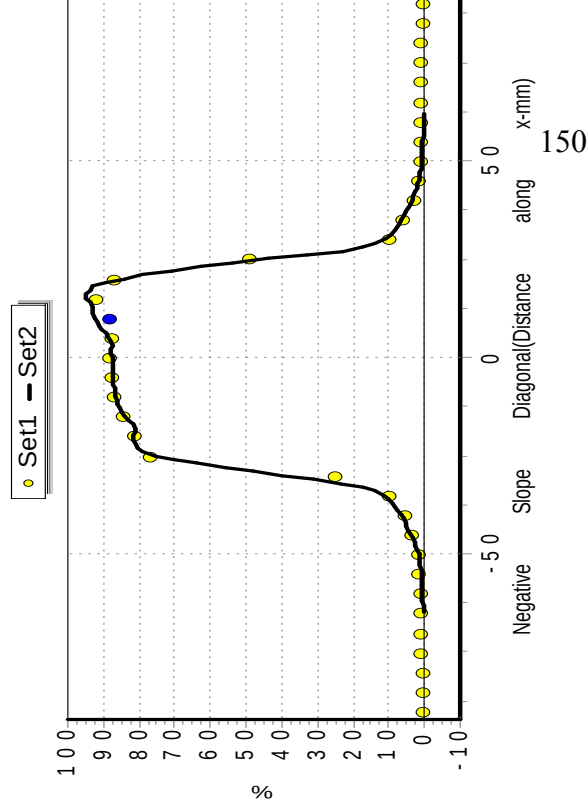
Set1-Set2



Set2



I:\Special Me...102LPO40WSa1doseplanes25597145



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 102
Passed : 101
Failed : 1
% Passed : 99

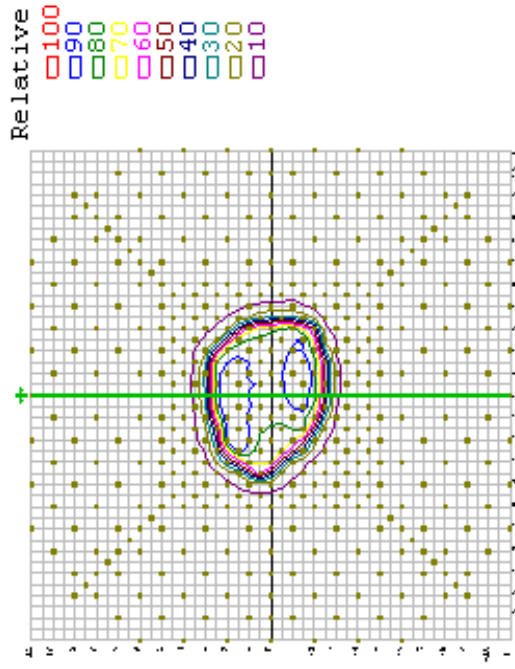
Dose Values in cGy

	Cax	Normal	Picked
Set1	23.36	26.24	23.36
Set2	23.17	26.64	23.17
Set1-Set2	0.20	-0.40	0.20
% Diff	0.74	-1.51	0.74
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	2.0	0.0

