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MEMORANDUM

The Medical Research Center

Brookhaven National Laboratory

DATE: 24 March 1971

Upton, L. I., New York

TO: A. Harrison

FROM: E. P. Cronkite, M.D. *E.P. Cronkite*

SUBJECT: CIRC Numbers

The following CIRC #s are inactive. Except for completing old records, they should not be used for identifying patient activity until reactivation is formally approved.

<u>Principal Investigator</u>	<u>CIRC #</u>
Dr. Cronkite . . . . .	3 4 20 23 35 35A
Dr. Dahl . . . . .	5 6 14 25
Dr. Jesseph . . . . .	1
Dr. Robertson . . . . .	9 ← 10 16 28
Dr. Schiffer . . . . .	22

EPC/ck  
cc: CIRC Committee  
Mr. Finn  
Dr. Dahl

REPOSITORY Records Holding Area, Bldg. 494  
 COLLECTION Committee-Clinical Investigations and  
 BOX No. 4 *Uses of*  
 FOLDER CIRC #9 *Radioisotope*

The Committee on Clinical Investigations and Uses of Radioisotopes  
hereby approves the program with the following title:

Biological Turnover of  $Cs^{137}$ ,  $Zn^{65}$  and  $Sr^{85}$  in Man

CIRC # 9 has been assigned to this program.

*Walton W. Shreeve*

Walton W. Shreeve, M.D., Ph.D., Chairman

*E. P. Cronkite*

Eugene P. Cronkite, M.D.

*E. Schackow*

Eckart Schackow, M.D.

*M. H. Van Woert*

Melvin H. Van Woert, M.D.

*J. S. Robertson*

James S. Robertson, M.D., Ph.D. (ex officio)

Date November 8, 1967

Place Medical Research Center  
Brookhaven National Laboratory  
Upton, New York

1179522



- G. 1. Are drugs not in the U. S. Pharmacopoeia (USP) or the NNR being used or contemplated for use? Yes \_\_\_ No X
2. Is an unusual use of a drug(s) accepted by the USP or NNR contemplated? (An example would be the use of an accepted drug in dosages far exceeding the recommended limits or for purposes distinctly different from the usual indications cited.) Yes \_\_\_ No X
3. Are any biological products to be administered that do not bear on their containers or labels notation of approval by the Biological Control Division of the National Institutes of Health? Yes \_\_\_ No X
4. Is external or internal radiation other than accepted diagnostic or therapeutic procedures to be administered? Yes \_\_\_ No X
5. Are any (other) unusual procedures being performed or proposed which in your judgment may entail a special hazard - particularly a hazard above and beyond any imposed by accepted diagnostic and therapeutic measures for that patient? Yes \_\_\_ No X

6. Are any radioisotopes to be administered to human beings? Yes X No \_\_\_
- a. If yes, are the radioisotopes to be used solely within the limits of procedures, specifically described in the USP? Yes \_\_\_ No X

Describe the radioisotopic preparation(s):

- b. Or are the radioisotopes to be used only in accordance with a project previously approved by the former Radioisotope Committee of this Department? Yes X No \_\_\_

Note the project number: H-61

However, amounts of isotope increased

IF ANY OF QUESTIONS 1 THROUGH 5 ARE ANSWERED AFFIRMATIVELY, a detailed analysis of the potential hazards must be appended, including pertinent bibliographic citations and other relevant information.

IF QUESTION 6 IS ANSWERED AFFIRMATIVELY, a completed supplementary form for Radioisotope Administration to Human Beings must be appended. However, this form need not be filed provided that question 6a or 6b is also answered affirmatively. A separate form must be submitted for each radioisotopic species to be administered.

