Dragon, Karen E. (CDC/NIOSH/EID)

From: DanMcKeel
Sent: Monday, August 19, 2013 5:56 PM
To: NIOSH Docket Office (CDC)
Cc: danmckeel
Subject: McKeel white paper: AEC NYO-4699 Stray radiation measurements
Attachments: McKeel_NYO-4699_8.19.13.pdf

Dear NIOSH Docket office,

Attachment: <McKeel_NYO-4699_8.19.13.pdf> 421K (PDF)

Please consider my new white paper, "**A Review of AEC Report NYO-4699: Accelerator (Including Betatron) Stray Radiation Measurements and Film Badge Data at 23 Sites**" by Daniel W. McKeel, Jr., MD, for posting under GSI Docket 140. Please use this title in the listing. Thank you.

--Dan McKeel Monday 8.19.13

Daniel W. McKeel, Jr., MD
GSI SEC-00105 co-petitioner

White Paper:
"HASL NYO-4699: The Missing Betatron Stray Radiation Monitoring Measurements and Film Badge Data Applicable to the General Steel Industries (GSI) AWE Site in Granite City, Illinois"

by

Daniel W. McKeel, Jr., M.D.
GSI SEC-00105 co-petitioner
(August 19, 2013)

There is an absolute lack of real, measured Betatron particle accelerator stray radiation data for the General Steel Industries (GSI) AWE EEIOCPA site.

At the 3/28/12 meeting of the ABRWH TBD-6000 work group (WG), Dan McKeel posed the following question to all WG participants: Board members Paul Ziemer (WG chair and former ABRWH chair), Wanda Munn, John Poston Sr., and Josie Beach; NIOSH (DCAS) members Dave Allen and James Neton; and SC&A members John Mauro and Robert Anigstein: "*Can any of you cite a publication that provides measured monitoring data from operating Betatrons*?" No one answered in the affirmative [**REF 1**].

The subject of this paper is a series of reports from the AEC Health and Safety Laboratory (HASL) under the rubric of NYO-4699 [**REFS 2 and 3**]. These papers provide careful x-ray, gamma photon and fast and thermal neutron radiation measurements and concomitant film badge readings at dozens of university and DOE facilities. REF. 3 includes measurements from 22 Mev and 300 Mev Allis-Chalmers Betatrons at three sites: Memorial Hospital in New York and the University of Illinois Champaign-Urbana; and the U. Illinois medical school. In addition, these papers offer comments and suggestions on adequacy of radiation measuring devices, of radiation shielding in current use, and of adequacy of neutron detection systems including film badges for high Mev sources such as particle accelerators.

NYO-4699(Suppl. 1) also references important information about the Brookhaven National Laboratory Off-site Monitoring Service [**REF 4**] and about NCRP radiation standards in 1954 [**REF 5**].

The author also provides [**REFS 6 and 7**] to the Board, to NIOSH, and to the TBD-6000 work group in further support of his contention that peer reviewed scientific journals insist that computer-generated dosimetry models based on transport codes such as MCNPx insist on close agreement (±10 to 20% was the figure McKeel cited) between modeled (*in silico* simulated or virtual) and measured data. The TBD-6000 WG and NIOSH and SC&A have resisted this assertion, saying that such rigid scientific validation with real measured data is not necessary under EEOICPA.

A Summarization of REFERENCE 3

Filename: OSTI_NYO-4699_suppl1.txt

7.27.13 Sat. - Today and yesterday Dan McKeel ran searches for "Betatron uranium" with 474 hits and located OSTI report NYO-4699(Suppl1) (1956) [**REF. 3**]. This is a terrific resource. Follows an overview of the contents of this report that are directly relevant to the GSI AWE site and its two Allis-Chalmers, Donald Kerst U. IL.-derived, 24-25 MEV Betatrons for which the ABRWH, TBD-6000 work group, SC&A and NIOSH have no (zero) measured data to validate the Attila and MCNP5 computer codes they used to simulate, *in silico*, the GSI "New"[1] Betatron photon, neutron and beta doses for the covered period 1952-1966. Radiation doses from the "Old" Betatron, which was used for all of the GSI NDT contract work for the AEC on MCW uranium between 1952 and 1963, has not been ascertained or bounded in compliance with OCAS-IG-003. In those years, the Old Betatron was the *only* Granite City, IL, GSI Betatron unit, as the other Betatron was used for NDT at the GSI Eddystone Division in Eddystone, PA.

The SEC petitioners, in their Administrative Review request concerning GSI SEC-00105 that began processing 5/17/13, cited this lack of modeling and bounding for the GSI Old Betatron, using measured Betatron data for model validation, as *discrete omission errors* on the part of NIOSH that merit reversing the HHS Secretary's decision to deny certified by letters from her dated 3/6/13.

NYO-4699 (Supplement 1) (1957) deals with stray radiation measurements and film badge readings at accelerator facilities. Thus, it is directly relevant to GSI Betatron operations. Presumably, NYO-4699 (1956) should also contain data relevant to GSI.

Complete Reference 3 citation: (8.16.13 Friday, DWM Jr., based on the OSTI (DOE database resource) downloaded PDF) file [**Also see Attachment A**]:

p. 1 (physical)
===

"Stray radiation measurements at particle accelerator sites."
Health and Safety Laboratory
New York Operations Office, AEC
and Division of Research, AEC
April 1, 1957

[1] The terms Old and New Betatron at GSI refer to the fact that from 1952-1963 the sole Betatron used at the Granite City EEOICPA covered facility for US Government/AEC NDT uranium contract work with the Uranium Division of Mallinckrodt Chemical Works (MCW) work was a government owned unit that is now referenced as the GSI Old Betatron. The term "New Betatron" derives from the fact that GSI closed the Eddystone Division sometime during 1963 and moved castings operations, and its A-C 25 MEV Betatron, to GSI in Illinois where a new facility was built at 1417 State Street in Granite City 300 yards away from the Old Betatron facility and very close to, and connected with, the GSI "10 building." Thus, from 1963 through June 1966 of the covered period there were two Allis-Chalmers 24-25 MEV Betatrons operating at GSI to perform AEC/MCW uranium NDT contract work.