Notes

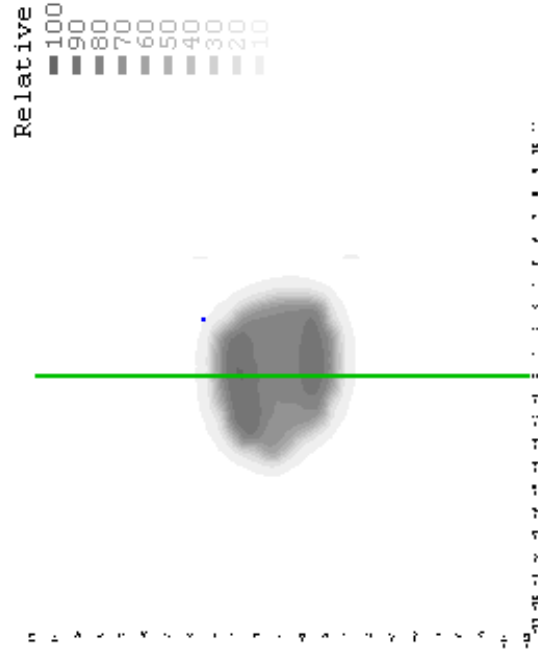
Beam 3

Set1

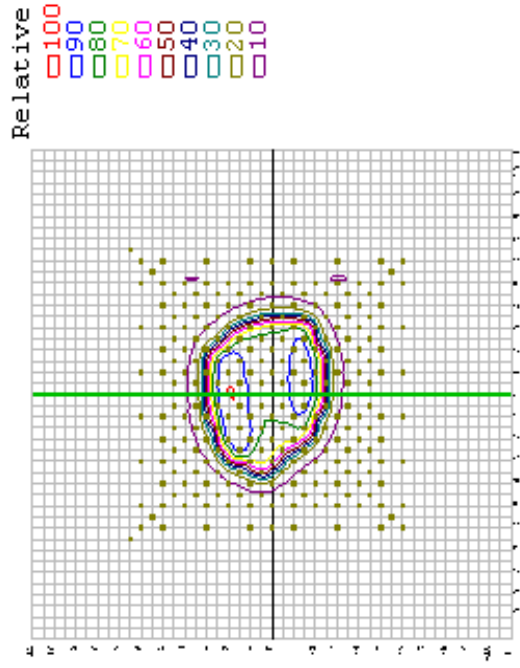


I:\Special Med Phy reports\SFH IMRT Reports...\3.txt

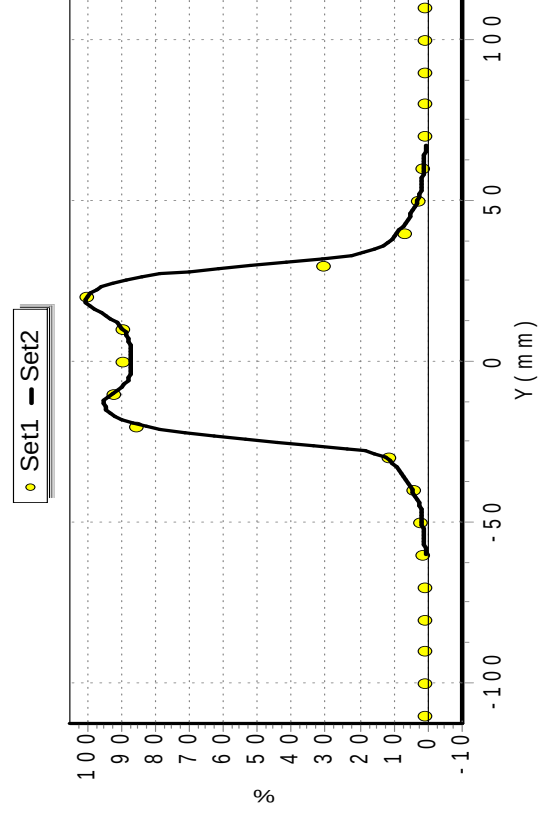
Set1-Set2



Set2



I:\Special Me...\03LPO80WSa1doseplanes25597145



Reviewed By :

QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 130
Passed : 126
Failed : 4
% Passed : 96.9

Dose Values in cGy

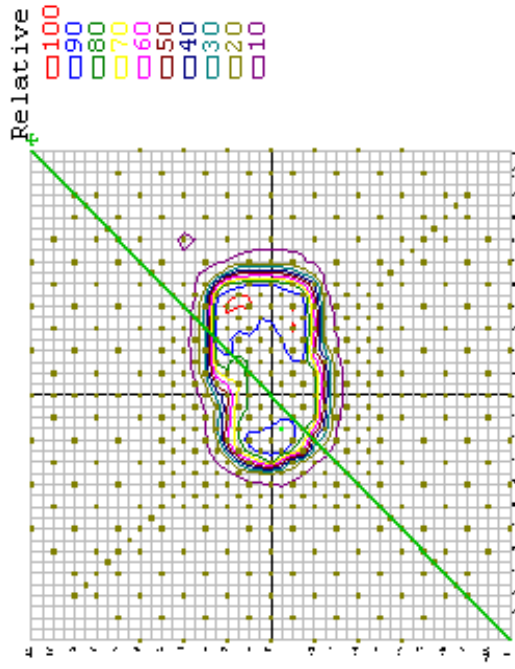
	Cax	Normal	Picked
Set1	22.18	27.53	22.18
Set2	22.25	27.68	22.25
Set1-Set2	-0.07	-0.16	-0.07
% Diff	-0.25	-0.57	-0.25
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-0.5,-1.5	0.0

Notes

Beam 4

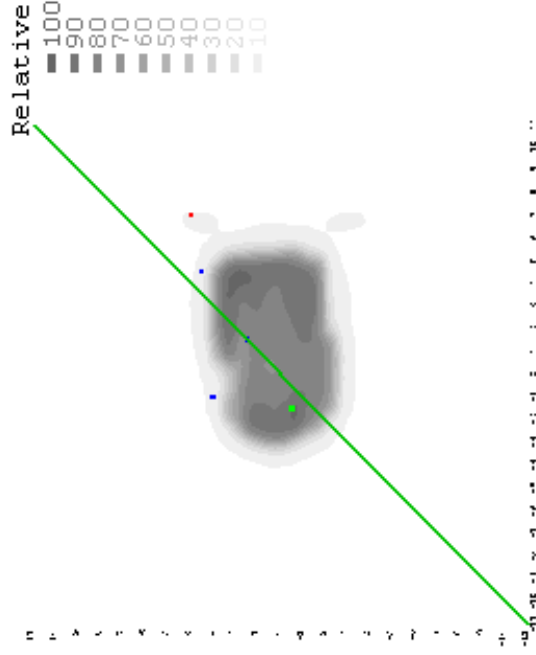
Reviewed By :