*J. S. Robertson*  
Sponsoring Physician

Committee on Clinical Investigations and Uses of Radioisotopes

Approval recommended ✓ Date 11/8/63

Disapproval \_\_\_\_\_ Date \_\_\_\_\_

V. P. Bond  
V. P. Bond, M. D.  
Chairman, Medical Department

JUN 29 1964 1179524

SUPPLEMENTARY FORM FOR RADIOISOTOPE  
ADMINISTRATION TO HUMAN BEINGS

## A. Radioisotope

1. Species: (Radioisotope or labeled compound, eg. Na<sup>24</sup>Cl or 1-C<sup>14</sup>-glucose)  
Cs<sup>137</sup>Cl<sub>2</sub>
2. Physical characteristics: (Physical half-life; decay scheme (or type, energy and relative frequency of major emissions):  
Cs<sup>137</sup> → Ba<sup>137</sup>  $\bar{E}_\beta = 0.23$  mev (Hine and Brownell, p. 899)  
 $t_{1/2} = 27$  years  $E_\gamma = 0.66$  mev
3. Source: (BNL reactor, cyclotron, hot lab.), commercial supplier, etc.)  
Nuclear-Chicago
4. Preparation: (Target material, quantity, special problems)  
U-n - separated from fission product mixture
5. Specific activity and isotopic purity of administered material:  
High specific activity
6. Radioassay and calibration procedures: (Include validation to be performed at BNL prior to use)
  1. Gamma spectrometric analysis
  2. Assayed by comparison with calibrated sources
7. Vehicle and route of administration:  
CsCl<sub>2</sub> sterile solution. I.V. - 15  $\mu$ c  
Oral - 0.1  $\mu$ c/day for 30 days
8. Procedures for control of sterility and pyrogenicity: (Or note that commercially supplied isotopes are certified as ready for administration to human beings.)
  1. Injection solution sterilized
  2. Injected into rabbit to test pyrogenicity
9. Extraneous effects, if pertinent: (Such as pharmacological or toxic actions of the parent compound or vehicle, etc.) None

## B. Radiation Dosage

1. Biological half-life or half-lives, including slow components:  
Biological half-life = 100 days
2. Organ, cellular, or subcellular localization: (Should account for the effects of special drugs or agents on altering the natural distribution of the radioisotope)
  - a. Critical or "target" organ(s): Total body
  - b. Gonadal exposure: Same as whole body dose calculated below

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3. Sample calculations: (Dosage should be calculated for the whole body and for "target" or other separate organs, where indicated)  
Summary equations are desired; not extensive calculations. Standard dosage equations from references such as Hine and Brownell's Radiation Dosimetry, National Bureau of Standards Handbook 69, and BNL Hospital Form 1167-A should be used where possible and the reference cited.

15  $\mu\text{c}$  Cs<sup>137</sup> Cl<sub>2</sub> - I.V. = 380 mr integrated dose

0.1  $\mu\text{c}/\text{day}$  for 30 days = 76 mr " "

Body burden for lifetime of Cs<sup>137</sup> = 30  $\mu\text{c}$  (ICRP)

#### C. Radiological Health Aspects

1. Hazards to other patients and to personnel from external or internal radiation: None
2. Monitoring procedures, if necessary: None
3. Special procedures for handling waste products, excreta, biological samples, etc., where indicated: None
4. Plan for isotope accountability, if required: None - experimental plan calls for initial excreta to be collected and disposed of through Health Physics.

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SUPPLEMENTARY FORM FOR RADIOISOTOPE  
ADMINISTRATION TO HUMAN BEINGS

