B-D BECTON-DICKINSON

Route 7 and Grace Way, North Canaan, Connecticut 06018 / (203) 824-5487 / Division of Becton, Dickinson and Company

March 5, 1985

RECEIVED
'85 MAR 28 A10:24
U.S.N.R.C.
LIC. FEE MGMT. BRANCH

U.S. Nuclear Regulatory Commission, Region I
Nuclear Material Section B
631 Park Avenue
King of Prussia, Pa. 19406

Dear Sir:

We are upgrading our safety systems and controls per the attached A.E.C.L. order acknowledgement. We expect this upgrade to be completed mid-March or April. As soon as this is completed we will make an amendment to this license.

Thankyou.

Sincerely,

William R. Case
Sterilization Supervisor
Canaan Facility

WRC/sac

8511190109 850911
REG1 LIC30
06-13514-01 PDR

SHIP TO	SHIP VIA	ORDER DATE
BECTON - DICKINSON COMPANY LIMITED ROUTE NO. 7 GRACE WAY CANAAN, CONNECTICUT 06018 U.S.A.	TRUCK TRANSPORT - PREPAID	85 JAN. 10
		OUR ORDER NO. PS 56155
SOLD TO	TERMS	REQ. SHIP. DATE
BECTON - DICKINSON COMPANY LIMITED ROUTE NO. 7 GRACE WAY CANAAN, CONNECTICUT 06018 U.S.A. ATTENTION: ACCOUNTS PAYABLE	NET 30 DAYS F.O.B. KANATA, ONTARIO, CANADA	SEE NOTES
		EST. SHIP. DATE 85 MAR. 20
CUSTOMER ORDER NO. & DATE	A.E.C.L. QUOTATION	
60071 VERBAL 1985 JANUARY 08	84-IPQ-257	

ITEM	DESCRIPTION - CAT. NO.	QTY. ORD.	QTY. SHIP	UNIT PRICE	AMOUNT
	IR - 21				
1	ONE RELAY PANEL ASSEMBLY ENCLOSED IN HAMMOND CABINET COMPLETE WITH INTERNAL WIRING, OMRON RELAYS, 7 TIME DELAY RELAYS & 14 WARNING OR FAULT INDICATOR LIGHTS. (REF. DRWG. NO. B120007-174/175)	1		4990.00	4990.00
2	FOUR DL 2 MONITORS IN 2 ASSEMBLIES AS PER (DRWG B120007-014)	2		1540.00	3080.00
3	PRODUCT BARRIER DOOR INTERLOCK INCL:				
	A) TIME-DELAY RELAY CAT. #3R210034	1		128.00	128.00
	B) MICRO SWITCHES CAT. #3S041552	2		11.00	22.00
4	SMOKE DETECTOR PYROTRONICS CA-4 #B120007-186	1		895.00	895.00
5	HIGH TEMPERATURE DETECTOR ASSEMBLY #B120007-185	2		30.00	60.00
	SPARE THERMOSTAT FOR ITEM #5 CAT. #3T029157	1		20.00	20.00
7	BEACON LIGHT CAT. #3L032018	1		152.00	152.00
8	EAGLE SIGNAL TIMER C X 32A601 CAT. #3T037116	1		400.00	400.00
9	INSTALLATION (CONCURRENT WITH NEXT COBALT SOURCE REPLENISHMENT)	1		1530.00	1530.00
	NOTE: IF THE INSTALLATION OF ITEMS 1 TO 8 CANNOT BE PERFORMED AT THE SAME TIME AS A SOURCE LOADING, AN ADDITIONAL CHARGE OF $1,830.00 WILL BE INCURRED TO COVER THE EXTRA COST OF TRAVEL TIME & AIRFARE FOR ONE (1) TECHNICIAN.				

ACKNOWLEDGEMENT

STATE, FEDERAL OR PROVINCIAL TAXES & DUTIES ARE NOT INCLUDED UNLESS NOTED.
ALWAYS REFER TO OUR P.S. NUMBER WHEN MAKING ENQUIRIES.

FUNDS TOTAL

THIS IS OUR **ACKNOWLEDGEMENT** OF YOUR ORDER

PLEASE REVIEW CAREFULLY AND ADVISE AT ONCE IF THERE ARE ERRORS OR OMISSIONS.

FOR TERMS AND CONDITIONS SEE REVERSE SIDE

Atomic Energy of Canada Limited
Commercial Products

P.O. BOX 6300, POSTAL STATION J,
OTTAWA, CANADA K2A 3W3
CABLE 'NEMOTA' TELEX 053-4162
TELEPHONE (613) 592-2790

ISSUED ON BEHALF
OF A.E.C.L. _____

SHIP TO
BECTON - DICKINSON COMPANY LIMITED
ROUTE NO. 7
GRACE WAY
CANAAN, CONNECTICUT 06018
U.S.A.

SHIP VIA
TRUCK TRANSPORT - PREPAID

ORDER DATE
85 JAN. 10

OUR ORDER NO.
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CABLE 'NEMOTA' TELEX 053-4162
TELEPHONE (613) 592-2790

ISSUED ON BEHALF
OF A.E.C.L. _____

ITEM 7

Following are designated "Responsible Individuals"

Kenneth Barker
James R. Blanquart
Shelley Bunce
William R. Case
Donald Coons
Adrian L. Costa
Ronald Love

ATOMIC ENERGY OF CANADA LIMITED

RADIOCHEMICAL COMPANY

Awards this certificate

to

Kenneth F. Barker

for

Successful Completion of AECL-RCC

Radiation Protection Course for Industrial Irradiators

Yves L. Doyle
Instructor

February 1, 1985
Date

AECL *Industrial Irradiators*

Atomic Energy
Of Canada Limited

Radiochemical Company

413 March Road,
P.O. Box 13500
Kanata, Ontario,
Canada,
K2K 1X8

L'Énergie Atomique
du Canada, Limitée

Société radiochimique

413 Chemin March,
C.P. 13500
Kanata, Ontario,
Canada,
K2K 1X8

Tel. (613) 592-2790
Telex 053-4162

1985 February 22

File: F92108

Mr. Kenneth F. Barker
Becton Dickinson
Route 7 and Graceway
Canaan, Connecticut
U.S.A. 06018

Dear Mr. Barker

Following the AECL-RCC Radiation Protection Course for Industrial Irradiators given at your facility, it is my pleasure to inform you that your results on the final exam were excellent. Actually, your score was 91 out of 100.