Set1

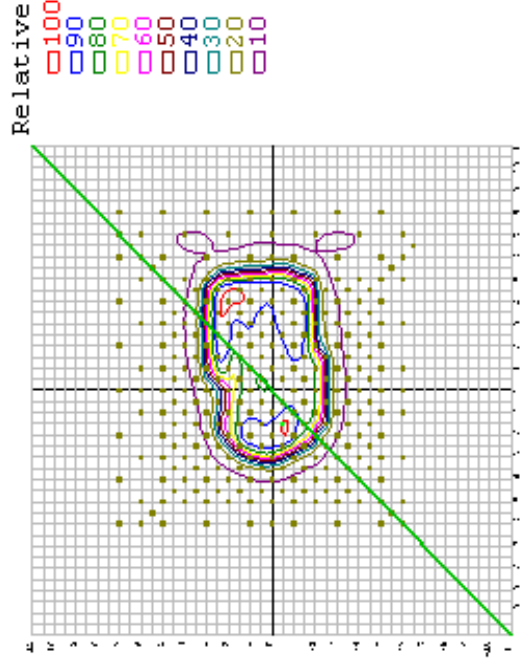


I:\Special Med Phy reports\SFH IMRT Reports... \4.txt

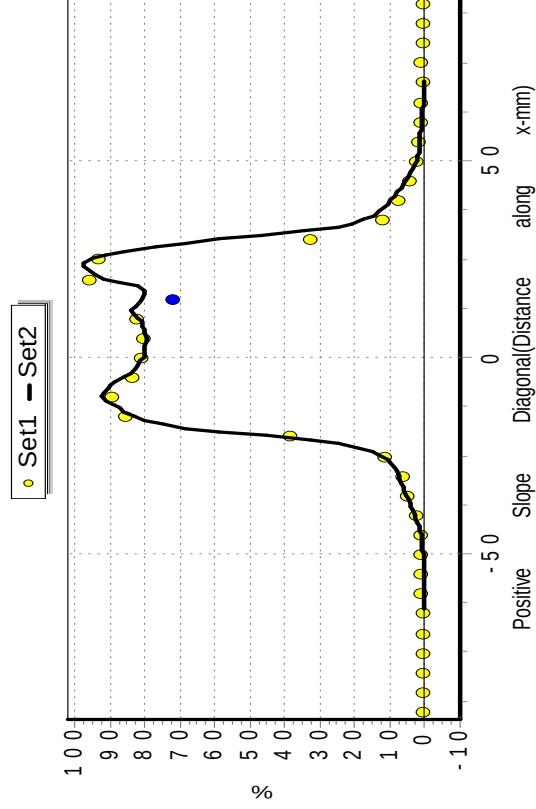
Set1-Set2



Set2



I:\Special M... \04L\AO120WSa1doseplanes25597145



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 155
Passed : 146
Failed : 9
% Passed : 94.2

Dose Values in cGy

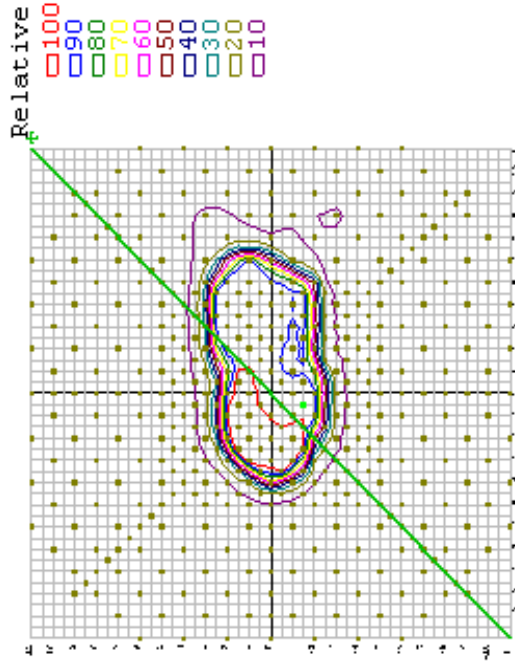
	Cax	Normal	Picked
Set1	28.22	29.29	28.22
Set2	28.34	29.60	28.34
Set1-Set2	-0.13	-0.32	-0.13
% Diff	-0.43	-1.07	-0.43
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,-0.5	0.0