## A. Radioisotope

1. Species: (Radioisotope or labeled compound, eg.  $\text{Na}^{24}\text{Cl}$  or  $1\text{-C}^{14}$ -glucose)  
 $\text{Zn}^{65}\text{Cl}_2$
2. Physical characteristics: (Physical half-life; decay scheme (or type, energy and relative frequency of major emissions) )  
245 days       $\text{Zn}^{65} \rightarrow \text{Cu}^{65}$        $\left\{ \begin{array}{l} \bar{E}_\beta = .01 \text{ mev} \\ E_\gamma = -1.12 \text{ mev} \\ K_\alpha\text{-x-ray} = 8.0 \text{ kev} \\ \text{Positron} = 0.32 \text{ mev (1.5\%)} \end{array} \right.$
3. Source: (BNL reactor, cyclotron, hot lab.), commercial supplier, etc.)  
Nuclear Sc. and Engineering
4. Preparation: (Target material, quantity, special problems)  
 $\text{Zn}^{65} (n, \gamma) \text{Zn}^{65}$
5. Specific activity and isotopic purity of administered material:  
Oral dose - 0.33  $\mu\text{c}/\text{day}$  for 30 days  
I.V. dose = 15  $\mu\text{c}$
6. Radioassay and calibration procedures: (Include validation to be performed at BNL prior to use)
  1. Gamma ray spectroscopy
  2. Assayed by calibration against standard source.
7. Vehicle and route of administration:  
 $\text{Zn Cl}_2$  in sterile saline
8. Procedures for control of sterility and pyrogenicity: (Or note that commercially supplied isotopes are certified as ready for administration to human beings.)
  1. Injection solution sterilized
  2. Injected into rabbit to test pyrogenicity
9. Extraneous effects, if pertinent: (Such as pharmacological or toxic actions of the parent compound or vehicle, etc.) None

## B. Radiation Dosage

1. Biological half-life or half-lives, including slow components:  
300 day biological half-life
2. Organ, cellular, or subcellular localization: (Should account for the effects of special drugs or agents on altering the natural distribution of the radioisotope)
  - a. Critical or "target" organ(s): Total body
  - b. Gonadal exposure: Same as total body (see below)

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3. Sample calculations: (Dosage should be calculated for the whole body and for "target" or other separate organs, where indicated)  
Summary equations are desired; not extensive calculations. Standard dosage equations from references such as Hine and Brownell's Radiation Dosimetry, National Bureau of Standards Handbook 69, and BNL Hospital Form 1167-A should be used where possible and the reference cited.

$15 \mu\text{c Zn}^{65}$  (I.V.) = 500 mr integrated dose  
 $0.33 \mu\text{c/day}$  for 30 days = 33 mr integrated dose

(See attached sheet for calculations)

$\text{Zn}^{65}$  max. perm. body burden for life =  $60 \mu\text{c}$  (ICRP)

#### C. Radiological Health Aspects

1. Hazards to other patients and to personnel from external or internal radiation: None
2. Monitoring procedures, if necessary: None
3. Special procedures for handling waste products, excreta, biological samples, etc., where indicated: None
4. Plan for isotope accountability, if required: None - initial excreta will be collected and disposed of through Health Physics.

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SUPPLEMENTARY FORM FOR RADIOISOTOPE  
ADMINISTRATION TO HUMAN BEINGS

## A. Radioisotope

1. Species: (Radioisotope or labeled compound, eg.  $\text{Na}^{24}\text{Cl}$  or  $1\text{-C}^{14}\text{-glucose}$ )  
 $\text{Sr}^{85}\text{Cl}_2$
2. Physical characteristics: (Physical half-life; decay scheme (or type, energy and relative frequency of major emissions)  
65 days;  $\text{Sr}^{85} \rightarrow \text{Rb}^{85}$   $\gamma = (\sim 100\%)$  0.51 mev  
 $\beta = 0$
3. Source: (BNL reactor, cyclotron, hot lab.), commercial supplier, etc.)  
Nuclear Sc. and Engineering
4. Preparation: (Target material, quantity, special problems)  
 $\text{Sr}^{84}$  (n, $\gamma$ )  $\text{Sr}^{85}$  I.V. - 15  $\mu\text{c}$   
Oral - 1  $\mu\text{c/day}$  for 30 days
5. Specific activity and isotopic purity of administered material:  
Carrier-free
6. Radioassay and calibration procedures: (Include validation to be performed at BNL prior to use)
  1. Gamma spectrographic analysis
  2. Assay against calibrated source
7. Vehicle and route of administration:  
I.V. and Oral: Sterile saline
8. Procedures for control of sterility and pyrogenicity: (Or note that commercially supplied isotopes are certified as ready for administration to human beings.)
  1. Injection to be sterilized
  2. Injection into rabbit for testing pyrogenicity
9. Extraneous effects, if pertinent: (Such as pharmacological or toxic actions of the parent compound or vehicle, etc.) None

