712925

CANCER RESEARCH AND TREATMENT CENTER
Biomedical Physics

DATE: June 2, 1976

TO: LAMPF Biomedical Channel Users

FROM: Alfred R. Smith ARS

SUBJECT: Pion dose calculations

Effective immediately all patient doses will be calculated using pion parameters in the Bragg-Gray equation:

$$D = \frac{100\ Q(W/e)S}{M \cdot K}$$

D = dose to muscle (rads)

Q = collected ionization charge (coulombs)

W = energy required to produce ion pair in gas (joules)

e = electronic charge (coulombs)

S = average mass stopping power ratio (wall/gas) for secondary particles.

M = mass of gas (kilograms)

K = kerma correction (plastic/muscle)

The pion parameters are:

	Constant	Air	TE Gas
Peak:	W/e	34.9	30.1
	S_g^W	1.09	1.006
	K_π	1.09	

	Constant	Air	TE Gas
Plateau:	W/e	34.5	29.6
	S_g^W	1.059	0.994
	K_π	1.02	

The corresponding cobalt-60 parameters are:

Constant	Air	TE Gas
W/e	33.73	29.1
S_g^W	1.146	1.001
K_γ	0.993	

All parameters are valid only for chambers which have walls made of shonka A-150 TE plastic. The mass of gas for all chambers has been calibrated for TE gas and is given in my memo of April 16, 1976. The gasing conditions must remain constant at a flow rate of approximately 5 cc/min. The collected ionization charge (Q) must be corrected for temperature and pressure referenced to 760 mm Hg pressure and 22°C temperature (273.15°K).

The relationships between the pion dose and the dose assuming that the collected charge came from cobalt-60 gamma rays are:

Peak:	Air gas	$D_\pi = 0.90\ D_\gamma$
	TE gas	$D_\pi = 0.95\ D_\gamma$
Plateau:	Air gas	$D_\pi = 0.92\ D_\gamma$
	TE gas	$D_\pi = 0.99\ D_\gamma$

It is understood that the pion parameters may vary with field size, momentum, etc. but the changes should lie well within the uncertainties in the calculated dose which is about 10%. I recommend that people responsible for dosimetry for radiobiology experiments adopt the patient dose calculation parameters so that the two can be related or at least always state the result of experiments in the patient dose scheme as well as in "cobalt-60 equivalent rads". I personally feel that "cobalt-60 equivalent rads" is a bad choice of units because it implies that an RBE of cobalt-60 versus pions has been factored into the dose.

ARS/jo

Dist: Kligerman
Kelsey
Lane
Rosen
Knapp
Bradbury
Dicello
Amols

OFFICE MEMORANDUM

TO Distribution DATE August 5, 1976

FROM E. A. Knapp

SUBJECT PION DOSE CALCULATIONS

SYMBOL MP-3

MAIL STOP 844

It appears that we still have a double definition of the rad in the biomedical dosimetry work. The UNM group has requested that for patient irradiations doses be calculated as outlined in the attached memo. I would suggest that all doses involved for our work for radiobiology or outside users be calculated in a uniform manner, and the parameters outlined in Al's memo seem OK to me. If there are no objections, I would like this instituted immediately. If there are objections, I would like to understand them and we can then discuss the problem with Al. We must have a uniform definition, however.

EAK:bl

Encl: Memo fm Smith dtd 6/2/76

Distribution:
Al Smith, UNM/CRTC
C. Kelsey, UNM/CRTC
M. M. Kligerman, M.D., UNM/CRTC
J. Bradbury, MP-3
J. Dicello, MP-3
J. Helland, MP-3, MS 809
H. Amols, MP-3
M. Zaider, MP-3, MS 809
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CANCER RESEARCH AND TREATMENT CENTER
MORTON M. KLIGERMAN, M.D., DIRECTOR ☐ TELEPHONE 505 277-3631

August 27, 1976

TO: Dr. Kligerman
Dr. Kelsey
Dr. Knapp
Dr. Bradbury ✓
Dr. Smith
Dr. Yuhas

FROM: Stephany Wilson SW

SUBJECT: Notes on Meeting, August 27, 1976

The above-named persons (with the exception of Dr. Smith and Dr. Yuhas) met to discuss dose rate for the run starting October 3, 1976. Dr. Kligerman said he needed to start larger ports as soon as possible, and he understands the UNM/LASL physics group plans to have the 8x10x7 static beam ready at that time. However, he finds from a simple extrapolation from the present 4x4x4 port at 100 micro-amps, that the larger port may be limited only 2 rads per minute. He is concerned about trying to treat patients with that dose rate, and wondered if the time in October might be better spent in developing the swept beam.

Dr. Bradbury said he would make some calculations, but he felt it might be possible to have at least 3 rads per minute and possibly 6 or 7.

Dr. Knapp said the greater dose rates possible with the fan beam would be possible only when the movable couch system is available. Dr. Kelsey said it would probably be at least 8 months before the couch system is ready. Dr. Knapp said that using the range shifter with a static beam might improve dose rate by only about 20 percent.

Dr. Kligerman said he wondered if the time in October could be better spent in further testing and characterizing the fan beam (including dosimetry). Dr. Bradbury noted that if little or no biology is done in September because of low dose rate, the physics for both the large static beam and the fan beam could possibly be done in September. Dr. Kelsey concurred. No final decision regarding patient treatment in October was reached.

SW/ah