==

[The front title page is marked: This document is "PUBLICLY RELEASABLE: HUGH KINSER, Authorizing Official
Date: 1-25-11"]

p. 2 blank (physical)

p. 3 DISCLAIMER (physical)

p. 4 DISCLAIMER (physical)

p. 5 (physical) Abstract partly scratched through or sloppily underlined but all still readable: 6 lines long. The complete abstract reads as follows:

"*This is a supplement to Report NYO-4699 performed under the* ***Continuing Accelerator Survey Program****. Stray radiation measurements made at 23 particle accelerator sites are summarized and discussed. Conclusions with regard to safe accelerator operation are drawn, as well as radiation dosimetry, maximum permissible levels, and instrumentation.*" (emphasis added)

p. 7 **(iii)** <==pages not numbered until this one "iii."

p. 8 **(iv)** ACKNOWLEDGMENTS ... especially everyone who assisted in the Accelerator Survey Program ... Irving Kingsley (HASL) ... D. J. Stearman of the University of Illinois ..."

p. 9-12 **(v thru viii)** Table of Contents and Tables: Last Table and entry:
"42 Summary of Radiation Levels at University of Michigan Synchrotron (December 1956), p. 73"

p. 13 (**number 1**; <u>note</u>: the actual bottom of page numbers will be used in this review from this point forward)

p. 1 STRAY RADIATION MEASUREMENTS AT PARTICLE ACCELERATOR SITES
1 INTRODUCTION

"Stray radiation surveys performed in 1953 and 1954 at 15 particle accelerator sites by the Health and Safety Laboratory (HASL) of the New York Operations Office were summarized earlier.1. This second report presents data and conclusions obtained during subsequent surveys conducted at 23 machines between December 1954 and December 1956. Thus the two reports represent a fairly complete picture of the radiation problems generally encountered at accelerators, including the five synchrocyclotrons in the United States as well as several other very high energy machines.

The measurements indicated that the radiation problems at older accelerators, most of which are located on university campuses, have tended to be a little troublesome with regard to unregulated outside areas and classroom buildings. The newer machines, in general, are in more remote locations; therefore, the principal radiation protection problem has to do with the unknowns in high-energy radiation dosimetry. As pointed out in the earlier report, personnel monitoring records show that the bulk of the measurable radiation exposures represent relatively few of the accelerator experimenters."

p. 1 cont'd. "The 23 radiation surveys were performed at the sites listed in Table 1. The energy of the accelerated particle at the time of the survey is also shown. The nature of the resulting radiation field for given beam conditions is discussed in Sec. 6.

The technique of an individual survey is determined by the nature of the available instrumentation and by the characteristics of the accelerator. An electron accelerator survey will consist principally of evaluating the x-radiation levels resulting from interactions of the beam electrons with the target materials and the various accelerator parts. The stray neutron problem was often of secondary importance, although **neutrons were the principal component of the stray radiation levels at two sites, a betatron** and a large linear accelerator which produced 500-Mev electrons at the time of the survey. Both cases are discussed later." (emphasis added)

p. 2 (not numbered) Table 1 list three "Betatrons": measured particle energy 22.5 MEV at Memorial Center for Cancer and Allied Diseases, NY on Dec 21, 1954; University of Illinois: 22.5 MEV Betatron, 300 MEV Betatron measurement date Oct.7, 1955.

p. 3 Loc map of facilities. 3. Instrumentation and Calibration. text...

p. 4 Instrumentation questions related to measuring photons and neutrons. RBE for neutrons = 10 required a BF3 meter to be added as a third neutron measuring device.

p. 5 Schematic diagrams of Fig. 2 Graphite-C02 ionization chamber (approximately half-size), and Fig. 3 BF3 ionization chamber (approximately actual size).

p. 6 Photon/neutron ratio was determined by measurements to be 0.0039 mrep/hr/n/cm2-sec compared to 0.0052 and 0.0046 (same units) in two other cited references.

"Gross disagreements between the predicted and observed tissue equivalent dose rates indicated important departures of the stray radiation spectra from the calibration radiation spectra. It was found that most discrepancies between the predicted and observed tissue dose rates could be explained, at least qualitatively, by apparent differences between the energies of stray neutrons and of Po-Be neutrons."

p. 9 Table 3, states that U. IL had 16 film badged person-operators of the cyclotron and 2 Betatrons. FB data from 4 persons accounted for 46% Of 73 measured dose entries for the doses received and recorded in the table. U. IL FB records were between Sept. 10, 1954 -> Jan. 10, 1957 (* biweekly period).

p. 10 Memorial NY Betatron: "6 INDIVIDUAL SURVEYS

6.1 Memorial Center for Cancer and Allied Diseases

• (quote) The measurements were made when this **betatron produced x rays by bombarding a platinum target**, located inside the "doughnut," with 22.5-Mev electrons. The survey was conducted during different beam orientations in the control room and in the corridor approaching the accelerator room proper. One reason for the additional measurements inside the vault was to attempt a determination of the importance of photoneutrons produced unintentionally in the betatron components. The only neutron detecting devices available for this study, other than the tissue equivalent ionization chamber, were the AEC No. SPC-6A fast neutron dosimeter and the AEC No. SBX-21A fast neutron scintillation counter. Both instruments were affected by x-ray pile-up in the exposed locations. (emphasis added; GSI Betatron target was also platinum)

• No neutrons were detected in the control room, although it was possible that low-energy neutrons were present, since both survey meters are insensitive to neutron energies below 0.2 to 0.4 Mev. Measurements made with NTA film indicated also that the neutron levels were low; however, as mentioned above, NTA film also cuts off at a few hundred kev. Results obtained with the tissue equivalent ionization chamber at the locations in Fig. 5 are shown in Table 4.

No special recommendations regarding the operation of the betatron were made on the basis of this survey. Radiation levels in the control room appeared to be well below the maximum permissible for continuous occupation." (end quote)

p. 11 Fig. 5 and Table 4 of stray radiation measurements at Memorial Betatron facility. Walls of the shooting room are drawn as "4 ft. concrete." A window and a thin door are shown. The table gives doses for photons only in mrep/hr. (highest 15 mrep/hr with "beam monitor 100 r/min").