## B. Radiation Dosage

1. Biological half-life or half-lives, including slow components:  
Limiting  $t_{1/2}$  is radioactive (65 days)
2. Organ, cellular, or subcellular localization: (Should account for the effects of special drugs or agents on altering the natural distribution of the radioisotope)
  - a. Critical or "target" organ(s): Bone
  - b. Gonadal exposure: Only gamma from bone deposited  $\text{Sr}^{85}$  will irradiate the gonads. Limiting dose taken as same as whole-body dose calculated below.

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3. Sample calculations: (Dosage should be calculated for the whole body and for "target" or other separate organs, where indicated) Summary equations are desired; not extensive calculations. Standard dosage equations from references such as Hine and Brownell's Radiation Dosimetry, National Bureau of Standards Handbook 69, and BNL Hospital Form 1167-A should be used where possible and the reference cited.

See attached sheet for dose calculations.

- a)  $15 \mu\text{c Sr}^{85}$  (I.V.) = 160 mr integrated dose  
b)  $1 \mu\text{c/day}$  for 30 days (oral) = 80 mr  
 $\text{Sr}^{85}$  max. permissible body burden =  $60 \mu\text{c}$  (ICRP)

C. Radiological Health Aspects

1. Hazards to other patients and to personnel from external or internal radiation: None
2. Monitoring procedures, if necessary: None
3. Special procedures for handling waste products, excreta, biological samples, etc., where indicated: None
4. Plan for isotope accountability, if required: None. Initial excreta will be collected for experimental purposes and disposed of through Health Physics.

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Oral Administration of following isotopes for 30 days - Assumption: 100% retention of absorbed activity.

$Cs^{137}$  Body burden = daily dose x time x fw  
=  $\mu c \times \text{days} \times \text{per cent GI absorption}$   
=  $(0.1)(30)(1.0) = 3.0 \mu c$

$f_w$  = fraction of isotope absorbed into blood from GI tract

Therefore dose is twice that calculated for I.V. administration of  $1.5 \mu c$  (see above calculation)

$$D_{\beta} = 50.9 \times 2 = 101.8 \text{ mr}$$

$$D_{\gamma} = 38 \times 2 = 76 \text{ mr}$$

~~$Zn^{65}$  Body burden =  $\mu c \times \text{days} \times fw$~~

$Zn^{65}$  Body burden =  $\mu c \times \text{days} \times fw$   
=  $(0.33)(30)(0.10) = 1 \mu c$

Dose is  $\frac{1.0}{1.5}$  or  $\frac{2}{3}$  of above dose or calculated for  $1.5 \mu c$  I.V.

$$D_{\beta} = \left(\frac{2}{3}\right)(3.2) = 2.1 \text{ mr}$$

$$D_{\gamma} = \left(\frac{2}{3}\right)(50) = 33.3 \text{ mr}$$

$Sr^{85}$  Body burden =  $\mu c \times \text{days} \times fw$

$$= (0.5)(30)(0.25)$$

$$= 3.75$$

$$D_{\gamma} = (16)\left(\frac{3.75}{1.5}\right) = 40.0 \text{ mr}$$

Table 2. Properties of isotopes employed.

Isotope	Radiol. $t_{1/2}$	Total Biol. $t_{1/2}$	Aver. $\beta$ energy $E_{\beta}$	$E_{\gamma}$ Gamma energy	$T$ ( $\mu\text{c-hr}$ at 1 cm)	fraction reaching blood from G.I. tract (Handbook 52)	MPC ( $\mu\text{c}$ ) for lifetime concent. (Handbook 69)
Cs-137 $\beta, \gamma$	30 y	140 d	0.23	0.662	3.2	0.25	30
Zn-65 $\beta^+, \gamma, E$	245 d	200 d	.01	1.12	2.7	0.50	60
Sr-85 $\gamma$	65 d	<del>140 d</del>	-	0.51	2.0	0.10	60

Table 1. Dose to patients.

