Power Burst Facility/Boron Neutron Capture Therapy Program for Cancer Treatment

Volume 4, No. 9

Bulletin

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Prepared for the U.S. Department of Energy
under DOE Contract No. DE-AC07-76ID01570

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

MONTHLY BULLETIN

PRINCIPAL INVESTIGATOR'S HIGHLIGHTS

Highlights of the PBF/BNCT Program during September 1990 include progress within the areas of:

1. Project 1: Supporting Technology Development

- Task 1: Gross Boron Analysis in Tissue, Blood, and Urine - Large numbers of samples from the WSU and ISU studies were received, prepared, and analyzed by ICP-AES. Steps have been taken to assure an adequate supply of deionized water for the instrument.
- Task 2: Analytical Methodologies Development for BSH (Borocaptate Sodium) Purity Determination - No reportable progress this month.
- Task 4: Boron Microscopic (subcellular) Analytical Development - No reportable progress this month.
- Task 5: Noninvasive Boron Quantitative Determination - Source code developed by Dr. Todd Richards at University of Washington has been transferred to INEL.
- Task 6: Dosimetry - Because of BMRR continued unavailability, no reportable progress this month.
- Task 7: Analytical Radiation Transport and Interaction Modeling for BNCT - The University of Utah participants have identified the source of the undefined surface problem and have corrected it. An option to the Monte Carlo transport modules has been added to perform a "fast"-neutron calculation only, greatly improving convergence of the fast-dose distributions.

MASTER

2. Project 2: Large Animal Model Studies - The 10-Gy dose group of dogs in the normal tissue tolerance studies continue to do well. A pilot study to examine ways of increasing BPA bioavailability from aqueous solutions has been initiated at INEL, WSU, and ISU.
3. Project 5: Neutron Source and Facility Preparation - EDFs were generated (1) in support of a draft environmental assessment and (2) as a plan for the radiobiological characterization of the reactor vessel and annulus.
4. Core A: Administration and Common Support - The National Academy of Sciences Institute of Medicine review committee has been formed to review the INEL proposal for PBF modification on November 5, 1990. Floyd Wheeler (INEL) and Dr. Patrick Gavin (WSU) traveled to Petten, The Netherlands to participate in a formal European Planning Session for Petten tolerance studies on normal dogs.
5. Core B: PBF Operations - Safety, training, preventive maintenance, and routine stand-by activities continue.

Ronald V. Dorn III, M.D.
Principal Investigator
PBF/BNCT Research Programs

ACRONYMS

AAPM	American Association of Physicists in Medicine
ACS	American Chemical Society
ASN	American Society of Neuroradiology
AWU	Associated Western Universities
BMRR	Brookhaven Medical Research Reactor
BNL	Brookhaven National Laboratory
BNCT	Boron Neutron Capture Therapy
BPA	Boronophenylalanine
BSH	Borocaptate Sodium
BSS(B)	$B_{24}H_{22}SS^{4-}$
BSSO(B)	$B_{24}H_{22}S_2O^{4-}$
CCF	Change control form
COCA	Consent Order Compliance Agency
CSF	Cerebrospinal Fluid
CSI	Chemical shift imaging
CT	Computed tomography
DOE	Department of Energy
DOE-ER	Department of Energy-Energy Research
DOE-HERAC	Department of Energy-Health and Environmental Research Advisory Committee
DOE-HQ	Department of Energy-Headquarters
DOE-ID	Department of Energy-Idaho Operations Office
DOE-NE	Department of Energy-Nuclear Energy
DOE-OHER	Department of Energy-Office of Health and Environmental Research
DSPC	Distearoyl phosphatidyl choline
EA	Environmental Assessment
ECAG	European Concerted Action Group
EDF	Engineering Design File
EE	Environmental Evaluation
EGS	Engineering Graphics Systems
EIRMC	Eastern Idaho Regional Medical Center
EPA	Environmental Protection Agency
EPRO	Experimental Power Reactor Operator
ERDP	Exploratory Research and Development Project
ES&Q	Environmental Safety and Quality
FDA	Food and Drug Administration
FIA	Flow injection analysis
FMEA	Failure Mode and Effects Analysis
GE	General Electric
HFR	High flux reactor
HMPAO	Hexamethyl-Propylene-Amineoxime

HPLC	High Performance Liquid Chromatography
HPLC-UV	High Performance Liquid Chromatography-UltraViolet
IACUC	Institutional Animal Care and Use Committee
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IM	Ion microscope
IND	Investigational New Drug exemption from FDA
INEL	Idaho National Engineering Laboratory
INPO	Institute of Nuclear Plant Operations
ISU	Idaho State University
IV	Intravenous
KURRI	Kyoto University Reactor Research Institute
LET	Linear energy transfer
LOFT/OECD	Loss-of-Fluid Test/Organization of Economic Cooperation and Development
MIT	Massachusetts Institute of Technology
MR	Magnetic resonance
MRI	Magnetic resonance imaging
MRS	Magnetic resonance spectroscopy
NAS	National Academy of Sciences
NCAR	National Center for Atmospheric Research
NCI	National Cancer Institute
NCS	Network computing system
NDE	New Device Exemption (FDA)
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Science and Technology
NMR	Nuclear magnetic resonance
NWI	Northwest Imaging
OCT	A low-temperature adhesive
OHSU	Oregon Health Sciences University
ORAU	Oak Ridge Associated Universities
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety Health Administration
PBF	Power Burst Facility
PDARS	Patient Data Acquisition and Retrieval System
PET	Position Emission Tomography
PMT	Photo multiplier tube
POM	Plant operating manual
RAP	Requirements Awareness Program
RBE	Relative Biological Effectiveness
RESL	Radiological and Environmental Sciences Laboratory
RF	Radiofrequency
RFP	Request for Proposal
SAR	Safety Analysis Report
SDD	System Design Description

SIMS	Secondary Ion Mass Spectrometry
TLD	Thermoluminescent dosimeter
TTAF	Test Train Assembly Area Facility
UCLA	University of California Los Angeles
UCSF	University of California San Francisco
UofU	University of Utah
USDA	United States Department of Agriculture
WSU	Washington State University

PROJECT 1: SUPPORTING TECHNOLOGY DEVELOPMENT

Task 1: Gross Boron Analysis in Tissue, Blood, and Urine

Approximately 530 samples were prepared for analysis and over 300 were analyzed by inductively coupled plasma-atomic emission spectroscopy (ICP-AES). A total of 446 samples were received for boron analysis during the month. Of the newly received samples, 227 are from the melanoma cell culture studies at Washington State University (WSU), 123 are from laboratory dogs, and 96 are from dogs involved in the Idaho State University (ISU) boronophenylalanine (BPA)-solubility enhancement studies. The total number of samples, including the actual samples, microfiltrations of blood serums, and QA/QC samples awaiting analysis, is approximately 1400.

The 27 samples received last month from a sectioned dog head were analyzed for background levels of C, H, N, O, S, P, Ca, K, Na, Mg, and Cl in critical tissues. Background boron levels on these samples are still pending.

Problems continue with the supply of deionized water for the INEL Research Center causing additional delays. The only water available was too impure to put through the instrument water purification system that is designed only for the final polishing of relatively clean feed water. Without the assurance of boron-free water, samples could not be prepared and new calibration standards could not be made. An additional two-tank purification system with high capacity ion exchange cartridges was purchased by Idaho National Engineering Laboratory (INEL) Facility Management to provide additional protection for the Program laboratory. This unit has been installed and there should be no further delays related to the water issue.

Task 2: Analytical Methodologies for BSH (Borocaptate Sodium) Purity Determination

No reportable progress this month.

Task 3: Analytical Methodologies Development for Active Form Identification

This task is presently unfunded.

Task 4: Boron Microscopic (Subcellular) Analytical Development

No reportable progress this month.

Task 5: Noninvasive Boron Quantification Determination

Pharmacokinetic Studies: No experiments performed this month.

Software Development: All of the source code developed by Dr. Todd Richards at University of Washington for Task 5 has been transferred to the INEL. Dr. Richards will be available to clarify any software issues, if the need arises, at no cost.

Documentation Transfer: A draft report detailing the hardware and software modifications required for the GE Signa™ magnetic resonance imaging (MRI) system to perform boron imaging has been submitted to the PBF/BNCT Program Office and is being reviewed for publication.

Task 6: Dosimetry

Because of Brookhaven Medical Research Reactor (BMRR) continued unavailability, no reportable progress this month.