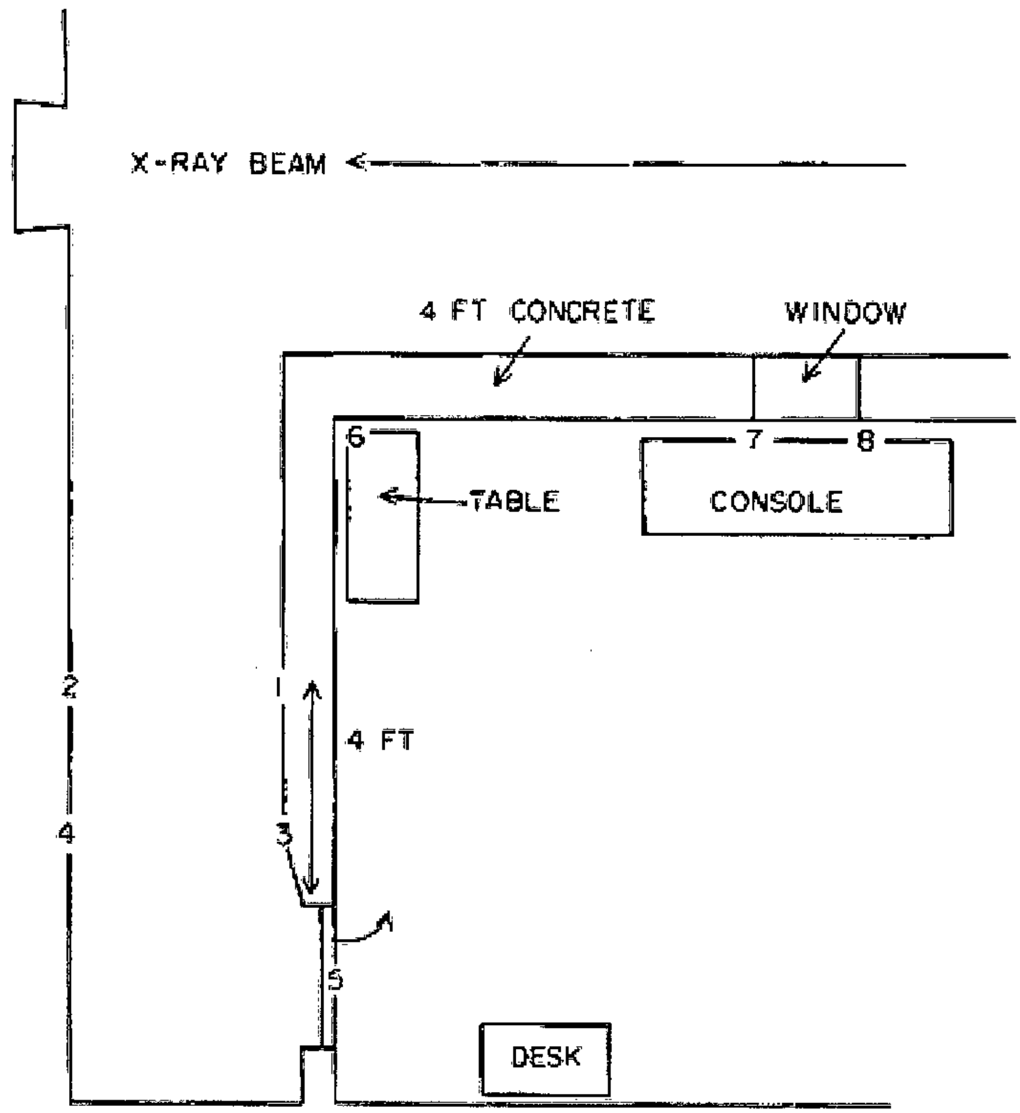

Fig. 5—Memorial Center for Cancer and Allied Diseases 22.5-Mev betatron layout, Dec. 21, 1954 (not to scale).

p. 46 thru 51 University of Illinois (IL) Cyclotron...

p. 51 thru 52 (text) U. IL Large Betatron (300 MEV) continues...

p. 53 Table 29 end of corridor Loc 2 = 3.49 MPD [maximum permissible dose]

p. 54 22-MEV Betatron begins (text and facility diagram) diagram shows thicker outside walls than interior walls but no measurements of wall thickness nor descriptions of wall materials.

- "(c) 22-Mev Betatron. The 22-Mev Illinois betatron produced about 9.5-Mev electrons on the date of the survey. The dose rate 100 cm from the molybdenum target was about 60 r/min. The betatron was pulsed about 180 times/sec with a pulse duration of 1 μsec. Radiation measurements were made at the locations appearing in Fig. 26.

"Stray radiation levels near the 22-Mev betatron observed on the date of the survey are shown in Table 31. The levels were uniformly low except in the control room, locations A through D. **A slight "hot" spot was encountered at location H (4 to 5 mr/hr), presumably due to the thinner shielding between this place and the betatron proper. Significant neutron levels seemed to be present according to the BF3-CO2 measurements**, although no substantiating measurements were made. In locations D and E these fluxes are much less important in terms of the maximum permissible level than the corresponding x-ray dose rate. (emphasis added)

"The last column in Table 31 lists the fraction of the MPD rate represented by the total (first-collision) dose rate as measured by the TE ionization chamber, except location B.

"The gradient of radiation levels between locations A and B is considerable. **A person must remain 23.5 hr In location A with the betatron on before accumulating a weekly MPD, but at location B the weekly MPD can be obtained in about 20 min**. (emphasis added)

"No significant levels were encountered outside the chain-link fence south of the betatron.

"Betatron operations employing higher energies and other targets will, of course, require a reevaluation of the stray radiations."

[NOTE: Insert here: Grab copy of Figures 25 and 26, U. IL 300 Mev and 22-Mev betatron layouts showing location B in one corner near door of the control room!]