Patient	Isotope	Administration			Integrated Dose to Patient	
		Concentration (μc)	Freq. Frequency	Mode	Beta (mR)	Gamma (mR)
1	Sr-85	1.5	1	I.V.	-	16
2	Cs-137	1.5	1	I.V.	51	38
3	Zn-65	1.5	1	I.V.	3.2	50
4	Sr-85	0.5	Daily	30 days Oral	-	40
5	Cs-137	0.1	"	"	5102	<del>38.36</del> 76
6	Zn-65	0.33	"	"	2.1	33

*Alan T. ...*

BROOKHAVEN NATIONAL LABORATORY

M E M O R A N D U M

Date: October 13, 1959

To: Committee on the Use of Radioisotopes

From: S.H. Cohn, <sup>512</sup>Ph.D. and R.A. Conard, M.D.

Subject: Request for permission to administer tracer levels of Cs-137, Zn-65 and Sr-85 in a clinical experiment.  
H-61

The Biological Turnover of Cs-137, Zn-65 and Sr-85

As a result of the world-wide increase in environmental radioactivity from nuclear weapons testing, the levels of internally-deposited radioisotopes have been rising in human beings. It is of great importance that data be obtained on (1) the absolute levels of the important fission products present in the population, (2) the biological turnover for these radioelements, and (3) the rate of equilibrium between the level in an individual and the amount in the environment.

A specific population that has shown a great increase in internal levels is that of the Marshallese people on Rongelap. In this population the body burdens of Cs-137 are one hundredfold greater, and the Sr-90 levels tenfold greater than present North American levels.

The whole-body gamma counter at BNL offers a unique tool for investigating some of these problems. It is proposed as an initial study that the metabolic turnover of three isotopes (Cs-137, Zn-65 and Sr-85) be studied in patients at Brookhaven. It is planned to extend this study in further work, particularly to very short-lived isotopes to be obtained from the BNL medical reactor.

However, before the whole-body counter can be used to determine absolute amounts of activity, the system must be carefully calibrated with known amounts of activity fixed in a characteristic way in the human body. The use of radioactive standards in pressedwood phantoms has not proved reliable as a substitute for actual human geometry and absorption. (A new phantom of carefully constructed

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likeness to a human being with compartments filled with tissue-equivalent fluid and appropriate replicas of the major organs into which isotopes can be introduced <sup>has been</sup> ~~is being~~ acquired, and may prove to be helpful in this study.)

The spectra of individual fission products taken individually and in combination are required for analysis of the complex spectra obtained from population studies. At present these data are needed for analysis of the measurements made on the Marshall Islanders, but they will also form the basis on which various population studies under consideration will have to be interpreted.

The second step following absolute determination of the levels of these radioisotopes is the assessment of the biological turnover. In the past, biological turnover data have been extrapolated from animal studies, but it is apparent that animal data are not always applicable to human beings. For example, the NBS Handbook indicates a biological half-life for Cs-137 of 17 days, based on animal studies. Studies with human beings, although limited, have already indicated that the biological turnover is probably over 100 days. Further, turnover rates are based on data obtained from single applications of the isotope, based on the assumption that a single application of an isotope is equivalent, in terms of human metabolic and turnover rates, to the application of the same total amount administered in fractionated doses over a period of time. In other words, the problem of chronic ingestion is represented as being identical with that of the administration of a single large dose. We propose to administer the isotope in both single doses and fractionated doses, to determine the effect of the multiple mode of application on the metabolic turnover rate. This approach should provide us with some information on the complex problem of chronic ingestion.