Task 7: Analytical Radiation Transport and Interaction Modeling for BNCT

Task 7A - Graphics Software Development: The University of Utah (UofU) has verbally informed program participants that they have located and corrected the source of the undefined surface problem. They have prepared a new transmittal tape, which, when received, will complete all requirements of the contract. Program participants can then begin the task of integrating the radiation transport module with the spline-based, geometric, medical image reconstructions produced by the UofU software.

Radiation Transport Module Development: Work continued on Monte Carlo transport modules for the patient treatment planning system. An option was added to perform a "fast"-neutron calculation only. The new-option source selection is biased toward higher energies and the particle history is terminated once its recoil collisions no longer cause ionization. Results from the "fast" calculation are merged into results from a full transport calculation. Validation runs using this new option show greatly improved convergence of the fast-dose distributions.

Task 7B - Animal Model Dosimetry Analysis: Because of BMRR unavailability, no canine activity took place this month.

Calculations were performed for a small monkey head in support of a meeting with Oregon Health Sciences University (OHSU). These analyses indicate that because of the smaller target volume, the BMRR deliverable ^{10}B dose rate is only two-thirds of that attainable in a typical dog head.

PROJECT 2: LARGE ANIMAL MODEL STUDIES

Normal Tissue Tolerance Studies: Dogs in the 10-Gy dose group are doing well. Blood parameters remain normal. No new skin lesions have developed and no neurological abnormalities have occurred.

Spontaneously-Occurring Brain Tumors: "Brandy" Grudzinski's (#35447-093) tissues have been received and histological results are pending.

Pharmacokinetics: On September 1, 1990, Beagle #2146 underwent a two-hour boron plasmapheresis exchange with saline return. On September 7, Beagle #1902 underwent a six-hour boron plasmapheresis exchange. Banked, boron-free plasma was returned to the dog.

The latest information from large animal model experiments is summarized in Appendix A.

MELANOMA PROJECT

A pilot study to examine ways of increasing BPA bioavailability from aqueous solutions was initiated in mid-September by INEL, ISU, and WSU. The goals of this study are to:

1. Develop analytical methodology for quantitation of BPA levels in dog blood.
2. Determine peak blood levels of BPA and boron after intravenous infusion of different aqueous formulations of BPA.
3. Calculate the half-life of BPA and boron in blood after intravenous administration of different formulations of BPA.

4. Evaluate the acute toxicity of different aqueous formulations of BPA.

Analytical Methods Development: Development of an extraction system and High Performance Liquid Chromatography-UltraViolet (HPLC-UV) method for isolation and quantitation of BPA levels in dog blood has been initiated. Initial results suggest that the UV system has a threshold detection limit around 30 μ g BPA/ml. While this method will be useful for monitoring blood levels of BPA, it is unlikely that the method will have the sensitivity necessary to measure BPA concentrations in tumor biopsies. Boron concentrations are analyzed by ICP-AES.

Formulation Studies: Prolonged shaking of BPA in room-temperature, 0.1-M phosphate buffer (pH 7.4) yields solution concentrations of 25-30 μ g boron per gram formulation. Complexing BPA with organic agents increases aqueous solution concentrations by a factor of 5-10.

In-Vivo Experiments: The first series of BPA-solubility studies began on September 12-14, 1990 at WSU. Intravenous infusion of 17 ml/kg of a "saturated" formulation of BPA in phosphate buffer (25-30 μ g boron/gram) to three Beagle dogs produced serum-boron levels of 4.0, 3.3, and 4.1 μ g/g at the termination of a one-hour infusion. Other time points are being analyzed. Clinical chemistry, urinalysis, and gross observation of the animals identified show no acute toxicities attributable to infusion of the BPA/phosphate buffer. The second series of experiments to evaluate potential BPA-solubility enhancers began September 26, 1990.

"Winston" Sistek-Lane (#39412-17) was returned to WSU for diagnostic evaluation because of the onset of clinical signs suggesting development of melanoma metastases. BPA, with a potential solubility enhancer, will be infused intravenously on September 28, 1990, following completion of the assessment for metastases by ISU and WSU researchers. Extensive sampling of metastases will be performed at necropsy.

PROJECT 3: HUMAN STUDIES

This project is currently not funded.

PROJECT 4: STABILITY, PHARMACOLOGY, AND TOXICOLOGY OF DRUGS

This project is currently not funded.

PROJECT 5: PBF TECHNICAL SUPPORT

Analysis: The Environmental Assessment and Permitting Unit of EG&G Environment, Safety and Quality Department (ES&Q) released a draft Environmental Assessment (EA) for the PBF/BNCT Program for an internal EG&G review. This draft incorporates comments from EG&G ES&Q and from DOE. The document has been reformatted from an Environmental Evaluation (EE) to an EA and structured to meet requirements for DOE National Environmental Policy Act (NEPA) documentation. An Engineering Design File (EDF), PBF-BNCT 169, was generated to support the EA. This EDF is titled "BNCT Radiological Dose Calculations for Potential Accidental Releases" and was released during the reporting period.

A draft fault tree risk analysis for the PBF/BNCT neutron filter, filter cooling system, and shutter was submitted for review. When approved, this risk analysis will satisfy the requirement for a Failure Mode and Effects Analysis (FMEA) for these items. A FMEA is noted as an outstanding action item from the final design review of these systems.

A plan for the radiological characterization of the reactor vessel and annulus was completed and released as EDF PBF/BNCT 166. This plan suggests using thermoluminescent dosimeters (TLDs) to measure the radiation levels at specific locations in the vessel and annulus for the purpose of planning the in-vessel modifications for BNCT. The plan suggests radiation measurements be deferred until the annulus loss-of-coolant accident piping is removed and then measuring the levels in the annulus area. This will give a better assessment of the radiation level without the contribution from the piping. After the annulus is characterized, the reactor water level will be lowered to the core support plate and in-vessel measurements will be made. If required, the measurements could be made with the vessel full of water and the TLDs lowered into the vessel in dry-pipes. This method would not give the most accurate results.

Neutron Filter Component Design: Design of the bismuth-filled canisters is progressing with the final design review tentatively scheduled for the last week in October. Refinement to improve accuracy and convergence of the physics model for the as-designed, PBF neutron filter is continuing.

CORE A: ADMINISTRATION AND COMMON SUPPORT

The National Academy of Sciences (NAS) Institute of Medicine has accepted Admiral Watkins' request to form a committee to review the INEL proposal to convert the PBF reactor for use in research and development for BNCT. The meeting has been set for November 5-6, 1990 at the NAS building in Washington, D.C. November 5 will be an open meeting for PBF/BNCT Program presentations and November 6 will be a closed session for panel deliberation. Dr. Samuel Hellman will chair the meeting.

Brookhaven Medical Research Reactor (BMRR): In early September, Brookhaven National Laboratory (BNL) ran the BMRR at 1 MW to catch up on their experimental backlog. On September 5, 1990, a leadwire broke on one control rod, dropping the rod, and shutting them down. Operation at 1 MW was resumed on September 7, 1990. Tests determined the following allowable duration at higher power operation:

<u>Reactor Power</u>	<u>Time Limit</u>
1 1/4 MW	Steady State
2 MW	19 minutes
2 1/2 MW	12 minutes
3 MW	7 minutes (estimated)

Operation of BMRR for 31 minutes at 3 MW, 46 minutes at 2 MW, or 73 minutes at 1 1/4 MW is required for the next series of studies, that treat brain-tumor dogs with an average of 50-ppm boron concentration in the tumor. The next series of dose-tolerance dogs cannot be irradiated at BMRR until 3-MW, continuous operation can be obtained. If New York State and the Department of Energy (DOE) cannot come to an agreement to use the existing cooling water extraction and reinjection wells, it will require more than a year to obtain an alternate, operational cooling system. BNL is also considering a stripping tower to remove the organics from the cooling water. It would take a year to design, construct, and install such a system.

Boron Compound: Callery Chemical Company had planned to ship borocaptate cesium salt for Ben Venue to begin processing the week of September 17, 1990; however, an acetone contaminant was discovered during the final purification test. The drug is being purified and Callery expects to ship the week of September 24, 1990. The delay (one week) will not affect the schedule as Ben Venue was not ready to startup their process line. Callery will have some of their chemists at Ben Venue to assist in the final-dosage-form production of the borocaptate sodium (BSH) compound.

Nondisclosure agreements on the "Direct Enantiospecific Synthesis of L-BPA" were sent to two producers of the BPA compound, Callery Chemical and Eagle-Picher. Both companies produce L-BPA and are very interested in obtaining a direct synthesis route for its production. The process was developed by Ed Samsel (at INEL) with Exploratory Research and Development Project (ERDP) funding.