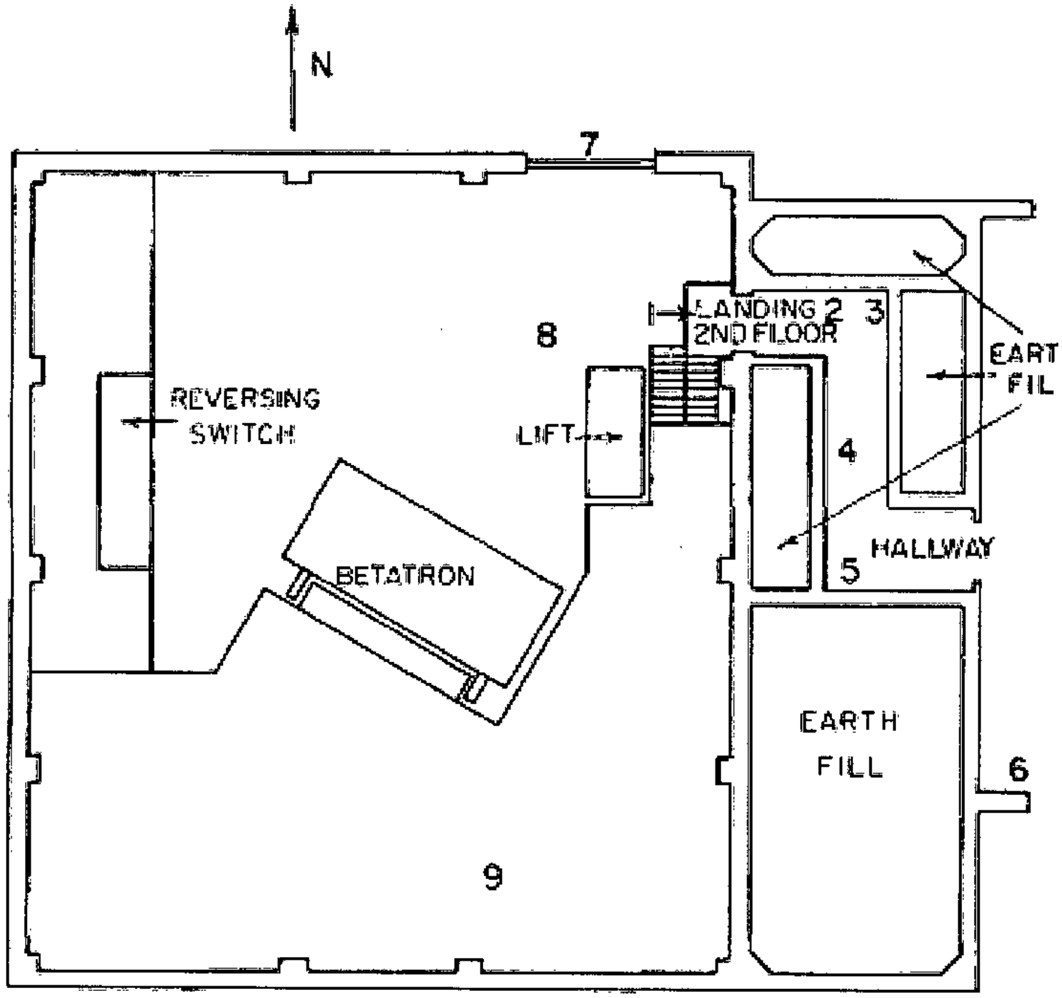

Fig. 25 — University of Illinois 300-Mev betatron layout.

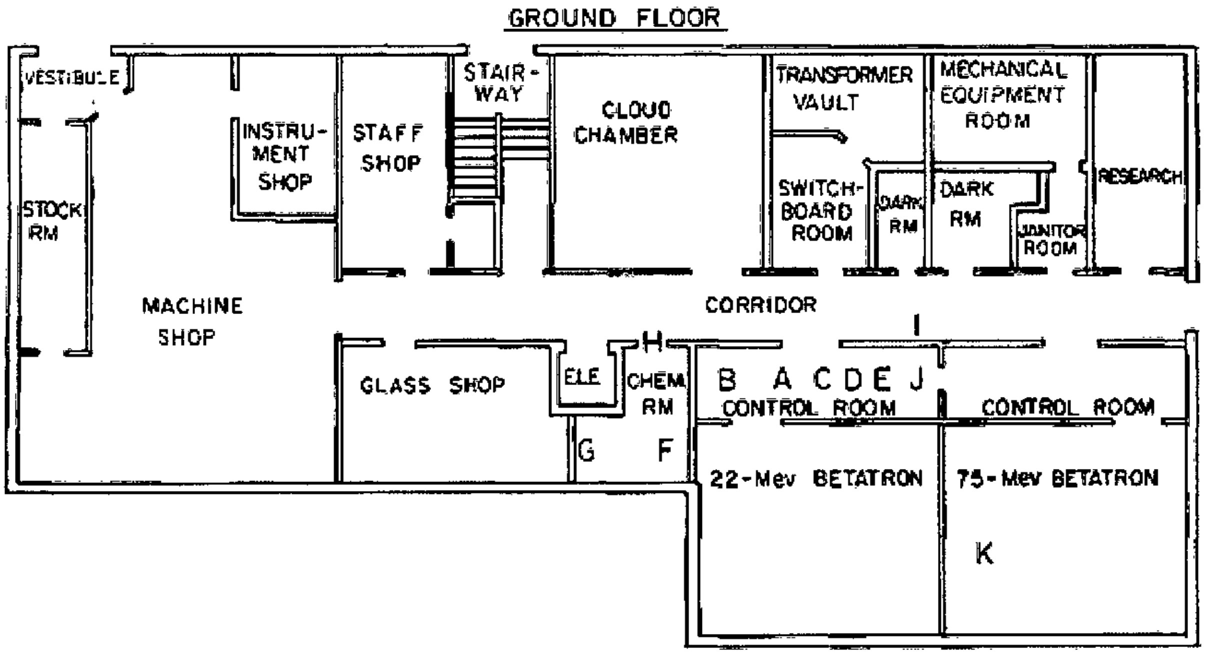

Fig. 26—University of Illinois 22-Mev betatron layout.