In recognition of your active participation and excellent performance, you will find enclosed a Certificate of Successful Completion.

It was a pleasure to have you in my class and I hope to see you again soon.

If you have any questions regarding radiation, please do not hesitate to call.

Sincerely,

Yves L. Doyle

Y. Doyle,
Senior Radiation Physicist
Industrial Irradiation Division

/cpg
Encl.

cc: Mr. Bill Case

ITEM 7

AECL-RCC

RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

DRAFT

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SESSION #1 WELCOME ADDRESS (1/2 hour)

WELCOME
HISTORY OF NUCLEAR PHYSICS

SESSION #2 BASIC MATHEMATICS (1 hour)

USEFUL MATHEMATICS FOR CALCULATIONS AND MEASUREMENTS OF RADIOACTIVITY
GRAPH OF FUNCTIONS
SCIENTIFIC NOTATION
COUNTING STATISTICS

SESSION #3 THE ATOM (1/2 hour)

STRUCTURE OF THE ATOM
ISOTOPES AND NUCLIDES

RADIOACTIVITY (1/2 hour)

NATURALLY OCCURRING RADIOACTIVITY,
PRODUCTION OF RADIONUCLIDES
RADIOACTIVE DECAY
NUCLEAR FISSION
NUCLEAR FUSION
NUCLEAR REACTORS
ANEUTRONIC FISSION

AECL-RCC

RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

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SESSION #4 RADIOACTIVE DECAY (1/2 hour)

- ALPHA PARTICLES
- BETA PARTICLES
- GAMMA RADIATION
- NEUTRONS
- HALF LIFE

SESSION #5 RADIATION QUANTITIES AND UNITS (1 hour)

- ACTIVITY - CURIE
- SPECIFIC ACTIVITY
- EXPOSURE - ROENTGEN
- ABSORBED DOSE - RAD
- DOSE EQUIVALENT - REM
- QUALITY FACTOR

SESSION #6 INTERACTION OF RADIATION WITH MATTER (1/2 hour)

- IONIZING RADIATION
- GAMMA RAYS
- X-RAYS
- PHOTOELECTRIC EFFECT
- COMPTON SCATTERING
- PAIR PRODUCTION

SESSION #7 BIOLOGICAL EFFECTS OF RADIATION, LOW DOSES (1 hour)

- A.L.A.R.A.
- GENETIC EFFECTS
- MUTATIONS
- THE PERCEPTION OF RISK
- CAUSED INCIDENCE
- LINEAR DOSE EFFECT THEORY
- THRESHOLD DOSE EFFECT THEORY

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SESSION #8 BIOLOGICAL EFFECTS OF RADIATION HIGH DOSES (1 hour)

- EFFECT OF RADIATION ON CELLS
- SOMATIC EFFECTS
- RADIOSENSITIVITY OF VARIOUS ORGANS
- ACUTE EXPOSURE
- EXTERNAL EXPOSURE
- EXTERNAL RADIATION
- INTERNAL RADIATION

SESSION #9 NATURAL BACKGROUND RADIATION (1/2 hour)

- COSMIC RADIATION
- RADIATION FROM NATURALLY OCCURRING RADIOACTIVITY (TERRESTRIAL, FOOD, AIR, WATER)

RADIATION FROM MAN-MADE SOURCES (1/4 hour)

- OCCUPATIONAL EXPOSURE
- MEDICAL EXPOSURE

DOSE LIMITS (1/2 hour)

- MAXIMUM PERMISSIBLE DOSE FOR RADIATION WORKERS
- DOSE LIMITS FOR POPULATIONS

SESSION #10 EXERCISES AND REVIEW (2 hours)

1. DEFINITIONS
2. HALF-LIFE
3. INVERSE SQUARE LAW CALCULATIONS
4. CALCULATE NATURAL BACKGROUND DOSE
5. DOSE LIMITS

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SESSION #11 RADIATION SHIELDING (2 hours)

- TRANSMISSION CURVES
- RELATIVE EFFECTIVENESS OF DIFFERENT MATERIALS
- HALF VALUE LAYERS
- TENTH VALUE LAYERS
- TIME
- DISTANCE
- MASS ATTENUATION COEFFICIENTS
- ENERGY ATTENUATION COEFFICIENTS
- BUILDUP FACTORS

SESSION #12 USNRC REGULATIONS (4 hours)

- TITLE 10, CHAPTER 1, CFR PART 19
- TITLE 10, CHAPTER 1, CFR PART 20
- TITLE 10, CHAPTER 1, CFR PART 21
- REGULATORY GUIDE 10.9
- CALIBRATION OF SURVEY METERS NRC GUIDELINE
- WIPE TEST
- WASTE DISPOSAL
- TRANSPORTATION

SESSION #13 ADMINISTRATIVE CONTROLS (2 hours)

- RECORD KEEPING
- NOTIFICATIONS OF INCIDENTS

SESSION #14 EMERGENCY PROCEDURES (2 hours)

- OVEREXPOSURE
- FAILURE OF SOURCE TO RETURN TO SAFE POSITION
- DAMAGE TO SOURCE PENCILS
- FIRE
- REPORT OF EXPOSURE
- LOW WATER
- CONTAMINATION

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MEASUREMENTS OF RADIATION

SESSION #15 TYPE OF INSTRUMENTS

- ION CHAMBER
- GEIGER
- PROPORTIONAL COUNTER
- SCINTILLATION DETECTOR
- FILM
- TLD
- POCKET DOSIMETERS
- L-118 (AECL)
- DL-2 (AECL)

SESSION #16 CALIBRATION OF INSTRUMENTS (1 hour)

- OUTSIDE SOURCE
- INSIDE
- REQUIREMENT

SESSION #17 OPERATION OF INSTRUMENTS/INSTRUMENT LIMITATIONS (1 hour)