Meetings, Conferences, etc.: Program participants met with OHSU biological researchers on September 4, 1990 to discuss preliminary research issues in BNCT of pituitary tumors. Pituitary tumors represent 10% of all brain tumors. Although generally benign, they are debilitating and difficult to treat because the pituitary is the master gland of the endocrine system and surgical removal results in life-long body chemistry complications that are difficult and expensive to regulate. Selective reduction in the number of cancerous cells via BNCT appears very attractive.

Ken Bradshaw (Project 1, Task 5) attended the Pulse Programming Language (PPL) training at GE Medical Systems September 9-14, 1990. This class concentrated on the changes in PPL associated with the new Signa™ 4.X release. Since most of the MRI systems Program participants will use in the future will have the 4.X upgrade, all software developed by Dr. Richards at University of Washington (3.X release) will have to be modified. Northwest Imaging is presently planning to retain the 3.3 release, thereby eliminating any software changes to their system for the time being.

PBF/BNCT Program participants met with UofU medical research imaging physicians and staff at the UofU Medical Center on September 26, 1990 to discuss collaboration in human BSH pharmacokinetic studies that will utilize INEL-developed, *in-vivo*, quantitative boron assay by magnetic resonance procedures.

Petten Reactor: Floyd Wheeler (Project 1, Task 7) and Dr. Patrick R. Gavin (WSU) (Project 2) traveled to Petten, The Netherlands, for a formal European Planning Session for Petten Tolerance Studies on Normal Dogs.

Also attending from the United States were Dr. Ralph Fairchild (BNL) and Dr. Reinhart Gebauer (Ohio State University).

Dr. Gavin presented the PBF/BNCT Program canine pharmacokinetics, dose-tolerance, and tumor studies performed to date. Dr. Gavin also explored the possibility of setting up a brain-tumor dog recruitment network in The Netherlands. He traveled to Utrecht, The Netherlands, to acquaint animal researchers there with his experience in the dog studies.

Floyd Wheeler presented the dosimetry, irradiation planning, and dose-prediction results for the Program. After the formal meeting he met with Drs. R. Moss, G. Constantine, and P. Watkins to discuss methods of collaboration on beam characterization and irradiation planning and toured the counting facilities (overseen by Dr. W. Voorbraak) to determine what is available to support beam measurements. There appears to be no serious impediments to collaborations in the above-mentioned areas. Dr. Watkins will provide "best prediction," numerical values of the Petten High Flux Reactor (HFR) beam characteristics and, when received, PBF/BNCT Program participants can begin to derive response functions for foil measurements of the neutron spectrum. The meetings were considered to be mutually beneficial. The Europeans will benefit from PBF/BNCT Program experience and we can benefit from their ongoing human pharmacokinetics studies and future dose-tolerance efforts. The beginnings of a joint collaboration were formulated and plans were made for cross calibration of the BMRR, HFR, and PBF beams so information generated at each facility would be useful to all participants.

At the meeting wrap up, Dr. Professor Detlef Gabel proposed a European/USA collaborative program in physics, dog irradiations, boron determination, and pharmacokinetics.

Visitors: The team-building focus of the PBF/BNCT Program is developing biological-researcher interest in the use of radioprotectors. Radioprotectors reduce the biological damage from low linear energy transfer (LET) irradiation. Low-LET irradiation in BNCT comes from the $^1\text{H}(n,\gamma)^2\text{H}$ reaction and is the major, unavoidable source of damage to normal tissue that limits deliverable tumor dose. Dr. Amos Norman, Professor of Radiation Oncology and Radiation Sciences at University of California Los Angeles (UCLA), was in Idaho Falls on September 27-28, 1990 in conjunction with an Associated Western Universities (AWU) meeting and presented a related seminar, entitled "Linoleic Acid as a Radioprotector" on September 27, 1990. It appears likely that Dr. Norman and others at UCLA will propose biological research needed in the furtherance of the PBF/BNCT Program.

MILESTONE STATUS

<u>Milestone</u>	<u>Schedule</u>	<u>Actual</u>
a. Complete Phase I: Acute Canine Radiation Tolerance Study	6/90	6/27/90
b. Revise PBF/BNCT Program Plan	9/90*	---
c. Complete Noninvasive Boron Quantification Development for Clinical Use	10/90	---
d. Radiation Transport and Interaction Software Ready for Clinical Use	3/91	---
e. Complete Phase II: Acute Canine Radiation Tolerance Study	9/91	---
f. Complete Vessel Weld Mockup	9/91	---

* Revision to this Program Plan will be deferred until the FY-91 Budget is established.

CORE B: PBF OPERATIONS

The monthly routine safety walkthrough of the plant was completed for the month of September. Those items identified during the walkthrough that can be corrected within the maintenance budget are being completed.

The scheduled preventive maintenance performed in the plant during the month of September consisted of: (1) fire extinguishers, (2) chemical treatment pump, (3) auxiliary air compressor, (4) stack gas monitor, (5) plant air compressor, (6) constant air monitors, (7) 5/15 ton crane, (8) air conditioners, (9) reactor building exhaust fans, (10) sewage lift pump, (11), plant air receiver, (12) demineralized water storage tank, (13) demineralizer exhaust hood, (14) steam line control valves, and (15) relief valves for canal cleanup system, nitrogen system, utility cooling water system, primary heat exchangers and secondary coolant/high pressure demineralized water heat exchanger.

Installation of the new PCM-1B personnel radiation monitor was completed at the reactor. Calibration and operational checkout of the system is continuing. Work continued on the design effort for installation of backflow preventers in the reactor portable water system.

Operational training conducted during the month consisted of: (1) satellite accumulation area training for operations personnel, (2) ethics training, (3) Emergency Manual training for operators, (4) general employee lockout and tagout training, (5) hazardous material shipper training, (6) PBF Standing Directive quarterly review training, (7) quarterly radiation worker refresher training, and (8) Occupational Safety Health Administration (OSHA) 40-hour safety training for health physics.

The closeout meeting for the DOE-Idaho Falls Operations Office (ID) PBF reactor safety appraisal was held August 31, 1990. The appraisal team had five recommendations, but may change some of these as a result of the closeout meeting. DOE cannot determine if they should review the reactor as a Category A, B, or shutdown reactor. They chose to review it as a Category A reactor, which is considered incorrect by Program participants.

APPENDIX A

LARGE ANIMAL MODEL STUDIES

SUMMARY OF PATIENT DATA

PBF/BNCT CANINE PHARMACOKINETIC STUDY SUMMARY OF PATIENT DATA BSH INTRAVENOUS INJECTIONS STUDY

Page 1 of 2

ANIMAL	NAME OF DOG	EUTHANASIA		CASE SUMMARY	PATHOLOGY DIAGNOSIS	DOSE (mg/kg)	BLOOD SERUM AND URINE ANALYSIS	TISSUE ANALYSIS	CT		MRI	
		DATE	MIN						UNENH.	ENH	UNENH.	ENH
35447-1	"Muffy" Klugh	03/23/87	540	Yes	Pituitary adenoma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-2	"Stashi" Christensen	05/18/87	750	Yes	No tumor/positive boron control	57	Yes	Yes	N/P	N/P	No	No
35447-3	"King" Henry	05/18/87	Control	Yes	No tumor/negative boron control	0	Yes	N/P	N/P	No	No	No
35447-14	"Marsha" Despain	06/30/87	780	Yes	Invasive adenocarcinoma	62	Yes	Yes	Yes	Yes	Yes	Yes
35447-15A	"Amos" Vallangdigham	08/03/87	780	Yes	Invasive nasal carcinoma	59	Yes	Yes	Yes	Yes	Yes	Yes
35447-18	"Slim" Pozzobon	09/14/87	770	Yes	Invasive nasal adenocarcinoma	30	Yes	Yes	Yes	Yes	Yes	Yes
35447-20	"Mischief" Scott	11/02/87	90	Yes	Meningioma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-23	"Rocky" Christensen	11/13/87	780	Yes	Pituitary adenoma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-24	"Mariah" May	11/24/87	720	Yes	Subarachnoid cyst	55	Yes	Yes	Yes	Yes	Yes	Yes
36845-25	"Sandy" Frazier	01/26/88	780	Yes	Meningioma	53	Yes	Yes	Yes	Yes	Yes	Yes
35447-28	"Boots" Belisle	02/22/88	125	Yes	Regional demyelinating disease	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-30	"Sunny" Seeley	03/01/88	420	Yes	Pituitary adenocarcinoma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-32	"Pip" Hahn	02/26/88	410	Yes	Meningioma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-33	"Coco" Pechtel	03/23/88	420	Yes	Nasal adeno carcinoma	56	Yes	Yes	Yes	Yes	Yes	Yes
35447-37	"Tucker" Reeves	04/14/88	420	Yes	No tumor/positive boron control	10	Yes	Yes	N/P	N/P	No	No
35447-39	"Fritts" Cogan	05/02/88	100	Yes	Meningioma	10	Yes	Yes	Yes	Yes	Yes	Yes
35447-40	"Rocky" Underwood	05/03/88	420	Yes	Fungal granuloma	30	Yes	Yes	Yes	Yes	Yes	Yes
35447-43	"Blue" Archer	05/23/88	420	Yes	Diffuse cortical astrocytoma	52	Yes	Yes	N/P	N/P	Yes	Yes
35447-49	"Jenny" Nelson	06/29/88	420	Yes	Diffuse astrocytoma	33	Yes	Yes	Yes	Yes	Yes	Yes
35447-50	"Caesar" Chenoweth	07/13/88	420	Yes	Meningioma	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-54	"Licorice" Meyers	08/03/88	410	Yes	No tumor/positive boron control	55	Yes	Yes	Yes	Yes	Yes	Yes
35447-55	"Kelley" Langston	08/17/88	410	Yes	Diffuse astrocytoma	55	Yes	Yes	No	No	Yes	Yes
35447-57	"Raiferty" Reber	09/01/88	410	Yes	Meningioma (plasmapheresis)	50	Yes	Yes	No	No	Yes	Yes
35447-59	"Heidi" Boyer	09/12/88	180	Yes	Meningioma	55	Yes	Yes	No	No	Yes	Yes