54

p. 55 Table 31. (Oct. 7, 1955) Ratios obs./calc. vary widely 0.05 to 2.70. MLD is exceeded in lines 1 and 2 = 1.60 and 133 Juno.

p. 56 22 MEV U. IL Betatron concluded: "Because of the generally low levels measured at the time of the survey, only one recommendation was made. It was suggested that the area immediately in front of the entrance to the vault, location B, be roped off and placarded with an appropriate radiation warning sign when the betatron is in operation. However, this radiation warning sign should not be displayed when the accelerator is off."

p. 64 Section 6.13 **Univ. of Illinois Medical School**:
"The University of Illinois Medical School 25-Mev betatron is located in the basement of a laboratory building connected to the hospital by an underpass. Figure 32 shows the floor plan of the area surrounding the accelerator, with the locations numbered where radiation measurements were made. Further measurements were made in the loading area adjacent to, and directly above, the betatron vault and also in the nurses' quarters across the courtyard. Readings were taken in the nurses' basement lounge, as well as in the first and second floor rooms facing the loading area. During the survey the betatron was operated at 22.5 Mev, the beam intensity being 75 r/min at 84 cm from the target.

Table 38 lists the observed neutron and gamma-ray intensities at the locations labeled on Figs. 32 and 33. **Readings higher than the maximum permissible were found at several points. Three instruments recorded a high neutron flux, both fast**

and thermal, in the passageway in front of the door to the betatron vault. This **high level has at least five times the maximum permissible flux** of «30 n/cm2-sec for fast neutrons. (emphasis added)

Considerably higher readings were recorded at the face of the concrete loading platform directly above the betatron vault. In a **localized area a radiation intensity of approximately 40 times the maximum permissible was observed** (location 7), whereas in regions a few feet away the intensity was considerably lower but still above the permissible (i.e., location 18). These readings indicated that a **narrow beam of neutrons and gamma rays was coming directly from the betatron through the thinnest portion of the concrete shield.** This beam was apparently **directed toward the nurses' quarters.** Measurements made there Indicated the **presence of levels in excess of the permissible in the first floor shower room near the stair well.** Measurable Intensities somewhat less than the permissible were found at several other locations on the first two floors.

It should be noted that the maximum permissible levels referred to, and which appear in Table 38, are applicable to a 40-hr/wk occupancy time in a regulated area. **For unregulated areas, such as the courtyard and nurses' quarters, weekly permissible levels should be reduced by a factor of 10**, and thus the MPD fractions for these areas should be increased by the same factor. Personnel occupancy time in radiation areas is an important factor to be considered before evaluating the significance of the radiation levels encountered.

An examination of the data indicates **inconsistencies in some of the neutron flux measurements. It is felt that this is due primarily to a pile-up effect**, resulting in spurious counts produced in the hand survey instruments by the pulsed radiation from the betatron. In this case the ionization chambers would be the most reliable. Those estimates of the neutron flux, based primarily on the portable survey meters where pile-up was thought to have a significant effect, are indicated in Table 38 by an asterisk. Wherever possible, permissible levels are estimated from the readings of the BF3-CO2 ionization chamber combination since this was not affected by gamma-ray pile-up.

In order to reduce the radiation levels observed in the loading area and nurses' quarters, it was recommended that additional concrete shielding be placed at location 7 along the ground next to the loading dock. To reduce these levels to the permissible, this additional concrete should be at least 10 ft long and 3 ft thick and about the same height as the loading dock, extending in from the outer end of the dock. A gamma survey should be undertaken after installation to check the effectiveness of the additional shielding.

It was recommended that all personnel involved in the routine operation of the betatron wear neutron-gamma film badges.

Because of the high neutron fluxes observed in the passage in front of the door to the betatron vault, it was recommended that this area be enclosed or otherwise protected from the intrusion of personnel during the operation of the betatron." (emphasis added throughout for bolded text)

p. 65 Photo of U. of Chicago Cockroft-Walton accelerator (not betatron) + Fig 32

[NOTE. Place Fig. 32 U IL Medical School betatron layout diagram here]