- SATURATION
- LOWER DETECTABLE LIMIT
- RESPONSE TIME
- RANGE OF DETECTION

SESSION #18 SURVEY TECHNIQUES (2 hours)

- IRRADIATOR SURVEY
- CONTAMINATION
- WATER SAMPLING
- AIR SAMPLING

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FOR INDUSTRIAL IRRADIATORS

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SESSION #19 USE OF PERSONAL MONITORING EQUIPMENT (1-1/2 hours)

ACTUAL MEASUREMENTS BY STUDENTS
QUESTIONS AND ANSWERS

SESSION #20 EXERCISES AND REVIEW ON (2 hours)

REGULATIONS
ADMINISTRATIVE CONTROLS
EMERGENCY PROCEDURES
SHIELDING

SESSION #21 IRRADIATOR DESIGN (1 hour)

DESIGN PRINCIPLES
DIFFERENT TYPE OR IRRADIATOR

SESSION #22 IRRADIATOR SAFETY SYSTEM (1 hour)

REVIEW OF ALL SAFETY INTERLOCKS
OPERATION OF SAFETY INTERLOCKS
SHIELD INTEGRITY
CONTINUOUS MONITORING

SESSION #23 COBALT-60 FROM THE GROUND UP (1 hour)

THE MANUFACTURING OF COBALT-60 SOURCE
REVIEW OF DIFFERENT PRODUCTION STAGES AND EMPHASIS ON PRECAUTIONS AND TESTING TO ENSURE SEALED SOURCES INTEGRITY.
TRANSPORTATION OF COBALT-60
CERENKOV RADIATION
PHOTO ACTIVATION IMPOSSIBLE
OZONE PRODUCTION

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RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

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SESSION #24 RADIATION STERILIZATION (1 hour)

- EFFECT OF RADIATION ON MICRO-ORGANISMS
- REVIEW OF GOOD MANUFACTURING PRACTICES USING AAMI PROCESS CONTROL GUIDELINES

SESSION #25 DOSIMETRY FOR IRRADIATOR (1 hour)

- REVIEW OF DIFFERENT DOSIMETER TYPES
- WHICH DOSIMETER TO USE AND WHEN
- DOSIMETER PLACEMENT
- DOSIMETER READING
- DOSIMETRY REPORT

SESSION #26 EXERCISES AND REVIEW (2 hours)

- SHIELDING CALCULATION
- TIME FOR LETHAL DOSE NEAR LARGE SOURCE
- DOSE NEAR SMALL CALIBRATION SOURCE

SESSION #27 QUESTION PERIOD (1 hour)

SESSION #28 EXAM (3 hours)

SESSION #29 REVIEW EXAM (2 hours)
QUESTION PERIOD

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: KENNETH BARKER JOB TITLE: STERILIZATION OPERATOR

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
REQUIRED READING:			
1 RADIATION SAFETY TECHNICIAN TRAINING COURSE		03572	
1.a. BASIC INFORMATION PAGES 21-28			2-21-86
1.b. PROPERTIES OF ALPHA, BETA, GAMMA X-RAYS & NEUTRONS PAGES 50-75			
1.c. CONCEPTS OF RADIATION UNITS AND DOSE DETERMINATIONS PAGES 78-108			
1.d. SHIELDING PAGES 115-127			10-25-84
1.e. BIOLOGICAL EFFECTS OF RADIATION PAGES 133-145			
1.f. BACKGROUND RADIATION PAGES 150-159			
1.g. RADIATION PROTECTION STANDARD PAGES 162-169			10-29-84
1.h. RADIATION DETECTION PRINCIPLES PAGES 207-231			
1.i. HEALTH PHYSICS INSTRUMENTS PAGES 269-305			
1.j. PERSONNEL MONITORING DEVICES PAGES 315-341			11-8-84
2 MANUFACTURER' OPERATING MANUAL			11-19-84
3 STUDY THE INSTALLATION BLUEPRINTS			12-7-84
4 TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS - PARTS 19, 20			
5 HIMA REPORT NO. 78-4.8 TITLED "OPERATOR TRAINING FOR RADIATION STERILIZATION EQUIPMENT".			1-14-85
6 SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL			
7 STUDY THE IN-HOUSE SPECIFICATIONS THAT RELATE TO THE OPERATION OF THE STERILIZER			
8 STUDY PAST MAINTENANCE RECORDS			2-13-85
			2-13-85

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: KENNETH BARKER JOB TITLE: STERILIZER OPERATOR

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY	COBALT OFFICE	R. CROOK + W.R. CASE	6/22/84 60 MINS.
II MONITORS	COBALT OFFICE	W. R. CASE	7/11/84
1. RATEMETER — ALSO DISCUSSED ROENTGEN, REM, RAD + MILLIREM WRC			1 1/2 HRS
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b SCALE READING			
C. CALIBRATION PROCEDURES			
III CONTROL CONSOLE	COBALT OFFICE	W.R. CASE	8/8/84 75 MINS
1 KEY SWITCHES (4)			
a. PURPOSE			
2. PILOT LIGHTS	Cobalt Office	W. R. Case	8/15/84 1 1/2 HRS.
a. DESCRIPTION			
b. PURPOSE			
3. RELAYS	COBALT OFFICE	W. R. CASE	8/22/84 1 1/2 hrs.
IV OPERATOR SAFETY			
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: KEN BARKER JOB TITLE: STERILIZER OPERATOR

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS (CONT.)	COBALT OFFICE	W.R. Carr	8/22/84 1½ hrs.
VI EMERGENCY & SAFETY DEVICES 1. EMERGENCY STOP CONTROLS 2. POWER FAILURE 3. MAZE DOOR INTERLOCK 4. SOURCE STORAGE RACK 5. SOURCE RACK GUIDE CABLE 6. TEMPERATURE SENSING DEVICE 7. CONVEYING SYSTEM 8. POOL WATER LEVEL SWITCH (2) 9. SOURCE HOIST 10. SOURCE ALARM 11. AIR PRESSURE 12. START UP SAFETY DELAY TIMER 13. SOURCE INTERLOCK			
VII NORMAL START-UP PROCEDURE	Cobalt office	W.R Carr	8/29/84 1½ hrs.
VIII NORMAL SHUTDOWN PROCEDURE			
IX CONTAMINATION DETECTION 1. OZONE a. DETECTION b. MEASUREMENT c. TIME-DELAY			
2. LEAK TEST OF SOURCE	Cobalt Room Actual Source wiper test	W.R. Carr J. Blanquart	9/26/84 1½ hrs.
3. LEAK TEST OF CALIBRATION SOURCE			
4. EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION ACCIDENT			
5. DECONTAMINATION PROCEDURE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: KEN BARKER JOB TITLE: STERILIZER OPERATOR