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

¹ Euthanasia time in minutes following start-of-boron administration. Boron administration requires approximately 50 minutes.

(P) Partial results

N/A Not applicable

N/P Not Performed

PBF/BNCT CANINE PHARMACOKINETIC STUDY

SUMMARY OF PATIENT DATA

BSH INTRAVENOUS INJECTIONS STUDY (CONTINUED)

Page 2 of 2

ANIMAL	NAME OF DOG	EUTHANASIA		CASE SUMMARY	PATHOLOGY DIAGNOSIS	DOSE (mg/kg)	BLOOD SERUM AND URINE ANALYSIS		TISSUE ANALYSIS	CT		MRI	
		DATE	MIN							UNENH.	ENH	UNENH.	ENH
35447-62	"Chester" Scott	10/09/88	180	Yes	Meningioma	55	Yes	Yes	Yes	No	Yes	Yes	Yes
35447-67	"Muffet" Hammel	11/01/88	180	Yes	Astrocytoma	55	Yes	Yes	Yes	No	Yes	N/P	N/P
35447-70	"Mac" Meyers	11/15/88	180	Yes	Fibrillary astrocytoma	55	Yes	Yes	Yes	No	Yes	Yes	Yes
35447-71	"Jake" Brede	01/04/89	180	Yes	Choroid plexus papilloma	55	Yes	Yes	Yes	Yes	Yes	N/P	N/P
35447-72	"Mandy" Ross	02/07/89	495	Yes	Choroid plexus papilloma	55	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-76	"Scotty" Klenm	05/28/89	410	Yes	Protoplasmic astrocytoma	55	Yes	Yes	Yes	No	Yes	Yes	Yes
35447-86	"Brutus" Halverson	09/11/89	240	Yes	Pituitary adenocarcinoma	50	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-88	"Scamper" Brewster	10/10/89	420	Yes	Pituitary adenocarcinoma	55	Yes	Yes	Yes	N/P	Yes	Yes	Yes
35447-97	"Kolsa" Joy	12/07/89	420	Yes	No tumor	55	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-101	"Ginger" Mott	12/12/89	180	Yes	Choroid plexus papilloma	55	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-104	"Killer" Divine	01/19/90	180	Yes	Choroid plexus papilloma	55	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-117	"Toby" Page	04/27/90	180	No	Diencephalic mass	50	Yes	Yes	P	Yes	No	No	No
35447-116	"Taffy" Gruel ^{2,3}	05/05/90	300	No	Pending	55	Yes	Yes	P	Yes	Yes	Yes	Yes
35447-121	"Shorty" Morgan	07/02/90	180	Yes	Pituitary adenoma	55	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35447-126	"Beau" Smith	07/26/90	180	Yes	Pituitary adenocarcinoma	55	No	No	No	Yes	Yes	Yes	Yes
35447-127	"Sam" Warner	07/31/90	180	Yes	Reticulosis	55	No	No	No	Yes	Yes	Yes	Yes
35447-128	"Wiki" Fox ^{2,3}	08/05/90	297	Yes	Choroid plexus papilloma	55	No	No	No	Yes	Yes	Yes	Yes

- 1 Euthanasia or irradiation time in minutes following start-of-boron administration. Boron administration requires approximately 50 minutes.
- 2 Boron pharmacokinetic data obtained on these animals using MRS.
- 3 Three-dimensional chemical shift imaging (CSI).

(P) Partial results
 N/A Not applicable
 N/P Not Performed

PBF/BNCT CANINE PHARMACOKINETIC STUDY
SUMMARY OF PATIENT DATA
BSH INTRA-ARTERIAL INJECTIONS STUDY

Page 1 of 1

<u>ANIMAL</u>	<u>SEX</u>	<u>DATE</u>	<u>EUTHANASIA (MIN)¹</u>	<u>BLOOD SERUM AND URINE ANALYSIS</u>	<u>TISSUE ANALYSIS</u>
2181	M	10/18/89	420	Yes	Yes
2067	F	10/26/89	420	Yes	Yes
2148	F	11/16/89	420	Yes	Yes

¹ Euthanasia or irradiation time in minutes following start-of-boron administration. Boron administration requires approximately 50 minutes.

PBF/BNCT CANINE TUMOR TREATMENT STUDY

Page 1 of 1

ANIMAL	SEX	NAME OF DOG	BIOPSY DIAGNOSIS	DATE	START TIME ³	DURATION MINUTES ¹	CALCULATED DOSE (CGY)	ESTIMATED ¹⁰ AVG. (DDM)	SURVIVING	DAYS	EUTHANASIA/DEATH CAUSE	
											DATE	CAUSE
35447-79	F	"Pugee" Krebs	Astrocytoma ²	07/07/89	375	77.8	1923	18.5	No	348	06/20/90	Urinary Disfunction
35447-80	M	"Mugsy" Marshall	Astrocytoma ⁴	08/07/89	369	78.0	1722	21.6	No	12	08/19/89	Anesthesia
35447-83	M	"Rusty" Collins	Meningioma ⁴	08/25/89	430	68.5	1829	21.4	No	170	02/11/90	Unknown
35447-87	M	"Benji" Williams	Nasal adenocarcinoma ⁴	09/28/89	420	80.3	1653	20.6	No	140	02/14/90	Euthanasia
35447-93	F	"Brandy" Grudzinski	Meningioma ⁴	10/30/89	310	68.1	1912	24.9	No	300	08/27/90	Seizure
35447-94	F	"Brandy" Hoff	Meningioma ²	10/25/89	464	86.0	1887	14.3	Yes			
35447-95	M	"Godfrey" Beers	Meningioma ⁴	10/24/89	388	63.3	1743	24.5	No	0.5	10/25/89	Unknown
35447-100	F	"Juno" Bagley	Meningioma ⁴	11/30/89	315	73.0	2185	28.9	No	43	01/12/90	Euthanasia
35447-108	F	"Trixie" Herklotz	Papilloma ²	02/16/90	225	49.0	1900	51.9(?)	No ⁵	(a)	06/??/90	Unknown

- 1 Irradiation time in minutes.
 - 2 Diagnosis from CT and/or MRI scans.
 - 3 Time from start of boron injection to start of irradiation.
 - 4 Biopsy confirmed.
 - 5 Did not improve neurologic status.
- (a) The dog died sometime the week of June 11, 1990, was buried without necropsy, and the owner did not return messages or communicate with WSU.