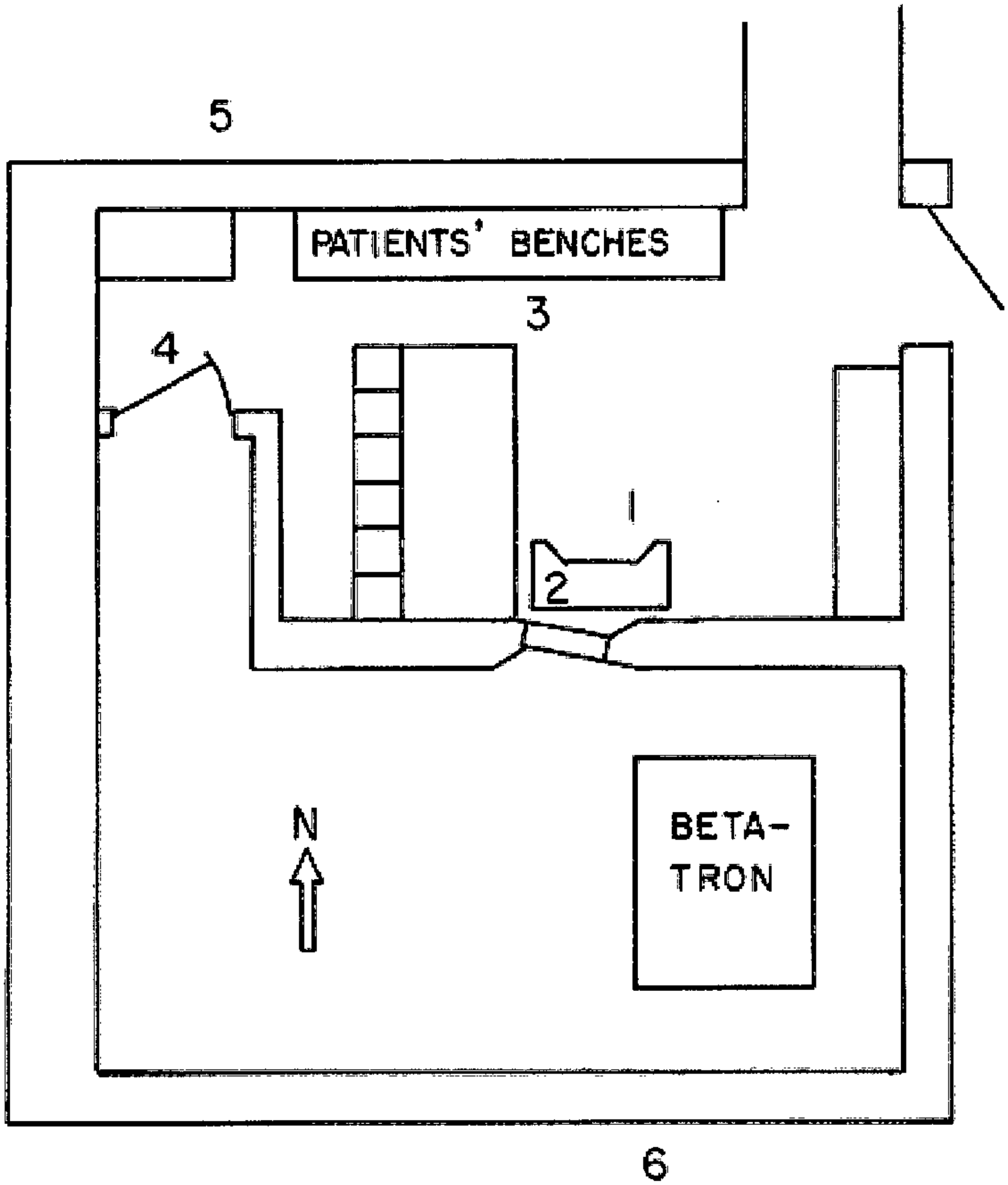

Fig. 32—University of Illinois Medical School betatron layout.

p. 66 Table 38 Radiation levels at U IL Med School Betatron Sept 1956:
Key data: MPD delivered 1.0, 2.21, 6.4, 5.74, ~40. [At or above MLD at 5 measured locations). Tissue dose mrep/hr Calc./obs. ratio varies wildly again. Calc. = 0.026 to 15.5; observed = 0.020 to 15.5.

p. 67 Fig 33 U IL Med School Betatron courtyard and nurses quarters area.

[NOTE: Place Fig 33 grab image here]

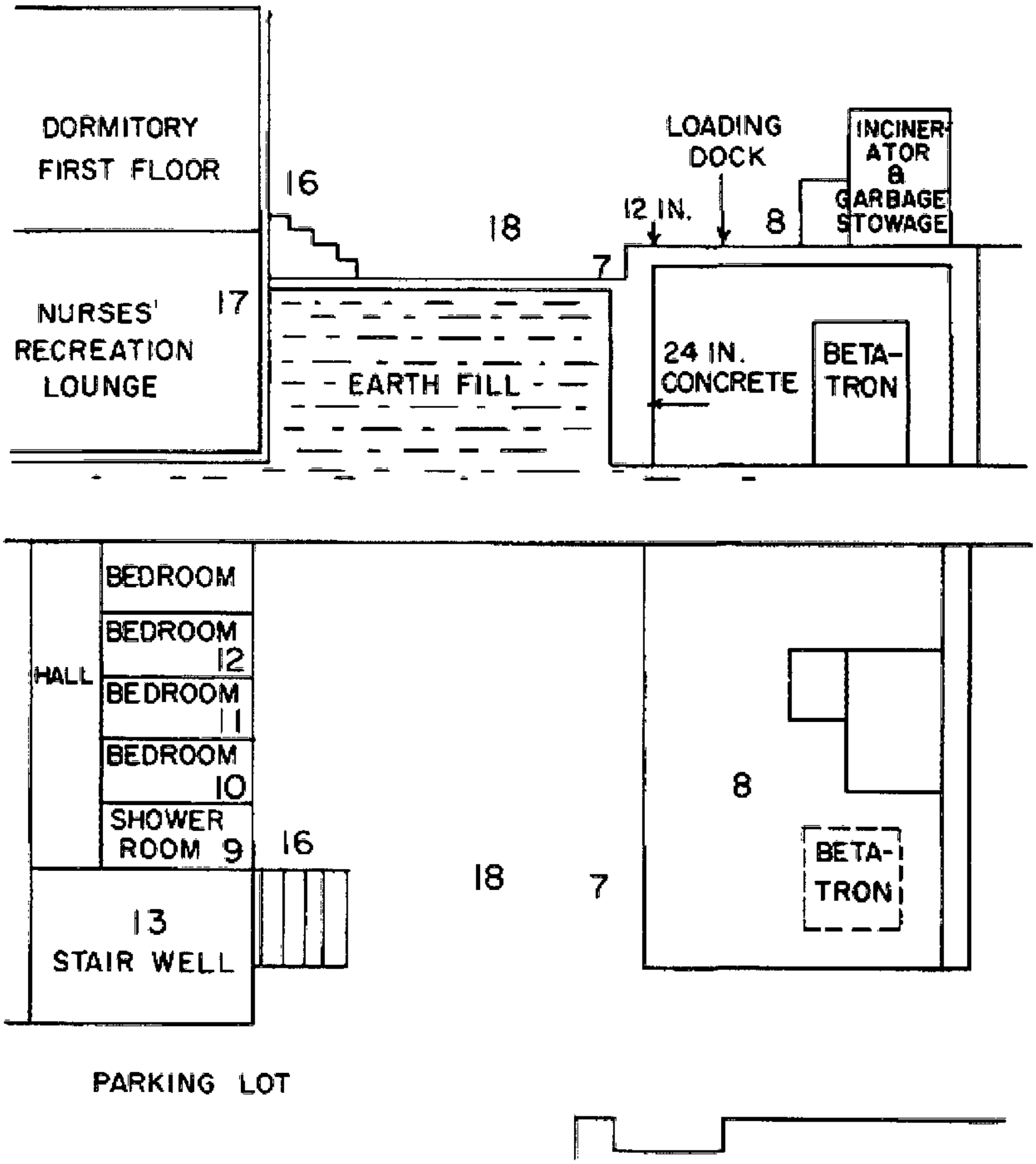

Fig. 33 — University of Illinois Medical School betatron, courtyard and adjacent area.

p. 74 Section 7 report CONCLUSIONS AND RECOMMENDATIONS:

"It was concluded in Report NYO-4699 that accelerator workers, in general, are not receiving excessive radiation doses. The film badge summaries reported earlier

[REF. 2] and in Table 3 indicate that 10 to 25 per cent of accelerator personnel accounted for roughly 50 per cent of the radiation exposure entries appearing in the summaries. However, the inadequacy of existing neutron personnel monitoring techniques in the intermediate energy range, as well as the insufficient knowledge with regard to any detecting device in the high-energy ranges, **implies that the film badges do not yield conservative estimates of an individual's radiation history**.