Notes

Beam 5

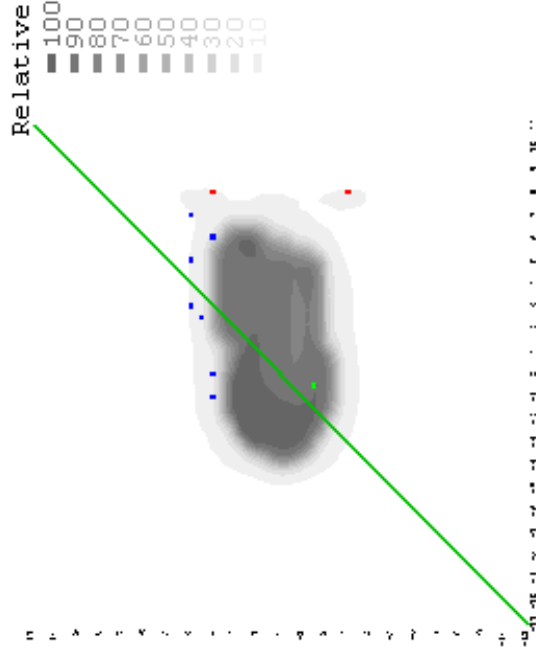
Reviewed By :

Set1

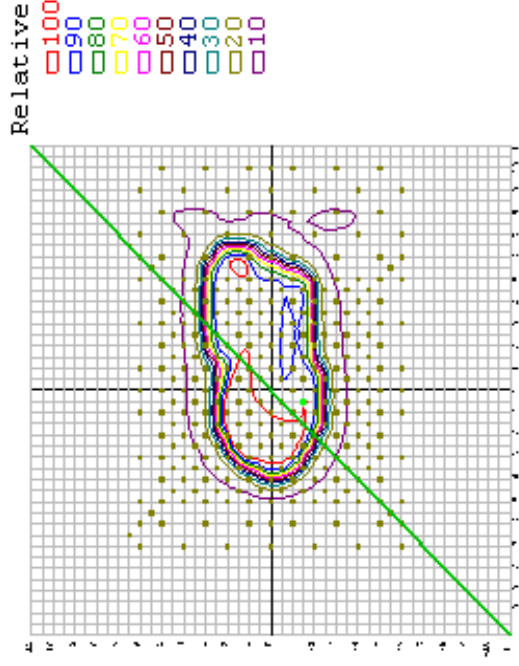


I:\Special Med Phy reports\SFH IMRT Reports...l5.txt

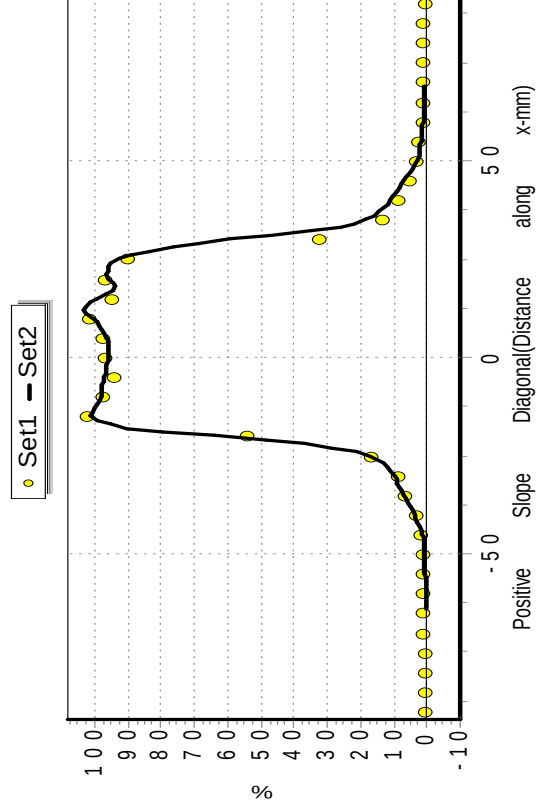
Set1-Set2



Set2



I:\Special M...l05LAO160WSa1doseplanes25597145



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 130
Passed : 128
Failed : 2
% Passed : 98.5

Dose Values in cGy

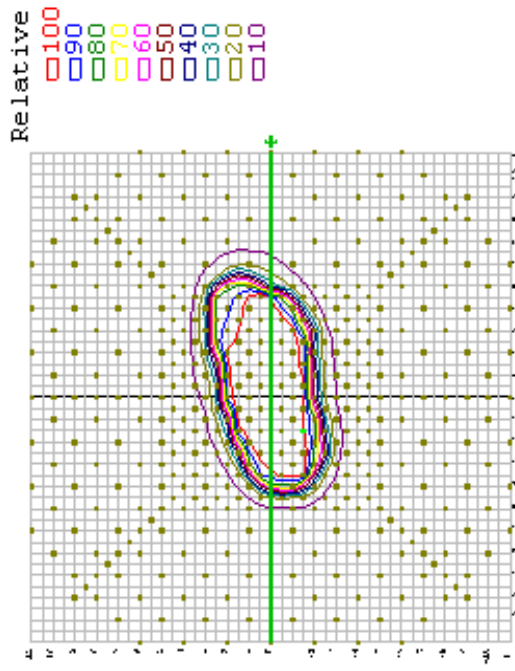
	Cax	Normal	Picked
Set1	26.50	24.24	26.50
Set2	26.40	24.56	26.40
Set1-Set2	0.11	-0.32	0.11
% Diff	0.43	-1.30	0.43
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.5,-1.5	0.0