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
X CELL EXHAUST SYSTEM 1. PROCEDURE FOR CHANGING FILTER	Cobalt office	W.R. Cann	11/7/84 1.0 HRS.
XI CHILLER 1. PURPOSE 2. CORRECT SETTING	COBALT OFFICE	W.R. Cann	10/10/84 45 MINS
XII DEIONIZER 1. PH OF WATER 2. PROCEDURE FOR CHANGING RESIN SACKS 3. CONDUCTIVITY METER	Cobalt Equipment Room	W.R. Cann	9/12/84 1.0 HRS.
XIII EMERGENCY CONDITION 1. PERSONNEL IN MAZE AT START-UP 2. MONITOR ALARM SIGNALS 3. MOMENTARY POWER FAILURE 4. PROLONGED POWER FAILURE 5. SAFETY PILOT ILLUMINATION 6. INTERAL CONVEYOR PILOT ILLUMINATION 7. AIR PRESSURE LIGHT ILLUMINATION 8. BOX ON CONVEYOR PILOT LIGHT 9. SOURCE RACK PILOT LIGHT ILLUMINATION 10. ONLY ONE SOURCE UP PILOT LIGHT ILLUMINATION	Cobalt office	W.R. Cann	9/19/84 1.5 HRS.
XIV MAINTENANCE 1. CHECKLIST	Cobalt office	W.K Cann	1.3 HRS. 11/14/84
XV ADMINISTRATIVE PROCEDURES XVI CLEARLY UNDERSTAND THE PERSONS TO CONTACT WHENEVER THERE IS ANY TROUBLE WITH THE MECHANICAL OPERATION OF THE STERILIZER	COBANT OFFICE	W. R Cann	11/20/84 1.3 HRS.

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: KEN BARKER JOB TITLE: STERILIZER OPERATOR

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
1. ATTEND A PERTINENT COURSE AT/FROM AN INSTITUTION	B-D CANADA	ATOMIC ENERGY OF CANADA LIMITED YVES L. DOYLE	2/1/85
2. WORK A MINIMUM OF FOUR (4) WEEKS AS AN OPERATOR TRAINEE	B-D CANADA	8-22-84 TO PRESENT	
3. DEMONSTRATE OPERATING PROFICIENCY	B-D CANADA	W.R. CASE	3/13/85

Ken Barker - 3/13/85 - 1:50 PM

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I. Carrier jam, stop safe, high temperature, low air pressure, source rack, cell door interlock, emergency buttons pushed.

II. Stop Safe - external conveyor - monorail inop.

Internal Conveyor - cylinder not making a switch
cylinder malfunction

Low Air - compressor down

High Temp - possible source jam
- exhaust inop.

Source Rack - didn't make the switch

III.

1. Pointed out meter - for an alarm condition. Meter is set at 80% for alarm.

   a. Behind the console .

   b. Had to show Ken location of monitor and how to adjust.

   c. In the chamber on the wall up high in maze.

   d. Induce an alarm into it w/monitor test.

2. Induce an alarm so you can get in which test the ratemeter circuits.

3. Ensures circuits are functioning.

4. After you induce an alarm it stays lit, (Memory), until it resets. Alarm lights and goes off.

   a. No

   b. Close the place up. Call the proper personnel on the Notification of Accident listing; Bill Case, R. Crook, A. Rowjohn, A.E.C.L..

   Question: What is the alarm telling you?

   Ken's reply - Monitoring the amount of radiation.

5. That's telling you that the machine is ready to start - 90 seconds of time has not timed out.

   Question: Does the door have to be closed before machine ready light is lit?

   Reply: Yes, if 90 seconds light exceeds 90 seconds machine light will not be on.

6. Monorail is over in front of the internal conveyor, position #1.

7. Resetting the monitor - not acceptable. I then simulated a power failure. He took the key out of the machine, (turning it off first), then inserted the key into the power switch and reset. Acceptable.

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III. (con't)

8. Pointed out cycle timer - the amount of time you set is for the type of product you are processing.

9. Pointed out to it on console - usually set 1 minute longer than cycle timer. Source will go down if time exceeds the overdose timer.

10. Pointed to light on console - it indicates exhaust system is working.

Question: If light is out?

Reply - Exhaust system is not working.

11. Pointed to light - indicates water pump is recycling.

Question: Is it a split pilot light?

Reply - Yes.

Question: If pilot light is lit what does it mean?

Reply - Resin sags have to be changed.

12. Pointed to light - indicates water level is up to the proper level of the pool.

There are two floats - one for water level and the other for lower water level. Explained to Ken that the second water level float when below the water level set for, will sound audio and visual alarm and the door lock would be prevented from opening.

IV. Radiation Safety Officer, R. Crook, Andy Rowjohn, A.E.C.L.. Pointed out notification of incident list.

V. 1. Person with the geiger counter.

2. Person with the geiger counter.

VI. 1. Pointed out the split pilot light/source up light.

Pointed out the source down pilot light for stored position.

2. Indicates making both switches on both sides of the pilot.

3. That it's in movement between either one - transit. Possibly something wrong with the switch.

4. Source up - located on each side rack - on frame so when source rack comes up it makes the source up switch on the frame.

Source down switch is located on hoist.

VI. 5. If the bulbs were not burned out, source rack is stuck.

a. Notify Bill Case per the Notification of Incident and others listed.

VII. Door interlock system.

Question: If they try to open door?

Reply - Source would go down.