It is recommended then that particle accelerator personnel should rely on periodic stray radiation measurements, as well as on the film badge data. It is emphasized that using ionization chamber instrumentation to obtain estimates of the stray neutron fluxes in terms of equivalent Po-Be neutron fluxes is, on the other hand, conservative since neutrons in the Po-Be energy range are regarded as the most hazardous. Furthermore, by inferring the importance of the fast neutron portion of the spectrum from strictly fast neutron measurements, it is believed confidently that the degree of conservatism in survey techniques will not become excessive.

In the high-energy ranges the picture appears to be less sanguine. The response of biological materials and survey instrumentation detectors to high-energy particles near meson producing devices is virtually unknown. It is hoped that the use of large quantities of moderating material in conjunction with the BF3 chamber, as well as nuclear track techniques and possibly threshold detectors, may eventually ease this problem. It was pointed out in Report NYO-4699 that linear energy transfer considerations indicate that very high energy particles are less deleterious to biological systems than lower energy particles of a higher specific ionization. However, it is emphasized once more that this conjecture should be examined carefully in view of the empirical data. Thus the recommendation that was made in Report NYO-4699 is repeated, namely, that research should be undertaken on the biological effects due to very high energy radiation, as well as on the necessary radiation dosimetry.

Increases in the efficiencies of existing particle accelerators, as well as the increase in the number of machines used in research and industry, indicate the need for a more serious consideration of shielding design. The survey experience has shown that the augmentation of the beam current of existing machines usually resulted in the need for additional shielding to offset the increased stray radiation levels. Often the supplemental shielding used up valuable floor space in accelerator experimental areas. Consequently adequate radiation shielding can be an important economic consideration, as well as simply one of radiation protection.

It is felt that a necessary condition for an adequate shield design is the attenuation of stray radiation levels in routinely occupied places to some fairly small fraction of the maximum permissible level. The effect of external radiation beams in these occupied areas should also be very small. **Great care should be exercised in employing accelerator use factors and personnel work factors in permitting radiation levels above this fraction of the maximum permissible level. Many of the newer high-energy machines are actually in use much more than 40 hr/wk, and often some of the personnel work for long periods of time on extended experiments**. Consequently it is recommended that the attenuation afforded by a shield should be determined for the optimum beam condition, with respect to stray radiation levels, and for an occupancy factor of unity (i.e., the work areas are in use 40 hr/wk. It is pointed out that the high cost of most accelerators necessitates almost continuous use as opposed to occasional use of the older machines.

The specific value of the fraction of the maximum permissible radiation level chosen by the shield designer should depend upon the individual site requirements. However, in view of the increases of beam currents accomplished in many existing accelerators, it is felt that shielding should be designed to permit no more than one-fourth the maximum permissible radiation level, or about 2 mrem/hr. **Fast neutrons appear to be the determining component of the stray radiations, and consequently a possible difficulty in radiation detection is emphasized**.

In the energy range 3 to 10 Mev, 30 n/cm2-sec for 40 hr is taken to correspond to 0.30 rem in that period. Thus the fast neutron flux in areas adjacent to a shield designed according to the criteria discussed above would not exceed about 8 n/cm2-sec, about the lower limit of the measuring ability of most existing portable fast neutron instruments."

p. 75

"It is emphasized that reducing radiation levels to one-fourth the maximum permissible level is an inadequate criterion when uncontrolled areas are involved. Rather, the level in these places should not exceed one-tenth of the MPD, and actually the shielding should be designed to permit only a small fraction of one-tenth of the MPD.

Since the early work reported in Report NYO-4699, the accelerator survey technique has been greatly improved. Beginning in early 1953, the surveys conducted at 36 different machines have shown that the ionization chamber —vibrating-reed electrometer combinations have been particularly dependable even during surveys performed far from the New York area, as mentioned earlier. Consequently the bulk of the instrumental refinement or development work at HASL will consist in improving the ionization chambers. One type of chamber that is being considered for use as an x-ray dosimeter consists of an iron vessel filled with argon. This device is expected to have roughly only one-seventh the sensitivity to 4-Mev neutrons exhibited by the present graphite-CO2 chamber.

On a mass basis both chambers are equally sensitive to x rays. Further work on the polyethylene-moderated BF3 chamber is also planned because of its sensitivity to scattered neutrons.

It had been hoped that the size of the instrumentation could be materially reduced. However, any such reduction seems unlikely until a portable battery-operated lightweight vibrating reed electrometer, or equivalent instrument capable of measuring 10~14 amp reliably, is developed for field use.

The possible importance of r-f energy at high-energy machines in producing injury was discussed. No further work in this direction has been carried out; on the other hand, there have been no reported cases of r-f injuries to accelerator personnel."

p. 75 REF. 1-16 of NYO-4699(Suppl.1):

• **Reference 1**: 1. L. R. Solon, J. E. McLaughlin, Jr., and H. Blatz, Stray Radiation Measurements at Particle Accelerator Sites, Report NYO-4699, June 1, 1956, p. 25.

HASL NYO-4688 Stray Betatron Radiation Monitoring Data

[Note: DWM Jr I have been unable to locate this reference online 8.16.13]

p. 76 REF. 17-20 of NYO-4699(Suppl.1).

--end of references and REF. 3 document--

GSI SEC-00105 Co-petitioner Dan McKeel's Concluding Comments and Executive Summary:

1. This paper and the preceding NYO-4699 (1956) paper not yet located are perhaps the most relevant in existence related to stray radiation measurements at Betatron facilities at the General Steel Industries (GSI) plant, a covered EEOICPA site, at 1417 State Street in Granite City, IL. It fills a gaping current hole in providing highly relevant direct measured data, and film badge data, on Allis-Chalmers 22.5 and 300 MEV Betatrons (electron particle accelerators operating in x-ray mode from an internal target) and Betatron operators at Memorial Hospital, NY and University of Illinois and its medical school.