Notes

Beam 6

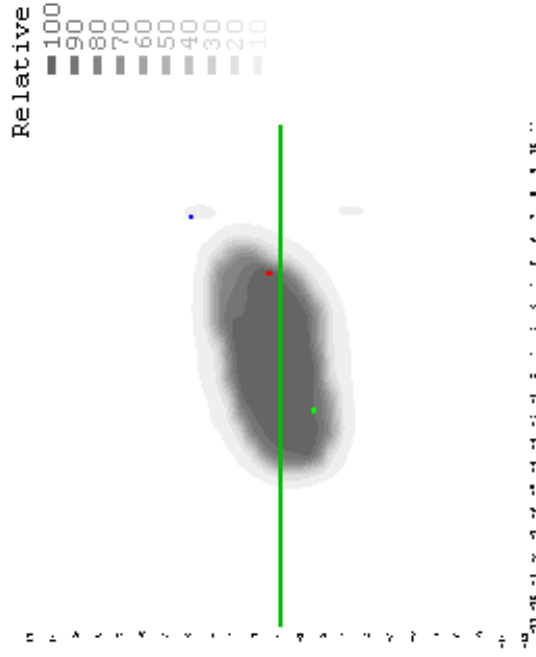
Reviewed By :

Set1

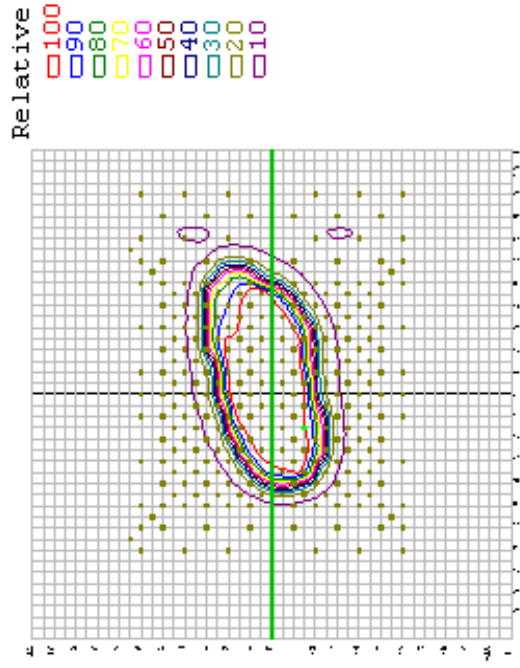


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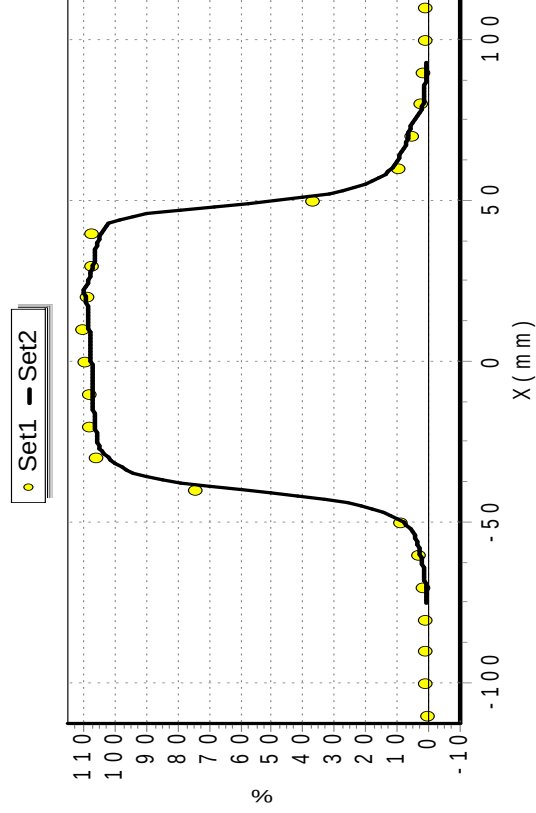
Set1-Set2



Set2



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QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 113
Passed : 110
Failed : 3
% Passed : 97.3

Dose Values in cGy

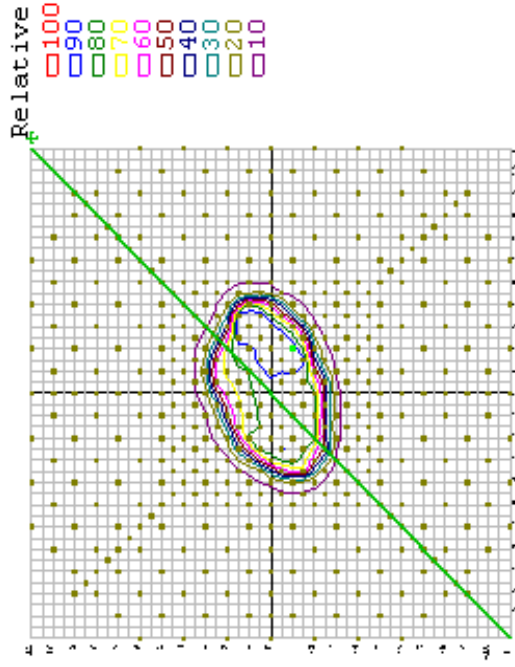
	Cax	Normal	Picked
Set1	19.18	22.05	19.18
Set2	18.99	22.05	18.99
Set1-Set2	0.19	0.00	0.19
% Diff	0.85	-0.01	0.85
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0.0	-1.2	0.0

