Subcommittee No. 1

MINUTES, MARCH 29, 1953 MEETING
TELETHERAPY EVALUATION BOARD - SUBCOMMITTEE NO. 1,
SOURCE EVALUATION AND SHIELD DESIGN

Members present: Dr. Isadore Meschan
Dr. Herbert D. Kerman
Dr. David S. Carroll
Dr. Stephen H. Weems
Dr. John Tolan
Dr. Carl E. Nurnburger
Dr. Marshall Brucer

Members absent: Dr. Frank Hoecker

Dr. Marshall Brucer opened the meeting with a discussion on the desirability and availability of sources. It was estimated that cobalt^{60}, with a five year half-life and a specific activity of approximately 240 curies per cubic centimeter, would be available for a few persons within the coming year. There appears to be a possibility of ten sources per year available thereafter. The early calculations on the cross section of europium$^{152-154}$ by Dr. Brucer and others at the Oak Ridge National Laboratory were reviewed and compared with calculations by Dr. Eastwood of Harwell, England. Dr. Brucer reviewed the neutron capture and decay characteristics of europium while in the reactor flux and pointed out that the calculations did not agree with observed data. It was pointed out that lastest calculations show that the europium isotope has an approximate half-life of 12.4 years. Dr. Brucer stated that the procurement and radiation of many sources of europium is now at a standstill pending further studies. Cesium^{137} with approximate specific activity of 95 curies per cubic centimeter was reviewed. Dr. Brucer pointed out that cesium is probably the one isotope that eventually will be readily available in very large quantities, due to fission products soon to be available from power and research reactors. In summarizing the desirability and availability of each isotope, it was recommended that each university's proposed contract with the Commission specify Co^{60}, Eu$^{152-154}$, or Cs^{137} whichever is available. Also, it was stated that the Executive Committee should decide immediately on the submission of formal applications for sources.

The second item on the agenda was the design of the experimental prototype unit. Dr. Brucer opened the discussion on the design of the unit by reviewing the functional requirements of the unit which necessitated a 9½ or 10 feet ceiling height. Also, it was pointed out that certain limiting factors existed in the current design, one of which was that a table limited the field of motion to less than a full 360 degrees, whereas, a chair used during rotational therapy would not limit the field of movement. Also, it was pointed out that a single support for the unit, such as the GE support, would not be stable enough for rotational therapy. The design of the W. F. and John Barnes Company permits a movement to within fourteen inches of the floor. Dr. Nurnburger questioned the necessity for the maximum motion and utilization provided for in the design and it was pointed out that the present unit is an experimental unit, therefore, should be designed with maximum possible movements; and once the preliminary studies have been completed, it would be a simple matter to omit some of the operational characteristics. It was felt desirable to include as much of the engineering cost as possible in the prototype unit.

The committee discussed the desirability of design permitting top versus side loading of sources. The W. F. and John Barnes Company engineers had expressed definite opinions as to the desirability of top loading which would permit much better weight distribution over bearing surfaces. Dr. Kerman insisted on designing the head for Co^{60}, but not for Cs^{137}, so as to provide for a loading technique that could be accomplished in the field. Following a detailed discussion, the committee requested a design to permit loading and unloading of sources by medical school personnel.

The committee next studied the design of the shutter mechanism. It was pointed out that the first factor in the design of a shutter mechanism was the total time required in the "on" position. It was agreed that for therapy ten minutes probably would be the maximum time, whereas, for physical measurement or experimental purposes the time might occasionally reach as high as four or five hours. Also, it was agreed that one second opening and closing time for shutter mechanism was adequate for contemplated research techniques. There was then reviewed a number of designs for a shutter mechanism using centrifugal force to operate the shutters. It was agreed that the design principles were good except that the mechanism is impractical in bulk and costly to maintain. The committee considered gravity mechanisms but it was pointed out that the principle is impractical because of the many operational positions of the machine.

There was then discussed a number of other designs by the W. F. and John Barnes Company such as the magnetic clutch, Borg-Warner overdrive, magnetic oils, etc. Due to safety factors and bulk, these were discarded as inefficient and impractical. A pneumatic tube system was described which provides for alternating forces to a double rack and pinion for operating the shutter mechanism without back lash. It was pointed out that this design had many good safety factors in that loss of air pressure would automatically close the shutter mechanism. Also, utilization of simple regulating pneumatic valves would prevent variable air pressure being a serious problem. The design of the pneumatic control is such as to start the opening movement with a fast motion but would be considerably slowed by springs as unit moves towards the open position. Dr. Meschan and other members of the committee pointed out that the simplified pneumatic system was completely removable for maintenance, thereby eliminating any exposure problems. Dr. Brucer also mentioned that the W. F. and John Barnes Company had been using this system in many industrial applications and that it had proved completely satisfactory. Dr. Tolan suggested a solinoid system for operating a similar rack and pinion device and Dr. Brucer informed the committee that such a system had been discussed and discarded by the Barnes Company on the basis of cost and size of solinoids required for moving the source wheel.