VIII. Grab the cable (safety cable).

IX. Pushed monitor test button.
Made the proper shutdown entry in logbook.
Placed meter under check source.
Inserted key into switch and opened door.
Removed chanin from across aisle.
Activated safety delay timer.
Inserted key switch to "on" then to "start".
Unit now operating.

We the undersigned agree that the Oral Exam was completed satisfactorily.

Test was administered by
Radiation Safety Officer
W. R. Case

W R Case

Test was witnessed by
R. G. Crook
Manager of Microbiological and
Sterilization Services

3/15/85

ITEM 7

NAME: JAMES R. BLANQUART

TRAINING

1. Satisfactorily completed a five-day course in Basic Health Physics at Louisiana State University.

   Attached -- Course outline and a certificate of completion.

2. Completed in-house training as listed below:

   I. Familiarization tour of Facility

   II. Monitors

      1. Ratemeter

         a. Its purpose
         b. Location of Monitor
         c. Location of Sensor
         d. Check for proper functioning.

      2. Berthold Meter and Eberline Geiger Counter

         a. Its purpose
         b. Scale Reading
         c. Calibration procedures

   Items I and II 2 hour session completed 8/25/82.

   III. Control Console

      1. Key Switches (4)

         a. Purpose

      2. Pilot Lights

         a. Description
         b. Purpose

      3. Relays

   IV. Operator Safety

      1. Key attached to Berthold Meter or Eberline Geiger Counter

      2. Check Source

   Items III and IV 1.5 hour session completed 9-1-82

V. Pneumatic Cylinders

1. Sequence of Operation

2. Maintenance

VI. Emergency and Safety Devices

1. Emergency Stop Controls

2. Power Failure

3. Maze Door Interlock

4. Source Storage Rack

5. Source Rack Guide Cable

6. Temperature Sensing Device

7. Conveying System

8. a. Pool Water Level Switch
   b. Second Pool Water Level Switch

9. Source Hoist

10. Source Alarm

11. Air Pressure

12. Start-up Safety Delay Timer

13. Source Interlock

Items V and VI 1.0 hour session completed 9-17-82

VII. Normal Start-up Procedure

VIII. Normal Shut-down Procedure

Items VII and VIII 1.0 hour session completed 9-22-82

IX. Contamination Detection

1. Ozone

   a. Detection
   b. Measurement
   c. Time-delay

2. Leak Test of Source

3. Leak Test of Calibration Source

IX. (continued)

4. Emergency action following a suspected ra' 'ation accident

5. Decontamination Procedure

2.3 hour session completed on 10-14-82 and 11-10-82

X. Cell Exhaust System

1. Procedure for Changing Filter

XI. Chiller

1. Purpose

2. Correct Setting

XII. Deionizer

1. PH of Water

2. Procedure for Changing Resin Sacks

Items X, XI, and XII 1.0 hour session completed 11-5-82

XIII. Emergency Condition

1. Personnel in maze at start-up

2. Monitor Alarm Signals

3. Momentary power failure

4. Prolonged power failure

5. Safety pilot illumination

6. Internal conveyor pilot illumination

7. Air pressure light illumination

8. Box on conveyor pilot light extinguisher

9. Source rack pilot light illumination

10. Only one source-up pilot light illumination

XIV. Maintenance

1. Checklist

XV. Administrative Procedures

Items XIII, XIV, and XV 1.0 hour session completed 11-10-82

Required Reading

1. Radiation Safety Technician Training Course

   Section 1 -- Basic Information

   Section 3 -- Properties of Alpha, Beta, Gamma, X-Rays and Neutrons

   (Sections 1 and 3 completed Oct. 9, 1982)

   Section 4 -- Concepts of Radiation Units and Dose Determination

   Section 5 -- Shielding

   (Sections 4 and 5 completed Oct. 14, 1982)

   Section 6 -- Biological Effects of Radiation

   Section 7 -- Background Radiation

   Section 8 -- Radiation Protection Standards

   (Sections 6, 7, and 8 completed Oct. 19, 1982)

   Section 9 -- Internal Dose Calculation

   Section 10 - Radiation Detection Principles

   (Sections 9 and 10 completed Oct. 24, 1982)

   Section 11 - Instrument Operating Characteristics and Counting Statistics (completed Oct. 26, 1982)

   Section 12 -- Health Physics

   Section 13 -- Personnel Monitoring Devices

   (Sections 12 and 13 completed Oct. 30, 1982)

2. Manufacturers Manual

   (Reading completed 9-6-83)

3. Study Installation Blueprints

   (Completed 8-9-83)

4. Title 10 -- Energy Code of Federal Regulations. Part 19, 20, & 21

   (Reading completed 11-1-83)

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5. Hima Report No. 78-48 entitled "Operator Training for Radiation Sterilization Equipment)

   (Reading completed 8-24-83)

6. Section 6 -- Corporate Quality Assurance Manual

   (Completed 5-10-83)

7. Study in-house specifications that relate to the operation of the unit.

   (Completed 7-8-83)

The
Division of Continuing Education
of
Louisiana State University
and Agricultural and Mechanical College

Certifies that

JAMES R. BLANQUART

has completed in a satisfactory manner

BASIC HEALTH PHYSICS

Granted on this 14 day of MAY 19 82.

John C Courtney
Instructor

Fitz A. McCarthen
Dean, Division of Continuing Education

NAME: JAMES R. BLANQUART

DATE OF BIRTH: 5-08-53

EDUCATION: High School

JOB TITLE: Sterilization Technician

DUTIES:

GENERAL FUNCTION: Under the general supervision of the Sterilization Supervisor, performs technical duties in the radiation and ethylene oxide sterilization of products, utilizing various laboratory, monitoring, and recording devices and in accordance with established procedures and regulations. Monitors and gathers data on the sterilization process and provides ready availability of materials and supplies used by the Sterilization Department.

PRIMARY DUTIES: ^{60}Cobalt Radiation Facility

1. Operate and adjust radiation equipment including all necessary material handling.

2. Be familiar and to remain current and practice all procedures, regulations and policies concerning radiation safety as established by Plant, Corporate, and Governmental Regulatory Agencies.