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

PBF/BNCT CANINE PLASMAPHERESIS STUDY

Page 1 of 3

GROUP	ANIMAL	SEX	DATE	PLASMA EXCHANGE			EUTHANASIA (MIN.)	BLOOD SERUM & URINE ANALYSIS	TISSUE ANALYSIS
				FIRST MIN ²	SECOND MIN ²	THIRD MIN ²			
1	2095 ¹	M	06/08/88	360	---	---	430	Yes	Yes
1	2084 ¹	M	06/09/88	360	---	---	446	Yes	Yes
1	2109 ¹	F	06/10/88	360	---	---	410	Yes	Yes
1A	2114 ¹	F	08/18/89	360	---	---	445	Yes	Yes
1A	2140 ¹	F	08/10/89	365	---	---	455	Yes	Yes
1A	2117 ¹	M	08/11/89	360	---	---	417	Yes	Yes
1B	2139 ¹	F	07/31/89	362	---	---	750	Yes	Yes
1B	2169 ^{1,3}	M	08/02/89	363	---	---	770	Yes	Yes
1B	2127 ¹	F	08/01/89	383	---	---	800	Yes	Yes
2	2097	M	06/14/88	360	---	---	413	Yes	Yes
2	2074	M	06/15/88	360	---	---	410	Yes	Yes
2	2092	F	06/16/88	360	---	---	400	Yes	Yes
2A	2066	F	08/17/89	360	---	---	390	Yes	Yes
2A	2145 ³	F	08/14/89	422	---	---	440	Yes	Yes
2A	2155	M	08/15/89	360	---	---	395	Yes	Yes
2A	1901	F	09/07/90	360	---	---	401	No	No
3	2103	M	06/20/88	360	---	---	755	Yes	Yes
3	2081	M	06/22/88	360	---	---	755	Yes	Yes
3	2089	F	06/24/88	360	---	---	790	Yes	Yes

¹ Control Animal (reinfused same boronated plasma that had just been extracted).

² Time from start of boron injection.

³ Dog went into respiratory arrest at 412 minutes, but was revived.

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

PBF/BNCT CANINE PLASMAPHERESIS STUDY (CONTINUED)

Page 2 of 3

GROUP	ANIMAL	SEX	DATE	PLASMA EXCHANGE			EUTHANASIA (MIN.)	BLOOD SERUM & URINE ANALYSIS	TISSUE ANALYSIS
				FIRST MIN ²	SECOND MIN ²	THIRD MIN ²			
3A	2076	F	08/04/89	365	---	---	760	Yes	Yes
	2112	M	08/03/89	374	---	---	775	Yes	Yes
3A	2149	M	09/27/89	---	---	---	420	Yes	Yes
	2131	F	09/28/89	---	---	---	420	Yes	Yes
	2165	F	09/27/89	---	---	---	420	Yes	Yes
	2143	M	09/28/89	---	---	---	420	Yes	Yes
	2179	M	09/29/89	---	---	---	420	Yes	Yes
	2102	F	09/29/89	---	---	---	420	Yes	Yes
	2148	M	11/16/89	---	---	---	420	Yes	Yes
	2181	M	10/19/89	---	---	---	420	Yes	Yes
	2067	F	*0/26/89	---	---	---	420	Yes	Yes
4	2096	M	06/27/88	360	470	600	640	Yes	Yes
	2104	M	06/28/88	360	480	600	660	Yes	Yes
	2098	F	06/29/88	385	545	640	785	Yes	Yes
5	2091	M	08/18/88	120	---	---	163	Yes	Yes
	2073	F	09/08/88	130	---	---	160	Yes	Yes
5	2090	M	09/09/88	129	---	---	180	Yes	Yes
	2078 ¹	F	09/15/88	120	---	---	180	Yes	Yes
6	2093	M	10/07/88	360	400	---	455	Yes	Yes
	2086	F	10/13/88	360	401	---	480	Yes	Yes
6	2088	M	09/23/88	405	505	---	560	Yes	Yes
	2082 ¹	M	10/28/88	365	400	---	440	Yes	Yes

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

- ¹ Control Animal (reinfused same boronated plasma that had just been extracted).
- ² Time from start of boron injection.

PBF/BNCT CANINE PLASMAPHERESIS STUDY (CONTINUED)

Page 3 of 3

GROUP	ANIMAL	SEX	DATE	PLASMA EXCHANGE			EUTHANASIA (MIN.)	BLOOD SERUM & URINE ANALYSIS	TISSUE ANALYSIS
				FIRST MIN ²	SECOND MIN ²	THIRD MIN ²			
A	1T79	F	07/20/90	120	---	---	180	Yes	No
A	EG79	M	07/23/90	120	---	---	180	No	No
A	ACK79	M	08/08/90	120	---	---	180	No	No
B	G-1	F	03/16/90	145	---	---	225	No	Yes
B	G-8	F	03/22/90	120	---	---	180	Yes	No
B	G-10	F	05/04/90	120	---	---	280	No	No
B	G-11	F	06/06/90	120	---	---	255	Yes	Yes
B	2146	F	09/01/90	155	---	---	205	No	No
C	G-2	F	03/23/90	360	---	---	440	No	No
C	G-6	F	03/23/90	370	---	---	440	Yes	P
C	G-7	F	04/06/90	360	---	---	460	Yes	No
E*	2174	F	05/24/90	---	---	---	420	Yes	N/A
E*	1846	F	05/23/90	---	---	---	420	Yes	N/A
E*	2173	F	05/24/90	---	---	---	420	Yes	N/A

1 Control Animal (reinfused same boronated plasma that had just been extracted).

2 Time from start of boron injection.

* Dosage was 100 mg boron/kg body weight.

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

PBF/BNCT CANINE DOSE-TOLERANCE STUDY

Page 1 of 2

ANIMAL	SEX	IRRADIATION			10 ⁶ B ppm EST. AVG	BLOOD SERUM URINE ANAL.	SURVIVING	DAYS	EUTHANASIA/DEATH		TISSUE ANALYSIS	
		DATE	START TIME ³	DURATION (MINS)					CALCULATED DOSE (CGY)	DATE		CAUSE
1592 ¹	M	01/11/89	345	58.0	1273	31.1	Yes	No	0	01/11/89	Euthanasia	Yes
1587 ¹	M	01/12/89	21	36.0	1275	57.8	Yes	No	0	01/12/89	Euthanasia	Yes
966	M	02/08/89	235	48.0	1453	47.6	Yes	No	365	02/08/90	Euthanasia	N/A
1588	M	02/09/89	220	49.0	1258	38.5	Yes	No	368	02/12/90	Euthanasia	N/A
995	M	02/09/89	238	42.0	1275	47.8	Yes	No	365	02/09/90	Euthanasia	N/A
1591	M	02/10/89	194	90.0	2629	45.5	Yes	No	368	02/13/90	Euthanasia	N/A
1564	M	02/28/89	204	87.0	2345	45.6	Yes	No	379	03/14/90	Euthanasia	N/A
997	M	03/02/89	190	74.0	2687	59.6	Yes	No	375	03/12/90	Euthanasia	N/A
983	M	03/02/89	160	149.0	3834	38.6	Yes	No	128	07/08/89	Seizures	N/A
1590	M	03/01/89	176	140.0	3800	41.4	Yes	No	155	08/05/89	Seizures	N/A
946	M	04/11/89	195	109.0	3821	57.1	Yes	No	137	08/26/89	Neurologic Disease	N/A
985	M	04/13/89	170.0	168.0	6363	62.7	Yes	No	153	09/13/89	Neurologic Disease	N/A
1700	M	04/12/89	182.0	166.5	6374	63.5	Yes	No	158	09/17/89	Neurologic Disease	N/A
980 ²	M	04/11/89	155.0	120.0	Sham	4.0	Yes	No	372	04/18/90	Euthanasia	N/A
1589 ²	M	04/15/89	125.0	120.0	Sham	4.0	Yes	No	370	04/20/90	Euthanasia	N/A

¹ Dosimeter animals euthanized after irradiation.