Notes

Beam 7

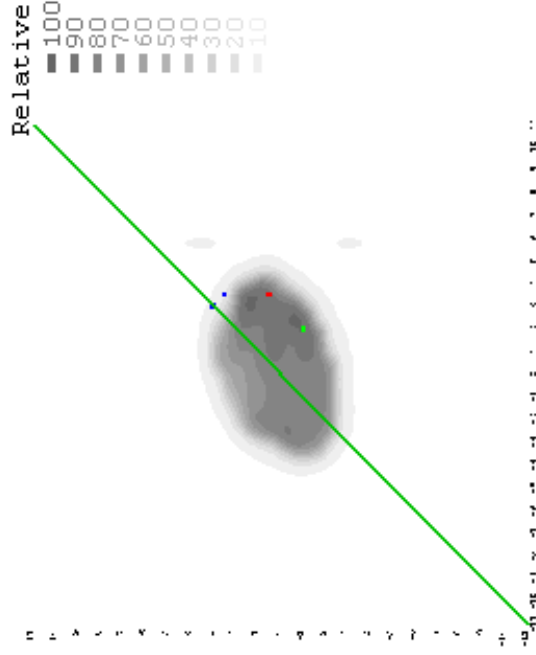
Reviewed By :

Set1

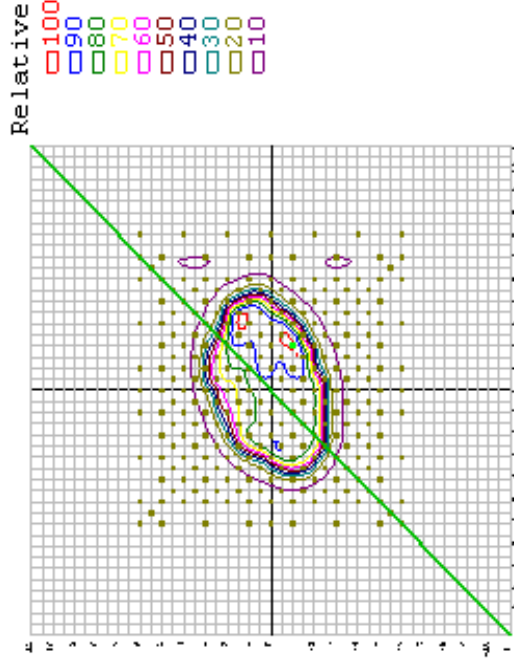


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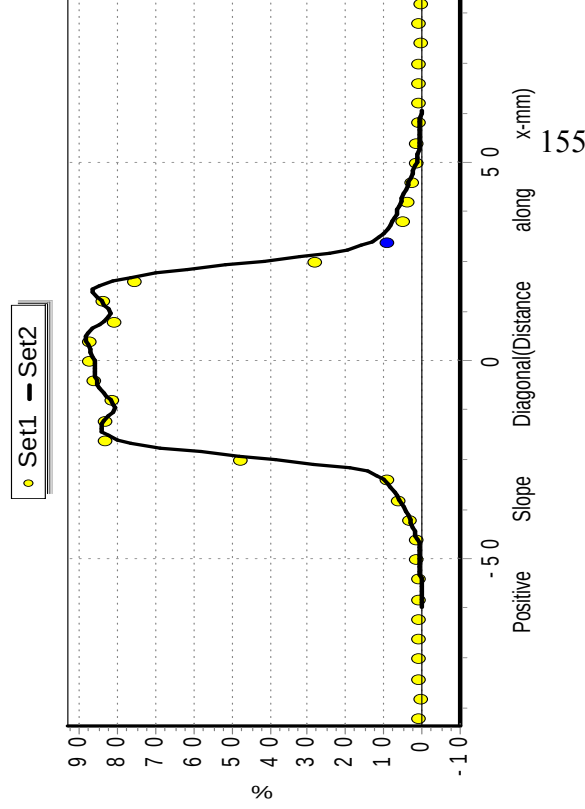
Set1-Set2



Set2



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QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 132
Passed : 128
Failed : 4
% Passed : 97