2. NIOSH, DOE, the Board and SC&A need to answer why it is that they have not mentioned this 1957 paper and its 1956 predecessor paper from the New York Office of the AEC, Health and Safety Laboratory (HASL) given that 22 meetings have been held regarding the GSI site: Procedures Review work group (n=4); TBD-6000/6001 Appendix BB (n=4); TBD-6000 work group (n=13); May 25, 2013 TBD-6000 WG technical call meeting (n=1).

• In 2006 Dan McKeel and SINEW submitted an extensive list of questions to DOE and its chief historian, Roger Anders regarding the GSI and Dow IL AWE sites. One of the questions was whether the AEC had a Betatron research program. His answer was no such records existed "at Germantown." This paper proves there was an active AEC Accelerator Survey Program during the 1950s.

• Recent DOE documents also proved the AEC was conducting Betatron NDT R&D on MCW uranium billets with a uranium shield built at MCW in the last quarter of 1952.

• On 3/28/13 Dan McKeel queried the TBD-6000 work group whether it's members could cite a single reference from the world's literature on A-C Betatron radiation dosimetry actual measurements. The answer was complete silence.

• On 7/27/13 Dan McKeel asked NIOSH SEC counselor Josh Kinman could he locate this paper in the NIOSH site research database (SRDB). The answer on 7/30/13 was "no."

Yet this paper, REF. 3, which is identified as being "Publicly Releasable" as of 1/25/2011, was located by McKeel in the OSTI database, which NIOSH site profile and SEC evaluation reports frequently cite as being a primary, standard search data resource for pertinent documents.

3. Petitioners assert that NIOSH and SC&A have seriously underestimated the importance of neutron doses from 24-25 Mev Betatron operations at GSI 1952-1966.

NYO-4699(Suppl. 1) (1957) REF. 3 underscores the importance of neutron doses and the difficulty in accurately measuring these doses using instrumentation or film badges. GSI had neither of these data. Petitioners assert the neutron flux situation in the Old (relatively isolated) and New (connected to Building 10) Betatron was (a) different, and (b) very complex as attested to by REF. 3. Because of these facts, the MCNPx modeled, but not validated data, used by both NIOSH and SC&A for GSI is also scientifically indefensible as being sufficiently accurate. Incorporating this reference measured Betatron and film badge data into the existing MCNPx model would enhance the accuracy of external photon and neutron exposure data in a revised Appendix BB.

4, The measured photon and neutron doses and film badge measurements at the Betatron facilities in REF 3 should be factored into the MCNPx models NIOSH and SC&A have used to assign external doses at GSI in 2008 and 2012. That is, the model MCNPx input assumptions and output values need to be adjusted to accordingly using this best available surrogate data.

5. Every possible effort by both NIOSH and SC&A should be undertaken to locate and review REF. 2, NYO-4699 (1956), the predecessor book that is the precursor to this NYO-4699 Supplement 1 (1957) paper. Whether or not this paper could be classified needs to be determined. It was for sale to the public in 1956 and is probably not classified.

References

1. TBD-6000 work group transcript 3/28/12 (288 pgs., 650 KB PDF), found at URL: **http://www.cdc.gov/niosh/ocas/pubm2012.html#mar28**

   [Note, should be read in conjunction with TBD-6000 work group transcript 3/15/12 (341 pgs., 641 KB PDF), found at URL: **http://www.cdc.gov/niosh/ocas/pubm2012.html#mar15]**

2. L. R. Solon, J. E. McLaughlin, Jr., and H. Blatz, Stray Radiation Measurements at Particle Accelerator Sites, Report NYO-4699, June 1, 1956. (REF 1 of main REF 3)

   Full Reference: This is a 62 page book, date 1956, sold through the US Government: Office of Technical Services, US Dept. of Commerce, 1956.

3. J. E. McLaughlin, Jr., Keran O'Brien, Leonard R. Solon, Albert V. Zua, Wayne M. Lowder, and Hanson Blatz, NYO-4699(Supplement 1), "Stray radiation measurements at Particle Accelerator sites," Health and Safety laboratory AEC and Division of Research AEC, April 1, 1957. 20 references. (86 page PDF file). Found at URL: **www.osti.gov/bridge/servlets/purl/4306039-Gel6fn/ [8 MB PDF]**

4. 17. F. P. Cowan, Technical Discussion of the Brookhaven Off-site Personnel Monitoring Service, Ra-Det, 6: 23-30 (1953), Official Use Only. (This is REF 17 of main REF 2)

5. 20. "Permissible Dose from External Sources of Ionizing Radiations," National Committee on Radiation Protection, National Bureau of Standards Handbook 59, Sept. 24, 1954. (This is REF 20 of main REF 2)

6. GSI AR Exhibit 7. Leone J, Furler M, Oakley M, Caracappa P, Wang B, Xu XG. Dose mapping using MCNP5 mesh tallies. Health Physics 88(Suppl. 1): 531-533, 2005. (calculated vs measured data agreement ± 2.5 to 5%) [GSI AR Exhibit #7]

7. Juste B, Miro R, Morera D, Diez S, Campayo JM, Verdu G. MCNP5 Monte Carlo simulation of amorphous silicon EPID dosimetry from MLC radiation therapy treatment beams. Conf Proc IEEE Eng Med Biol Soc 2012; 2012:5786-89. [Full citation and abstract attached.] (calculated vs measured data agreement ± 2%) URL: **http://www.ncbi.nlm.nih.gov/pubmed/23367244.**

Attachment A: Reference 3 Bibliographic Citation

(see following page 17)

Respectfully submitted,

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Co-founder SINEW
GSI SEC-00105 co-petitioner

INFORMATION BRIDGE

STRAY RADIATION MEASUREMENTS AT PARTICLE ACCELERATOR SITES

Description/Abstract

Stray radiation measurements made at 23 particle accelerator sites are summarized and discussed. Conclusions with regard to safe accelerator operation are drawn, as well as general conclusions regarding radiation dosimetry, maximum permissible levels, and instrumentation. (auth)

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