² Control dogs given sham irradiations (0 cGy)

³ Time from start of boron administration

N/A Not applicable

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

PBF/BNCT CANINE DOSE-TOLERANCE STUDY (CONTINUED)

Page 2 of 2

ANIMAL	SEX	IRRADIATION		CALCULATED DOSE (CGY)	¹⁰ B ppm EST AVG	BLOOD SERUM URINE ANAL.	SURVIVING	DAYS	EUTHANASIA/DEATH		TISSUE ANALYSIS
		START TIME ³	DURATION (MINS)						DATE	CAUSE	
2255	M	01/31/90	N/A	157.0	0	No	Yes	90	04/30/90	Euthanasia	Yes
2256	M	01/30/90	N/A	236.0	0	No	No				
2257	M	02/01/90	N/A	157.0	0	No	Yes				
2258	M	01/31/90	N/A	236.0	0	No	No	91	05/02/90	Euthanasia	Yes
2259	M	02/01/90	N/A	157.0	0	No	Yes	101	04/14/90	Euthanasia	Yes
2260	M	02/02/90	N/A	236.0	0	No	No	N/A	08/08/90	Euthanasia	
2261 ²	M	02/05/90	N/A	N/A	N/A	No	No				
2262	M	02/01/90	N/A	157.0	0	No	Yes	98	04/14/90	Euthanasia	Yes
2263	M	02/05/90	N/A	236.0	0	No	No	88	05/01/90	Euthanasia	Yes
2264	M	02/02/90	N/A	236.0	0	No	No				
2265	M	02/05/90	N/A	157.0	0	No	Yes	N/A			
2266 ²	M	02/05/90	N/A	N/A	N/A	No	No		08/13/90	Euthanasia	No

- 1 Dosimeter animals euthanized after irradiation.
- 2 Control dogs given sham irradiations (0 Cgy)
- 3 Time from start of boron administration

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

PBF/BNCT BMRR CALCULATED DOSE CONTRIBUTIONS AT LOCATION OF THE PEAK BLOOD-VOLUME DOSE (DOSE RATE COMPONENTS AT PEAK DOSE LOCATION)

Page 1 of 1

DATE	SUBJECT	Beam Size (cm)	$\bar{d}_b$	$\bar{d}_f$	$\bar{d}_g$	$\bar{d}_n$	$\bar{d}_r$
12/16/88	Dog head phantom						
01/10/89	Dog head phantom						
01/11/89	Dog 1592	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
01/12/89	Dog 1587	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
02/08/89	Dog 966	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
02/09/89	Dog 1588	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
02/09/89	Dog 995	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
02/10/89	Dog 1591	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
02/28/89	Dog 1564	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
03/01/89	Dog 1590	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
03/02/89	Dog 983	5 x 10	0.1680	0.1680	1.6700	0.2600	2.0920
03/02/89	Dog 997	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
04/11/89	Dog 946	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
04/12/89	Dog 1700	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
04/13/89	Dog 985	5 x 10	0.1680	0.1600	1.6700	0.2620	2.0920
07/07/89	Dog 35447-079, "Pugee"	10 x 10	0.2750	0.3000	2.4200	0.4300	3.1500
08/07/89	Dog head phantom	10 x 10	0.3480	0.3580	3.1200	0.6070	4.0850
08/07/89	Dog 35447-080, "Mugsy"	10 x 10	0.2310	0.3000	1.9210	0.4030	2.6240
08/25/89	Dog 35447-081, "Rusty"	10 x 10	0.2660	0.3000	2.4800	0.4280	3.2080
09/28/89	Dog 35447-087, "Benji"	10 x 10	0.2160	0.3000	1.735	0.3770	2.4120
10/24/89	Dog 35447-095, "Godfrey"	10 x 10	0.2580	0.3000	2.1500	0.4505	2.9005
10/25/89	Dog 35447-094, "Brandy"	10 x 10	0.2920	0.3000	2.3300	0.5090	3.1390
10/31/89	Dog 35447-093, "Brandy"	10 x 10	0.2521	0.3000	2.3000	0.4396	3.0396
11/30/89	Dog 35447-100, "Juno"	10 x 10	0.2430	0.3000	2.2300	0.4250	2.9550
02/16/90	Dog 35447-108, "Trixie"	10 x 10	0.2630	0.3000	2.092	0.4580	2.8500

$\bar{d}_b$ = Dose rate (cGy/(min·MW·ppm)) from the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction.

$\bar{d}_f$ = Dose rate (cGy/(min·MW)) from above-thermal neutron (primarily hydrogen recoil).

$\bar{d}_g$ = Gamma dose rate (cGy/min·MW).

$\bar{d}_n$ = Dose rate (cGy/min·MW) from the $^{14}\text{N}(n,p)^{14}\text{C}$ reaction, assuming 1.87 weight percent nitrogen in brain tissue (also a peak location).

$\bar{d}_r = \bar{d}_f + \bar{d}_g + \bar{d}_n$

PBF/BNCT CANINE MELANOMA PHARMACOKINETIC STUDY

SUMMARY OF PATIENT DATA

D, L-BPA STUDY

Page 1 of 1

ANIMAL	NAME OF DOG	DATE	BORON DOSE	FORM OF BPA**	ADMINISTRATION ROUTE*	COLLECTION LENGTH	SURGERY OR EUTHANASIA	DATE
39412-001	"Cindy" Coyne	01/11/89	50 mg/kg	D, L HC1	Orally	6 hrs	Euthanasia	01/11/89
39412-002	"Smokey" Griffith	01/18/89	50 mg/kg	D, L HC1	Orally	6 hrs	Euthanasia	01/18/89
39412-003	"Minnie" Martin	02/10/89	50 mg/kg	D, L HC1	Orally	6 hrs	Euthanasia	02/10/89
39412-004	"Tracker" Gill	04/25/89	200 mg/kg	D, L Nat	SQ,QID	36 hrs	Euthanasia	04/26/89
39412-005	"Percie" Nissley	06/07/89	200 mg/kg	D, L Nat	SQ,QID	48 hrs	Surgery	06/09/89
39412-006	"Heidi" Meshishnek	08/16/89	200 mg/kg	D, L Nat	SQ,QID	48 hrs	Surgery	08/18/89
39412-007	"Corky" Treadway	08/21/89	200 mg/kg	D, L Nat	SQ,QID	48 hrs	Surgery	08/23/89
39412-008	"Lucy" Dowling	10/27/89	500 mg/kg	D, L Nat	Orally	6 hrs	Euthanasia	10/27/89
		08/22/89	203 mg/kg	D, L Nat	SQ,QID	48 hrs	Surgery	08/24/89
39412-009	"Peanuts" Wetterayer	09/05/89	250 mg/kg	D, L Nat	SQ,QID	12 hrs	Euthanasia	09/06/89
39412-010	"Mindy" Sachtjen	09/14/89	750 mg/kg	D, L Nat	SQ,QID	48 hrs	Euthanasia	09/16/89
39412-011	"Benji" Gebhard	10/28/89	400 mg/kg	D, L Nat	SQ,QID	48 hrs	Surgery	10/04/89
39412-012	"Muff" Hoglund	10/11/89	491 mg/kg	D, L Nat	Oral,QID	48 hrs	Euthanasia	10/13/89
39412-013	"Corky" Newby	11/14/89	750 mg/kg	D, L Nat	Orally	6 hrs	Euthanasia	11/14/89
39412-015	"Missy" Freeman	03/29/90	250 mg/kg	D, L Nat	Orally	6.5 hrs	Surgery	03/29/90
39412-016	"Lucky" Nisonger	04/10/90	250 mg/kg	D, L Nat	Orally	5.5 hrs	Surgery	04/10/90
39412-017	"Winston" Sisteck-Lane	04/26/90	250 mg/kg	D, L Nat	Orally	6.5 hrs	Surgery	04/26/90
39412-017	"Winston" Sisteck-Lane	08/26/90	48 mg/kg	D, L in M	IV	7.0 hrs	Euthanasia	08/28/90

* SQ = subcutaneously

QID = four times per day

BID = two times per day

** 3-p-Boronophenylalanine

IV = intravenously

M = molécusol

EGG-BNCT-8777
Vol. 4, No. 9
September, 1990

APPENDIX B

UPCOMING MEETINGS AND CONFERENCES

UPCOMING MEETINGS AND CONFERENCES

September 3-7, 1990

15th International Conference on Solid State Nuclear Track Detectors, Marburg, F.R.G. Contact: Professor R. Brandt, Intl. Nucl. Track Society, Philipps-Universitat, Nuclear Chemistry Dep., D-3550, Marburg, F.R.G.

September 4-7, 1990

3rd International Conference on "Applications of Physics in Medicine and Biology," Montreal, Quebec, Canada. Contact: WFNMB Congress Secretariat, GEMS Conference Services, P.O. Box 997, Snowdon Station, Montreal, Quebec, Canada H3X 3Y1.

September 4-15, 1990

New Trends in Pharmacokinetics, Internal School of Pharmacology, Erice, Italy. Deadline for applications: July 15, 1990. Contact: Professor Giuliano Mariani, CNR, Institute of Clinical Physiology, via Savi 8, I-56100 Pisa, Italy. (050) 554065.

September 6-9, 1990

Physics of Diagnostic Radiology, Nuclear Medicine, and Radiation Biology, University of California, Davis, CA. Contact: Office of Continuing Medical Education, UC Davis, School of Medicine, 2701 Stockton Boulevard, Sacramento, CA 95817 (916) 734-5390.