3. To perform routine maintenance on equipment and to closely supervise work done by outside maintenance. Must be familiar with proper use of hand tools such as wrenches, electric drills, torches, and soldering irons.

4. Be proficient in operation and maintenance of all types of radiation tests and detection equipment such as dosimeters, survey meters, etc. -- includes calibration.

5. Assist in various projects concerning radiation sterilization including experimental and engineering studies.

6. To run routine safety and operational checks on the facility and to oversee the compliance with mandatory safety requirements by visitors and non-departmental personnel.

7. To record pertinent data and file records, logs, and Lot Disposition Records.

PRIMARY DUTIES (continued)

8. Instrument calibrations to NRC standards for other B-D facilities. Maintain records.

9. Requisition supplies and parts to maintain the facility. Keep inventory of critical parts.

NAME: JAMES R. BLANQUART

EXPERIENCE

1. 8 months on-the-job training on AECL type IR 21 irradiation at Becton, Dickinson & Company, Canaan, Connecticut.

2. Calibration of Berthold Rato/F and Eberline instruments. 4-29-83

3. Performed leak test on cobalt 60 source and Tech-ops calibration unit, Model To/571. 11-10-82

03572

Nuclear Science Center
LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE
BATON ROUGE · LOUISIANA · 70803
504/388-2163

September 29, 1982

Mr. William Case
Becton-Dickinson
Rt. 7, Graceway Road
Canaan, CT 06018

Dear Mr. Case:

The LSU Nuclear Science Center will offer a five-day course in basic health physics in Baton Rouge beginning on December 13, 1982. The registration fee of $425 includes all the required notes and materials.

The objective of this short course is to present the basic principles of radiation safety to engineers, scientists, managers, and other technical personnel. An educational background equivalent to a BS degree in science or engineering or a high school diploma and several years' experience in a technical area should be sufficient. The use of advanced mathematics will be minimized since the emphasis will be on solutions to practical problems.

All sessions will be conducted in the Nuclear Science Center on the Louisiana State University campus at Baton Rouge, Louisiana, 8:30 a.m. to 5:00 p.m., Monday through Friday. To provide maximum effectiveness in instruction, the class size is restricted to 20 students. Quotas will be filled on a first-come first-serve basis.

Rooms are available in LSU's Pleasant Hall which is reserved for persons attending education conferences, short courses, and similar meetings on the campus. The building is completely air conditioned, and rooms are reasonably priced.

Additional information may be obtained by contacting Dr. W. F. Curry or me at the letterhead address or telephone number. Please write or telephone as soon as possible if you would like to attend.

Sincerely,

John C Courtney

John C. Courtney
Professor of Nuclear Engineering
Certified Health Physicist

Basic Course in Health Physics
LSU Nuclear Science Center

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:30 - 9:30	Registration & Introduction	Dosimetry Units	Radiation Protection Guides	Basic Radiation Shielding	Sources of Information
9:40 - 10:30	Structure of Matter	Biological Effects of Radiation	Licensing and Regulation	Basic Radiation Shielding	Emergency Procedures
10:40 - 11:30	Properties of Radiation	Biological Effects of Radiation	Licensing and Regulation	Facility Design	Decontamination Techniques
11:30 - 1:00	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
1:10 - 2:00	Radiation Interactions	Environmental Monitoring	Respiratory Protection	Transportation of Radioactive Material	Individual Problems and Special Topics
2:10 - 3:00	Radiation Interactions	Biological Effects of Radiation	Survey Instruments	Personnel Monitoring	
3:10 - 4:00	Radiation Measurement	Radiation Sources	Laboratory Exercise	Internal Sources	
4:10 - 5:00	Radiation Measurement	Laboratory Measurement Systems	Radiation Measurement	Health Physics Exercise	

OPERATOR TRAINING PROGRAM

Test Questions

NAME: JAMES R. BLANQUART

OBJECTIVE:

An oral test to determine whether or not a trainee has sufficient knowledge to operate the irradiator in an efficient and safe manner. The Operator should have a knowledge of what sources he should refer to for specific information regarding the operation of the irradiator. Test is to be given by the Radiation Safety Officer and/or the Sterilization Supervisor.

Question - Under what conditions will the unit shut down?

Response - A. High radiation level -- Victoreen sounding

B. Internal conveyor jamming or not completing its cycle within the proper time.

C. Pneumatic cylinder not completing the transition.

D. Power failure

E. Cell door interlock

F. Carrier jam at unload or load side

G. High temperature

H. Loss of air

I. Monorail jam or failure

Question - How do you determine the shutdown?

(Have the trainee point out the pilot lights on the console and explain.)

Response - A. Stop safe -- Cell door interlock/Box jam external conveyor/Power failure/No carrier at "box on" station/Monorail not at "position 1."

B. Internal conveyor -- jam internal conveyor

C. High temperature

D. Low air pressure

E. Source rack -- Both Microswitches not made by source rack.

Question - Have the trainee point out the pilot light on the console.

Explain: Ratemeter

Response - Measures radiation levels inside the cell.

Question - Where is monitor located?

Response - Monitor located behind console.

Question - How is it adjusted?

Response - Two adjustments, ambient and alarm level.

Question - Where is the sensor located?

Response - Jim pointed out sensor location in maze.

Question - How do you check the sensor for proper functioning?

Response - Monitor Test Button -- Alarm condition should exist -- Alarm memory light will light.

Question - Explain "Monitor Test" pilot light.

Response - Sends a signal to ratemater to check that monitor is operating correctly for an alarm condition.

Question - Explain "Monitor Check" pilot light.

Response - Will pulse-checking that the circuits are functioning.

Question - "Alarm/Memory" pilot light.

Response - Split pilot light -- Alarm light will light and memory will illuminate to show that an alarm condition occurred.

Question - If alarm light is lit, can you open maze door?

Response - No.

Question - If an alarm condition exists, what procedure should an operator take?

Response - Check for source rack position/Ratemeter. Check to ensure functionability/ Contact Supervisor.

Question - If Supervisor is not available?

Response - Call R. Crook/Contact those listed on the emergency call list.

Question - Explain "Machine Ready" pilot light.

Response - Machine is set on automatic phase ready to start.