Dose Values in cGy

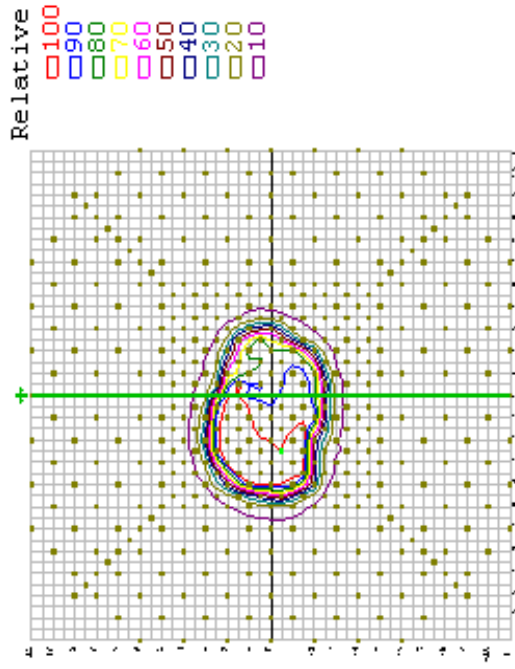
	Cax	Normal	Picked
Set1	23.72	27.12	23.72
Set2	23.82	27.37	23.82
Set1-Set2	-0.10	-0.25	-0.10
% Diff	-0.38	-0.93	-0.38
DTA(mm)	0.00	0.00	0.00
Coords (Y,X) cm	0.0	-0.5,-2.5	0.0

Notes

Beam 8

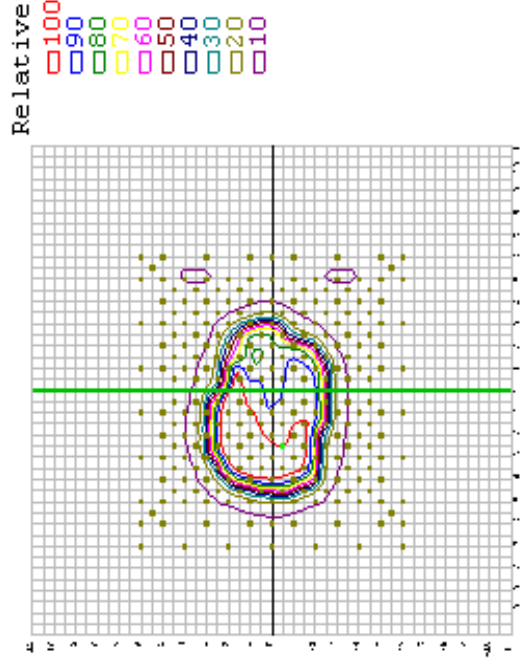
Reviewed By :

Set1



Set2

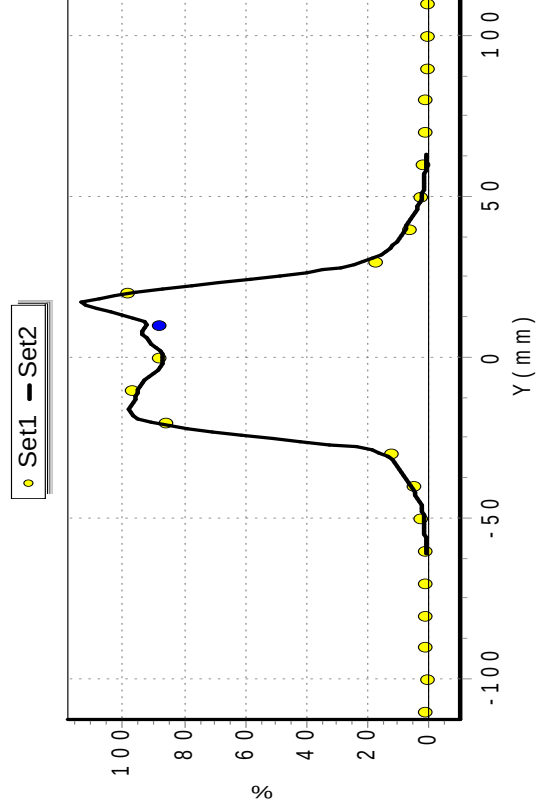
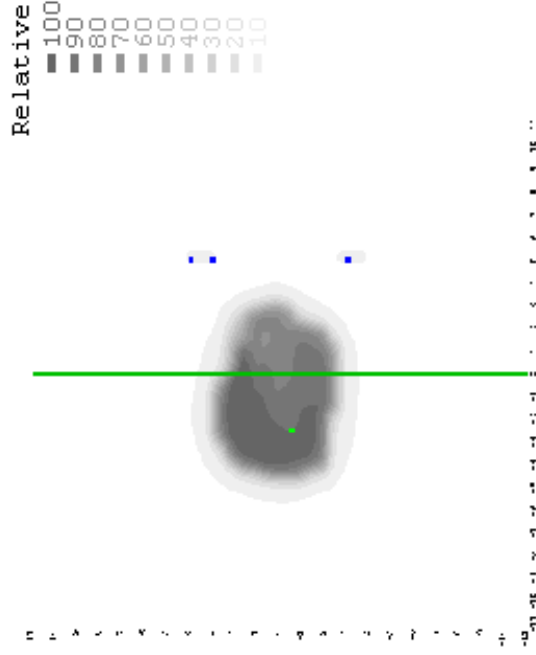
CAX Offset X=1 Y=1