September 10-13, 1990

9th Annual ESTRO Meeting, Montecatini, Italy. Contact: Germaine Heeren, Public Relations Department, ESTRO, University Hospital St. Rafael, Department of Radiotherapy, Capucijnenvoer 35, 3000 Leuven, Belgium.

September 10-13, 1990

104th Annual Meeting of the AOAC, New Orleans, LA. Contact: M. Ridgell, AOAC, 2200 Wilson Boulevard, Suite 400, Arlington, VA 22101.

Upcoming Meetings (continued)

September 10-14, 1990

Courses in Physics Related to Therapeutic Radiology, Dosimetry of High-Energy Electron and X-Ray Therapy Machines, Houston, TX. Contact: University of Texas M.D. Anderson Cancer Center, Radiation Physics Department, HMB 221, 1515 Holcombe Boulevard, Houston, TX 77030 (713) 792-3076.

September 12-15, 1990

9th Annual Meeting of the European Society for Therapeutic Radiology and Oncology, including sessions on Biology and Quality Assurance, Centro Congressi, Montecatini, Italy. Contact: ESTRO Secretariat, University Hospital St. Rafael, Department of Radiotherapy, Capucijnenvoer 35, 3000 Leuven, Belgium.

September 12-15, 1990

4th Biannual Nuclear Medicine Congress, Kruger National Park, Eastern Transvaal, Southern Africa. Contact: Ms. J. Landman, Congress Coordinator, c/o Elscint (Pty) Ltd.-South Africa, P.O. Box 32260, Braamfontein, 2017 Johannesburg, South Africa (011 482-3000).

September 12-16, 1990

Medical Physics '90 Institute of Physical Sciences in Medicine Annual Conference and EFOMP 10th Annual Conference, Oxford, UK. Contact: Institute of Physical Sciences in Medicine, 2 Low Ousegate, York YO1 1QU UK.

September 21-27, 1990

American College of Radiology, Opryland Hotel, Nashville, TN. Contact: American College of Radiology, 1891 Preston White Drive, Reston, VA 22091 (703) 648-8900.

September 23-28, 1990

23rd Annual Meeting of the European Society for Radiation Biology, Trinity College, Dublin, Ireland. Contact: ESRB Secretariat, Nuclear Energy Board, Clonskeagh Square, Dublin 14, Ireland (353-1-697766).

Upcoming Meetings (continued)

September 24-26, 1990

10th Annual Pharm Tech Conference, New Brunswick, NJ. Contact: Pharm Tech Conference Registrar, 859 Willamette Street, P.O. Box 10460, Eugene, OR 97440.

September 24-27, 1990

Radiation Transport Calculations Using EGS4: A four-day hands on course, Division of Physics, National Research Council of Canada, Ottawa, Canada. Contact: Dr. A. F. Bielajew, Division of Physics, National Research Council of Canada, Ottawa, Canada, K1A 0R6 (613) 993-2715.

Sept 30-October 3, 1990

3rd International Ion Chromatography Symposium, Cornado, CA. Contact: Carole Wade-Clark, Waters Chromatography Division of Millipore, 34 Maple Street, Milford, MA 10757.

October 1-5, 1990

20th Annual Dosimetry Conference, Charleston, SC. Contact: Mrs. Janet Cox, Medical University of South Carolina, Radiation Oncology, 171 Ashley Avenue, Charleston, SC 29424 (803) 792-4255.

October 2-4, 1990

Southwest Oncology Group, Hyatt Regency, Columbus, OH. Contact: Marjorie Godfrey, SWOG, 5430 Fredericksburg Road, No. 618, Oak Hills Tower Building, San Antonio, TX 78229-6197 (512) 366-9300.

October 4-6, 1990

The Second Annual ICP Conference, J. W. Marriott Hotel, Washington, D.C. Contact: Colleen Clifton, Conference Coordinator, ICP Educational Division, 1101 Connecticut Avenue, N.W., Suite 700, Washington, D.C. 20036 (202) 857-1135.

October 4-6, 1990

Pheresis Conference, Houston, TX. Contact: Jeff Rasco, Conference Services, M.D. Anderson Cancer Center, Houston, TX (713) 792-2222.

Upcoming Meetings (continued)

October 5-7, 1990

1990 Society of Nuclear Medicine Fall Meeting: New Views and Reviews of Nuclear Medicine, Red Lion Inn, Omaha, NE. contact: James Littlefield, M.D., MVC Program Director, St. Louis VAMC 115-JC, 915 North Grand, St. Louis, MO 63130 (314) 289-6348.

October 11-13, 1990

1st International Consensus Workshop on Radiation Therapy of Metastatic and Locally Advanced Cancer, Washington, D.C. Contact: American College of Radiology, 1101 Market Street, 14th Floor, Philadelphia, PA 19107 (215) 574-3181.

October 14-19, 1990

7th Annual Meeting of the Society for Radiation Oncology Administrators, Miami Beach, FL. Contact: Office of the Secretariat, 1101 Market Street, Suite 1400, Philadelphia, PA 19107 (215) 574-3181.

October 15-20, 1990

American Society for Therapeutic Radiology and Oncology, Fontainebleau Hilton, Miami Beach, FL. Contact: American Society for Therapeutic Radiology and Oncology, 1101 Market Street, 14th Floor, Philadelphia, PA 19107-2990 (215) 574-3180.

October 19-21, 1990

31st Annual Meeting, Southeastern Chapter, Society of Nuclear Medicine: Tomographic Imaging: SPECT and PET, Hyatt Regency Hotel, Savannah, GA. Abstracts deadline: July 6, 1990. Contact: Dr. Vincent J. Sodd, Executive Director, Southeastern Chapter, SNM, Inc., 5989 Turpin Hills Drive, Cincinnati, OH 45244 (513) 231-6955.

October 26-28, 1990

American Society of Clinical Oncology Fall Conference, Anaheim, CA. Contact: ASCO, 435 North Michigan Avenue, Suite 1717, Chicago, IL 60611 (312) 644-0828.

Upcoming Meetings (continued)

November 2-4, 1990

16th Annual Scientific Meeting of the Society of Nuclear Medicine, New York Penta Hotel, New York, NY. Contact: Mitchell Stromer, Executive Director, Greater New York Chapter, SNM, Inc., 360 Cedar Lane, East Meadow, NY 11554 ((212) 904-4180.

November 4-7, 1990

14th Symposium on Computer Applications in Medical Care, Sheraton-Washington Hotel, Washington, D.C. Contact: The George Washington University Medical Center, Office of Continuing Education, 2300 K Street NW, Washington, D.C. 20037.

November 5-6, 1990

National Academy of Sciences, Institute of Medicine Review of the PBF/BNCT Program, Washington, D.C.

November 5-9, 1990

International Symposium on High-Dose Dosimetry for Radiation Processing, Vienna, Austria. Contact: Conference Service Section, IAEA, P.O. Box 100, A-1400, Vienna, Austria.

November 7, 1990

Physiological Monitoring of Subjects in the Bore of NMR Magnets, London, UK. Contact: Mr. D. T. Delpy, Department of Medical Physics and Bioengineering, University College London, 1st Floor, Shropshire House, 11-20 Copper Street, London WC1E 6JA.

November 11-14, 1990

Tenth International Conference on the Use of Computers in Radiotherapy, Sanjary Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India. Contact: Dr. S. Hukku, Department of Radiotherapy, Sanjay Gandhi P.G.I., Rai Bareli Road, P.O. Box 375, Lucknow 226001, India Tele: 0522-54336; Telex: 535-411 SPG IN Gram AYURVIGYAN.

Upcoming Meetings (continued)

November 11-16, 1990

Winter Meeting of the American Nuclear Society, Washington, D.C. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

November 12-15, 1990

3rd International Symposium on Intraoperative Radiation Therapy, Kyoto, Japan. Contact: Mitsuyuki Abe, M.D., Professor and Chairman, Department of Radiology, Faculty of Medicine, Kyoto University Shogoin-kawahara-cho, Sakyo-ku, Kyoto 606 Japan.

November 19-22, 1990

Biomedical Engineering '90, North Sea Conference, Antwerp, Belgium. Contact: Conference Office, Technologisch Instituut-K, VIV, Desguinlei 214, B-2018 Antwerp, Belgium

November 21-25, 1990

XIVth International Pigment Cell Conference (IPCC), International Conference Center, Port Island, Kobe, Japan. Contact: Dr. Yutaka Mishima, Chairman, Department of Dermatology, Kobe University School of Medicine, 7-5-2 Kusunoki-Cho, Chuo-Ku, Kobe 650, Japan (078) 341-7451, ext. 5760.