Question - Explain "Position #1" pilot light.

Response - When light is illuminated monorail is ready to receive and discharge.

Question - Explain "Reset" pilot light.

Response - This light will illuminate when power is removed from console. Power failure indicator.

Question - Explain "Cycle Timer."

Response - Determines dose rate.

Question - Explain "Overdose Timer."

Response - Will shut down unit if goes beyond cycle timer setting.

Question - How many more minutes should the overdose timer be set using the cycle timer time as a reference?

Response - One minute greater than cycle timer.

Question - Explain "Exhaust Fan" pilot light.

Response - When illuminated unit is operating. When any problem occurs light will be off.

Question - Explain "Filter Pump" pilot light.

Response - When lit pump is running. When there are any problems light will be off/when pump shuts down for any reason.

Water regeneration pilot light will illuminate when deionizer sacks need changing. To change the sacks you would shut down unit, turn off pump, check deionizer with survey meter, remove caps and check again with survey meter.

Question - Explain "Water Level" pilot light.

Response - Ensures that a safe level of water is in pool when lit. Not lit, you have a low water level. Second float detects a water level lower than the low water level. Will sound alarm.

Question - In case of an emergency or a discovery of any deviation or defect which could possibly present a substantial safety hazard, who is notified?

Response - Call Safety Officer -- explained to Jim at this time that he should reference emergency call list.

Question - Who is the first person to enter the irradiator maze?

Response - Licensed operator with meter.

Question - How do you determine when the source is in the up or stored position? (Have trainee point out the pilot light.)

Response - Pilot on console -- (Pointed to lights) Red pilot light, source is up -- exposed. Green pilot light, source is down -- submerged in pool.

Question - When in the up position, what does the split pilot light indicate?

Response - Both micro-switches are made when source is up -- rack is not tilted or jammed.

Question - When the source up and source down pilot lights are both lit, what does this signify?

Response - Problem with the switches. Determine where the source rack is. Indicated to trainee he should check source rack hoist.

Question - Where are the limit switches located for the source down pilot light and the source up pilot light? (Have trainee point out the limit switches.)

Response - Source down -- in the cell on the frame. Indicated to trainee that the switch is located on source hoist.

Source up -- in the cell on the frame. Trainee pointed out micros on source up. I showed trainee limit switch on source hoist.

Question - If neither the source up or source down pilot light is lit, what does this signify?

Response - Rack could be jammed/Emergency procedure, call Supervisor, if unable to contact, R. Crook, R. Rowjohn, A.E.C.L.

Question - Irradiator is in an operating mode. There is more than one key for the key switches. What is to prevent someone from using the spare key to open the maze door?

Response - Would have to go through the proper steps, monitor test. Cell door interlock would shut down unit.

Question - Jim and John entered the maze. John had the ratemeter, started the safety timer, left the maze and closed the door behind him. Jim was left in maze. What immediate action should Jim take?

Response - Pull on safety cord.

Question - Have trainee start the unit. Observe that he uses all safety procedures.

The following occurred:
Jim reset the Overdose timer/Pushed Monitor Test button/Checked meter against check source/Inserted Key into maze door/Removed chain across maze corridor/Activated the Safety timer/Replaced chain across corridor/Closed door/Activated Machine Key Switch/Set product log chart/Made entry into log. As we walked into irradiator Jim led the way with meter, constantly checked for any radiation level. As we left the irradiator Jim followed us out.

We the undersigned agree that the above questions were answered in a satisfactory manner.

Test was administered by
Radiation Safety Officer
W. R. Case

Test was witnessed by
R. G. Crook
Manager of Microbiological and
Sterilization Services

ATOMIC ENERGY OF CANADA LIMITED

RADIOCHEMICAL COMPANY

Awards this certificate

to

Shelly Rice Bunce

for

Successful Completion of AECL-RCC

Radiation Protection Course for Industrial Irradiators

Lyes L. Doyle
Instructor

February 1, 1985
Date

AECL ***Industrial Irradiators***

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AECL-RCC

RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

DRAFT

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SESSION #1 WELCOME ADDRESS (1/2 hour)

- WELCOME
- HISTORY OF NUCLEAR PHYSICS

SESSION #2 BASIC MATHEMATICS (1 hour)

- USEFUL MATHEMATICS FOR CALCULATIONS AND MEASUREMENTS OF RADIOACTIVITY
- GRAPH OF FUNCTIONS
- SCIENTIFIC NOTATION
- COUNTING STATISTICS

SESSION #3 THE ATOM (1/2 hour)

- STRUCTURE OF THE ATOM
- ISOTOPES AND NUCLIDES

RADIOACTIVITY (1/2 hour)

- NATURALLY OCCURRING RADIOACTIVITY,
- PRODUCTION OF RADIONUCLIDES
- RADIOACTIVE DECAY
- NUCLEAR FISSION
- NUCLEAR FUSION
- NUCLEAR REACTORS
- ANEUTRONIC FISSION

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RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

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SESSION #4 RADIOACTIVE DECAY (1/2 hour)

- ALPHA PARTICLES
- BETA PARTICLES
- GAMMA RADIATION
- NEUTRONS
- HALF LIFE

SESSION #5 RADIATION QUANTITIES AND UNITS (1 hour)

- ACTIVITY - CURIE
- SPECIFIC ACTIVITY
- EXPOSURE - ROENTGEN
- ABSORBED DOSE - RAD
- DOSE EQUIVALENT - REM
- QUALITY FACTOR

SESSION #6 INTERACTION OF RADIATION WITH MATTER (1/2 hour)

- IONIZING RADIATION
- GAMMA RAYS
- X-RAYS
- PHOTOELECTRIC EFFECT
- COMPTON SCATTERING
- PAIR PRODUCTION

SESSION #7 BIOLOGICAL EFFECTS OF RADIATION, LOW DOSES (1 hour)

- A.L.A.R.A.
- GENETIC EFFECTS
- MUTATIONS
- THE PERCEPTION OF RISK
- CAUSED INCIDENCE
- LINEAR DOSE EFFECT THEORY
- THRESHOLD DOSE EFFECT THEORY