Dr. Brucer next opened the discussion on a variable aperture diaphragm designed as a twelve-sided unit giving a zero to fifteen inch opening at the skin surface. Dr. Carroll discussed the sizes of variable cones, irregular, and rectangular portals. It was pointed out that the Barnes design does not provide for irregular or rectangular patterns. Dr. Brucer pointed out that this mechanism could be used for two functions. One as a variable circular aperture and two as a mechanism for inserting irregular and rectangular portals. If the variable diaphragm is to be used as a variable circular portal then the mechanism would have to be constructed of lead plates four centimeters thick. If used as a supporting mechanism it would be desirable to fabricate the mechanism of steel plates two centimeters thick. Dr. Nurnburger brought up some questions

regarding the characteristics of the present design and its relationship to the bearing surfaces of the twelve-piece unit. The committee discussed the fabrication of the mechanism of such metals as lead, brass, steel, tungston, etc. Dr. Brucer pointed out, as an example of the costs of materials, to fabricate a small source unit of tungston, cast about two mill tolerance, would cost approximately $5,000 for raw material alone; whereas, the materials for a similar unit fabricated of lead would probably cost around $600. Discussion brought out that the thickness of the shutter mechanism was not critical and in line with this, Dr. Meschan suggested that a medium Z metal could be used. However, this in turn would give a higher transmitted penumbra.

Dr. Brucer outlined studies by the Barnes Company to provide an automatic wedge filter. The committee discussed the many problems of moving a doughnut wedge filter into the field from any direction, to maintain homogenous tissue dosage under rapidly changing conditions. The filter must move in three directions and under control of the "computor", and must be fully automatic to be satisfactory. Dr. Brucer stated that it might be necessary to eliminate the filter as no satisfactory control had been devised as yet.

Dr. Richardson outlined a procedure for using the Co^{60} light localizer in the delineation of penumbra. The design of the cobalt unit light localizer was discussed and Dr. Brucer stated that a similar design would be used on the cesium unit, unless a more desirable design is suggested.

Dr. Brucer reported on table design problems, and the possible utilization of a sectional table approximately 20 inches wide and 9 feet long, with a center section cut to a narrow width to permit greater rotational freedom. Only preliminary discussions have so far been completed on the table design.

The committee discussed the most desirable position for the rest position of the machine. It was shown that the control mechanism must always return to, and start operating from, one given rest position. The committee agreed that a rest position directly above the table would simplify design of unit and provide a safety factor..

During a discussion of automatic and mechanical controls of the machine, Drs. Meschan, Tolan, and Weems pointed out the need of a surface body contact plate to operate a micro switch for immediate stopping of the unit if it should come in contact with the table or patient while under treatment. The committee unanimously requested such a safety device and recommended a simple design for the unit.

Copies distributed to the entire Teletherapy Evaluation Board without review by the committee. Committee members are requested to make any deletions or additions felt necessary. Any such corrections will be distributed by the Oak Ridge Institute of Nuclear Studies, Medical Division.

SUMMARY OF DISCUSSION OF CHARACTERISTICS OF PROTOTYPE UNIT

	Cs^{137}	Co^{60} or Eu^{152}
SSD	(90, 70, 50)	(100, 80, 60)
Variable Diaphragm	Use	Questionable
Portal Sizes	12.5 x 12.5, 10 x 15, 10 x 10, 6 x 12, 4 x 6	
Fork Height	54"	54"
Ceiling Height	9½' if possible	9½' if possible
Table Height	36" max., rest 30", min. 24"	
Light Localizer	Use	Use
Wedge Filter	May be impractical	
Loading Device (field)	No	Yes
Shutter Device Time	1 sec.	1 sec.
Table Size	9 feet length, 20 inch width	
Rest Position	Center of table	
Max. Size of Patient Phantom	30 x 40 c.m. x 100	
Telescoping Cone	Yes	Questionable

Marshall Brucer

Marshall Brucer,
Chairman,
Subcommittee No. 1