In order to study the rate of equilibration of the body burden with the dietary environment, the administration of small oral daily doses of these isotopes will be necessary. Such rates of equilibration, with the exception of Strontium, are not well-known. Determination of this rate of uptake is of considerable practical interest at this time. From these studies it will also be possible to determine the rate of gastro-intestinal absorption (circulatory uptake) of these isotopes.

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Specific Proposals

1. Each of three patients will receive one of the following isotopes: Cs-137, Zn-65 and Sr-85, 1.5  $\mu\text{c}$ , I.V. A calibrated spectrum will be obtained by the whole-body counting technique and will then be compared with that obtained from a phantom in which a like amount of radioactive material has been placed.
2. The biological turnover of radionuclides in these three patients will be followed by measuring body retention over a six-month period with frequent counting, and also by determination of urinary excretion rates.
3. Cs-137 and Zn-65 will be administered separately to two patients in daily oral doses of 0.1  $\mu\text{c}$  and 0.33  $\mu\text{c}$ , respectively, for at least 30 days. Sr-85 will be administered orally to one patient at a level of 0.5  $\mu\text{c}$  per day for 30 days. The circulatory uptake of the isotopes will be measured by use of a columnated shielded counter placed over the forearm. The whole-body counting procedures will be followed for the period of administration, and for six months following cessation, to determine the time of attainment of equilibrium and the turnover and excretion rates. These data will be compared with those obtained following administration of the single dose of the isotope.
4. Each patient will have preliminary and follow-up blood work (WBC, differential, and platelet counts). The radioisotopes will be prepared in normal saline solution and sterilized before administration. In addition, aliquots will be administered to rabbits prior to human injection to make certain that there are no pyrogenic or other untoward effects.

Patients

The use of terminal cases would be less satisfactory for this study than the use of the patients proposed below, since a number of interfering physiological derangements can be expected in such cases, and further because of the impracticality of carrying out repeated whole-body counts in such patients. Dr. Irving L. Schwartz is beginning a study of metabolic disorders in patients, using a double tagging system with C-14 and tritium, and has offered the use of his patients in this study. It has been determined that there would be no interference in carrying out the two studies simultaneously, and the type of patients to be studied would be satisfactory for our purposes. \*

\*See addendum #4 attached.

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Oral Administration of following isotopes for 30 days - Assumption: 100% retention  
of absorbed activity.

$$\begin{aligned} \text{Cs}^{137} \quad \text{Body burden} &= \text{daily dose} \times \text{time} \times \text{fw} \\ &= \mu\text{c} \times \text{days} \times \text{per cent} & \text{fw} &= \text{fraction of isotope} \\ &= (0.1)(30)(1.0) = 3.0 \mu\text{c} & & \text{absorbed into blood} \\ & & & \text{from G.I. tract.} \end{aligned}$$

Therefore, dose is twice that calculated for I.V. administration of  
1.5  $\mu\text{c}$  (see above calculation).

$$D_{\beta} = 50.9 \times 2 = 101.8 \text{ mr}$$

$$D_{\gamma} = 41.6 \times 2 = 83.2 \text{ mr}$$

$$\begin{aligned} \text{Zn}^{65} \quad \text{Body burden} &= \mu\text{c} \times \text{days} \times \text{fw} \\ &= (0.33)(30)(0.10) = 1 \mu\text{c} \end{aligned}$$

Dose is  $\frac{1.0}{1.5}$  or  $\frac{2}{3}$  of above dose or calculated for 1.5  $\mu\text{c}$  I.V.

$$D_{\beta} = \left(\frac{2}{3}\right)(101.8) = 67.9 \text{ mr}$$

$$D_{\gamma} = \left(\frac{2}{3}\right)(83.2) = 55.5 \text{ mr}$$

$$\begin{aligned} \text{Sr}^{85} \quad \text{Body burden} &= \mu\text{c} \times \text{days} \times \text{fw} \\ &= (0.5)(30)(0.25) \\ &= 3.75 \end{aligned}$$

$$D_{\gamma} = (18.1) \left(\frac{3.75}{1.5}\right) = 45.3 \text{ mr}$$

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Table 1. Dose to patients.