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Set1-Set2



QA File Parameter
Patient Name : RGRT Patient #3
Patient ID :
Plan Date :
SSD : 90
Depth : 10
Energy : 6
Angle :

Relative Comparison
% Diff : 3.0
Distance (mm) : 3.0
Threshold : 10
Rotation Angle : 0.0 Degs
Meas Uncertainty : Yes

Summary (DTA Analysis)
Total Points : 139
Passed : 137
Failed : 2
% Passed : 98.6

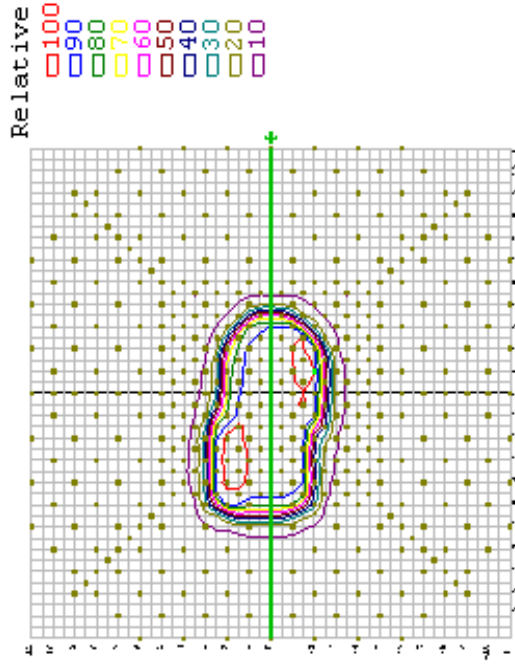
Dose Values in cGy

	Cax	Normal	Picked
Set1	30.96	31.61	30.96
Set2	30.83	32.06	30.83
Set1-Set2	0.13	-0.45	0.13
% Diff	0.39	-1.42	0.39
DTA(mm)	0.00	0.00	0.00
Coords (y,x) cm	0,0	-2,1	0,0

Notes

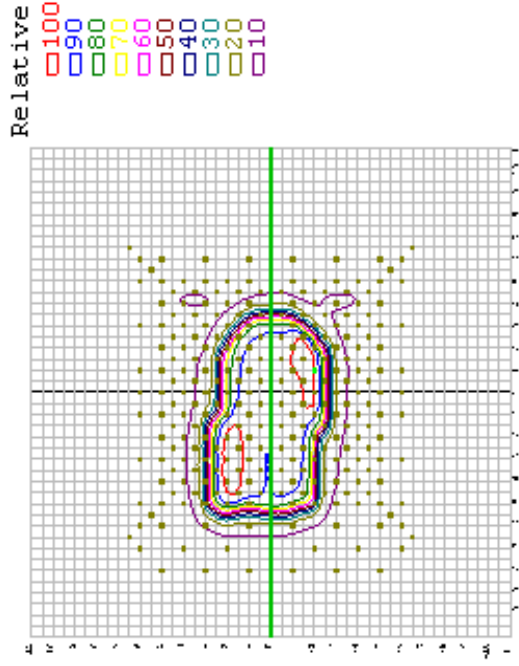
Beam 9

Set1



Set2

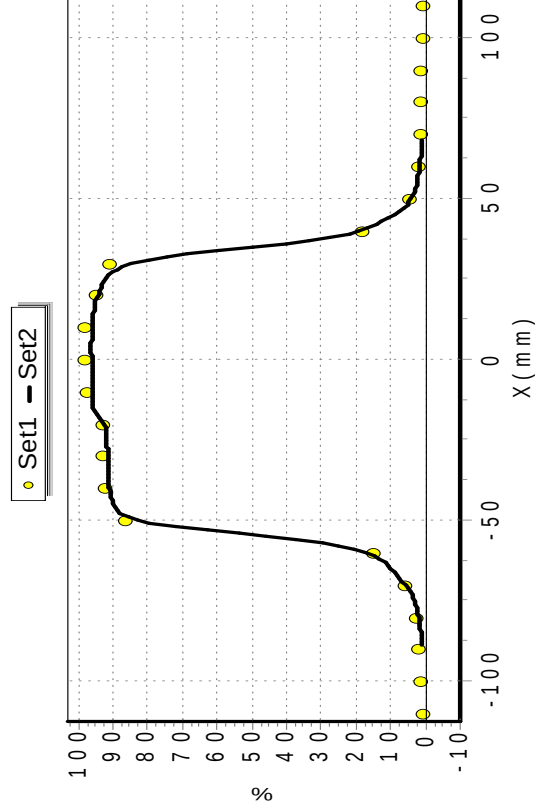
CAX Offset X=1 Y=1



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Set1-Set2



Reviewed By :