November 25-30, 1990

Joint Meeting of AAPM with the Radiological Society of North America, Chicago, IL. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

December 4-7, 1990

Fourth International Symposium on Neutron Capture Therapy, University of Sydney, Sydney, Australia. Abstracts due June 30, 1990. Contact: Dr. Barry J. Allen, President, International Society for Neutron Capture Therapy, ANSTO, PMB 1, Menai NSW 2234, Australia.

Upcoming Meetings (continued)

December 6-8, 1990

Sixth International Conference on Biomedical Engineering, Chicago, IL. Contact: The Secretary, Sixth Biomedical Conference 1990, Department of Orthopaedic Surgery, National University Hospital, 5 Lower Kent Ridge Road, Singapore, Republic of Singapore.

May 2-4, 1991

Radiology 91, 49th Annual Congress of the British Institute of Radiology, Brighton, United Kingdom. Contact: Programme Office, The British Institute of Radiology, 36 Portland Place, London W1N 4AT, United Kingdom (01-580-4085).

May 13-17, 1991

International Conference on Nuclear Data for Science and Technology, Juelich, F.R.G. Contact: Professor W. Hafele, KFA Julich GmbH, Postfach 1913, D-5170, Julich, F.R.G., Telex: 833 556-0 kf d; FAX: (02461) 61 53 27.

June 2-6, 1991

Annual Meeting of the American Nuclear Society, Orlando, FL. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

June 17-20, 1990

Canadian Organization of Medical Physicists Annual Meeting with Canadian College of Physicists in Medicine and Canadian Radiation Protection Association, Winnipeg, Manitoba, Canada. Contact: Dr. Walter Huda, Medical Physics, 100 Olivia Street, Winnipeg, MAN R3D 0V9, Canada (204-787-4191, FAX: 204-783-6875, ENA: WHUDA@UOOFMCC).

July 7-12, 1991

9th International Congress of Radiation Research, Sheraton Center, Toronto, Ontario, Canada. Contact: Ms. Meg Keiser, Radiation Research Society, 1101 Market Street, 14th Floor, Philadelphia, PA 19107 (215) 574-3153.

Upcoming Meetings (continued)

July 7-12, 1991

9th Meeting of the International Organization for Medical Physics, Kyoto, Japan. Contact: Dr. C. G. Orton, Secretary General, International Organization for Medical Physics, Gershenson Radiation Oncology Center, Harper-Grace Hospitals, 3990 John R., Detroit, MI 48201.

July 21-25, 1991

33rd Annual Meeting American Association of Physicists in Medicine, San Francisco, CA. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404).

July 28-August 1, 1991

33rd Annual Meeting of the American Association of Physicists in Medicine, San Francisco, CA. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

August, 1991

19th Meeting of the International Organization for Medical Physics, Kyoto, Japan. Contact: Dr. L. H. Lanzl, President, IOMP, Department of Medical Physics, Rush-Presbyterian St. Luke's Medical Center, 1753 West Congress Parkway, Chicago, IL 60612.

September, 1991

Interregional Seminar on Radiotherapy Dosimetry, Leuven, Belgium. Contact: Conference Service Section, IAEA, P.O. Box 100, A-1400, Vienna, Austria.

September 8-14, 1991

International Conference on Magnetism, UK. Contact: The Meetings Officer, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX, UK, Tele: 01 235 6111.

October 27-31, 1991

10th Annual Meeting of the European Society for Therapeutic Radiology and Oncology, Firenze, Italy. Contact: ESTRO Secretariat, U.Z., St. Rafael, Department of Radiotherapy, Capucijnenvoer 35, 3000 Leuven, Belgium.

Upcoming Meetings (continued)

November 3-8, 1991

American Society of Therapeutic Radiology and Oncology, Fontainebleau Hilton, Sheraton Washington, Washington, D.C. Contact: American Society for Therapeutic Radiology and Oncology, 1101 Market Street, 14th Floor, Philadelphia, PA 19107-2990 (215) 574-3180.

November 10-15, 1991

Winter Meeting of the American Nuclear Society, San Francisco, CA. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

November 17-20, 1991

15th Symposium on Computer Applications in Medical Care, Sheraton-Washington Hotel, Washington, D.C. Contact: The George Washington University Medical Center, Office of Continuing Education, 2300 K Street, N.W., Washington, D.C., 20037.

December 1-6, 1991

Joint Meeting AAPM and Radiation Society of North America, Chicago, IL. Contact: AAPM Executive Officer, 335 East 45th Street, New York, NY 10017.

April 26-May 1, 1992

6th International Symposium on Hyperthermic Oncology, Tucson, AZ. Contact: Ms. Meg Keiser, Radiation Research Society, 1101 Market Street, 14th Floor, Philadelphia, PA 19107 (215) 574-3153.

May 18-20, 1992

Radiology 92, 50th Annual Congress of the British Institute of Radiology, Birmingham, United Kingdom. Contact: Programme Office, The British Institute of Radiology, 36 Portland Place, London W1N 4AT, United Kingdom (01-580-4085).

June 7-12, 1992

Annual Meeting of the American Nuclear Society, Boston, MA. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

Upcoming Meetings (continued)

August 23-27, 1992

Joint Meeting of American Assoc. of Physicists in Medicine, 34th Annual Meeting with the Division of Medical and Biological Physics of the Canadian Assoc. of Physicists, Calgary, Alberta, Canada. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9-404.

September 1-4, 1992

11th Annual Meeting of the European Society for Therapeutic Radiology and Oncology, Malmo, Sweden. Contact: ESTRO Secretariat, U.Z. St. Rafael, Department of Radiotherapy, Capucijnenvoer 35, 3000 Leuven, Belgium.

September 13-17, 1992

American College of Radiology, Phoenixian Hotel, Phoenix, AZ. Contact: American College of Radiology, 1891 Preston Drive, Reston, VA 2201 (703-648-8900).

November 8-11, 1992

16th Symposium on Computer Applications in Medical Care, Baltimore Convention Center, Baltimore, MD. Contact: The George Washington University Medical Center, Office of Continuing Education, 2300 K Street, N.W., Washington, D.C. 20037.

November 8-13, 1992

American Society for Therapeutic Radiology and Oncology, San Diego Convention Center, San Diego, CA. Contact: American Society for Therapeutic Radiology and Oncology, 1101 Market Street, 14th Floor, Philadelphia, PA 19107-2990 (215) 574-3180.

November 15-20, 1992

International Meeting of the American Nuclear Society, Washington, D.C. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60625.

November 29-4 Dec, 1992

Joint Meeting AAPM and Radiation Society of North America, Chicago, IL. Contact: AAPM Executive Officer, 335 East 45th Street, New York, NY 10017.

Upcoming Meetings (continued)

June 6-11, 1993

Annual Meeting of the American Nuclear Society, Las Vegas, NV. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

August 8-12, 1993

35th Annual Meeting of the American Association of Physicists in Medicine, Washington, D.C. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

November 14-19, 1993

12th Annual Meeting of the European Society for Therapeutic Radiology and Oncology, Israel. Contact: ESTRO Secretariat, U.Z. St. Rafael, Department of Radiotherapy, Capucijnenvoer 35, 3000 Leuven, Belgium.

November 14-19, 1993

Winter Meeting of the American Nuclear Society, San Francisco, CA. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

Nov 28-December 3, 1993

Joint Meeting of AAPM with the Radiological Society of North America, Chicago, IL. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

June 19-24, 1994

Annual Meeting of the American Nuclear Society, New Orleans, LA. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

July 23-28, 1994

36th Annual Meeting of the American Association of Physicists in Medicine, Anaheim, CA. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

Upcoming Meetings (continued)

November 13-18, 1994

Winter Meeting of American Nuclear Society, Washington, D.C. Contact: Meetings Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60625.

Nov 27 - December 2, 1994

Joint Meeting of AAPM with the Radiological Society of North America, Chicago, IL. Contact: AAPM, 335 East 45th Street, New York, NY 10017 (212) 661-9404.

June 11-16, 1995

Annual Meeting of the American Nuclear Society, Atlantic City, NJ. Contact: Meeting Department, American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525.

Oct 29-November 3, 1995

Winter Meeting of the American Nuclear Society, San Francisco, CA. Contact: Meeting Department, American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60525.

END

DATE FILMED

02 / 08 / 91