<u>Patient</u>	<u>Isotope</u>	<u>Administration</u>			<u>Integrated Dose to Patient</u>	
		<u>Concentration (μc)</u>	<u>Frequency</u>	<u>Mode</u>	<u>Beta (mr)</u>	<u>Gamma (mr)</u>
1	Sr-85	1.5	1	I.V.	-	18.1
2	Cs-137	1.5	1	I.V.	51	41.6
3	Zn-65	1.5	1	I.V.	3.2	50.0
4	Sr-85	0.5	Daily - 30 days	Oral	-	45.3
5	Cs-137	0.1	" - "	Oral	102	83.2
6	Zn-65	0.33	" - "	Oral	2.1	33.0

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Table 2. Properties of isotopes employed.

Isotope	Radiol. $t_{1/2}$	Total Body Biol. $t_{1/2}$	Aver. $\beta$ Energy $E_{\beta}$	Gamma Energy $E_{\gamma}$	$T$ r/mc-hr at 1 cm	Fraction Reaching Blood from G.I. Tract (Handbook 52)	MPC ( $\mu$ c) for Lifetime Concent. (Handbook 69)
Cs-137 $\beta, \gamma$	30 y	140 d	0.23	0.662	3.2	0.25	30
Zn-65 $\beta^+, \gamma, e$	245 d	200 d	.01	1.12	2.7	0.50	60
Sr-85 $\gamma$	65 d	190 d	-	0.51	3.0	0.10	60

Request approved:

Walton W. Shreeve  
W. W. Shreeve, M.D., Ph.D.  
Chairman

E. E. Stickley  
E. E. Stickley, Ph.D.

D. C. Borg  
D. C. Borg, M.D.

J. S. Robertson  
J. S. Robertson, M.D., Ph.D.  
Ex Officio

L. E. Farr  
L. E. Farr, M.D.  
Ex Officio

John L. Bateman  
J. L. Bateman, M.D.

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

DATE: December 2, 1959

TO: Dr. W.W. Shreeve, Chairman, Isotope Com

FROM: Dr. S. H. Cohn *SHC*

SUBJECT: Further information on experimental proposal on "Biological Turnover of Cs<sup>137</sup>, Zn<sup>65</sup> and Sr<sup>85</sup>."

1. Isotopes Cs<sup>137</sup> Cl<sub>2</sub> and Zn<sup>65</sup> Cl<sub>2</sub> were obtained from Mary Kinsley (Hot Lab). She also standardized the solutions ~~for use in~~ <sup>using</sup> a 4π beta counter. Sr<sup>85</sup> Cl<sub>2</sub> is obtained from Nuclear Science and Engineering Corp.

All of these isotopes are re-assayed by us using a previously calibrated deep-well scintillation counter. The isotopes are checked for isotope purity in a gamma scintillation spectrometer.

2. The critical organ for Zn<sup>65</sup> is the whole body (see NBS Handbook No. 69, p. 33). The MPC as total body burden is listed as 60 μc. The distribution and MPC for other organs are all listed as having a body burden of greater than 60 μc.
3. The calculated dose for Zn<sup>65</sup> is a reasonable estimate, I believe. 49% of the γ energy is 1.14 mev and 39% is .008 mev X<sub>K</sub> (see Slack and Way, "Radiations from Radioactive Atoms," p. 27). Only 3.4% of the electromagnetic radiation is from the annihilation γ (0.511 mev).
4. The primary medical responsibility for the patients to be used will be that of Dr. Schwartz ~~or other physicians~~ allowing additional use of this patients for this project. However, Dr. Conard will have the responsibility connected with the procedures used in this project as well as evaluation of the accumulative radiation dosage to the patients from this and other radiation procedures used or having been used.

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