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FOR INDUSTRIAL IRRADIATORS

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SESSION #8 BIOLOGICAL EFFECTS OF RADIATION HIGH DOSES (1 hour)

EFFECT OF RADIATION ON CELLS
SOMATIC EFFECTS
RADIOSENSITIVITY OF VARIOUS ORGANS
ACUTE EXPOSURE
EXTERNAL EXPOSURE
EXTERNAL RADIATION
INTERNAL RADIATION

SESSION #9 NATURAL BACKGROUND RADIATION (1/2 hour)

COSMIC RADIATION
RADIATION FROM NATURALLY OCCURRING RADIOACTIVITY (TERRESTRIAL, FOOD, AIR, WATER)

RADIATION FROM MAN-MADE SOURCES (1/4 hour)

OCCUPATIONAL EXPOSURE
MEDICAL EXPOSURE

DOSE LIMITS (1/2 hour)

MAXIMUM PERMISSIBLE DOSE FOR RADIATION WORKERS
DOSE LIMITS FOR POPULATIONS

SESSION #10 EXERCISES AND REVIEW (2 hours)

1. DEFINITIONS
2. HALF-LIFE
3. INVERSE SQUARE LAW CALCULATIONS
4. CALCULATE NATURAL BACKGROUND DOSE
5. DOSE LIMITS

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SESSION #11 RADIATION SHIELDING (2 hours)

- TRANSMISSION CURVES
- RELATIVE EFFECTIVENESS OF DIFFERENT MATERIALS
- HALF VALUE LAYERS
- TENTH VALUE LAYERS
- TIME
- DISTANCE
- MASS ATTENUATION COEFFICIENTS
- ENERGY ATTENUATION COEFFICIENTS
- BUILDUP FACTORS

SESSION #12 USNRC REGULATIONS (4 hours)

- TITLE 10, CHAPTER 1, CFR PART 19
- TITLE 10, CHAPTER 1, CFR PART 20
- TITLE 10, CHAPTER 1, CFR PART 21
- REGULATORY GUIDE 10.9
- CALIBRATION OF SURVEY METERS NRC GUIDELINE
- WIPE TEST
- WASTE DISPOSAL
- TRANSPORTATION

SESSION #13 ADMINISTRATIVE CONTROLS (2 hours)

- RECORD KEEPING
- NOTIFICATIONS OF INCIDENTS

SESSION #14 EMERGENCY PROCEDURES (2 hours)

- OVEREXPOSURE
- FAILURE OF SOURCE TO RETURN TO SAFE POSITION
- DAMAGE TO SOURCE PENCILS
- FIRE
- REPORT OF EXPOSURE
- LOW WATER
- CONTAMINATION

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MEASUREMENTS OF RADIATION

SESSION #15 TYPE OF INSTRUMENTS

- ION CHAMBER
- GEIGER
- PROPORTIONAL COUNTER
- SCINTILLATION DETECTOR
- FILM
- TLD
- POCKET DOSIMETERS
- L-118 (AECL)
- DL-2 (AECL)

SESSION #16 CALIBRATION OF INSTRUMENTS (1 hour)

- OUTSIDE SOURCE
- INSIDE
- REQUIREMENT

SESSION #17 OPERATION OF INSTRUMENTS/INSTRUMENT LIMITATIONS (1 hour)

- SATURATION
- LOWER DETECTABLE LIMIT
- RESPONSE TIME
- RANGE OF DETECTION

SESSION #18 SURVEY TECHNIQUES (2 hours)

- IRRADIATOR SURVEY
- CONTAMINATION
- WATER SAMPLING
- AIR SAMPLING

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SESSION #19 USE OF PERSONAL MONITORING EQUIPMENT (1-1/2 hours)

ACTUAL MEASUREMENTS BY STUDENTS
QUESTIONS AND ANSWERS

SESSION #20 EXERCISES AND REVIEW ON (2 hours)

REGULATIONS
ADMINISTRATIVE CONTROLS
EMERGENCY PROCEDURES
SHIELDING

SESSION #21 IRRADIATOR DESIGN (1 hour)

DESIGN PRINCIPLES
DIFFERENT TYPE OR IRRADIATOR

SESSION #22 IRRADIATOR SAFETY SYSTEM (1 hour)

REVIEW OF ALL SAFETY INTERLOCKS
OPERATION OF SAFETY INTERLOCKS
SHIELD INTEGRITY
CONTINUOUS MONITORING

SESSION #23 COBALT-60 FROM THE GROUND UP (1 hour)

THE MANUFACTURING OF COBALT-60 SOURCE
REVIEW OF DIFFERENT PRODUCTION STAGES AND EMPHASIS ON PRECAUTIONS AND TESTING TO ENSURE SEALED SOURCES INTEGRITY.
TRANSPORTATION OF COBALT-60
CERENKOV RADIATION
PHOTO ACTIVATION IMPOSSIBLE
OZONE PRODUCTION

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SESSION #24 RADIATION STERILIZATION (1 hour)

- EFFECT OF RADIATION ON MICRO-ORGANISMS
- REVIEW OF GOOD MANUFACTURING PRACTICES USING AAMI PROCESS CONTROL GUIDELINES

SESSION #25 DOSIMETRY FOR IRRADIATOR (1 hour)

- REVIEW OF DIFFERENT DOSIMETER TYPES
- WHICH DOSIMETER TO USE AND WHEN
- DOSIMETER PLACEMENT
- DOSIMETER READING
- DOSIMETRY REPORT

SESSION #26 EXERCISES AND REVIEW (2 hours)

- SHIELDING CALCULATION
- TIME FOR LETHAL DOSE NEAR LARGE SOURCE
- DOSE NEAR SMALL CALIBRATION SOURCE

SESSION #27 QUESTION PERIOD (1 hour)

SESSION #28 EXAM (3 hours)

SESSION #29 REVIEW EXAM (2 hours)
QUESTION PERIOD

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: SHELLY BUNCE JOB TITLE: STERILIZATION TECHNICIAN

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
REQUIRED READING:			
1 RADIATION SAFETY TECHNICIAN TRAINING COURSE			
1.a. BASIC INFORMATION PAGES 21-28	B.D. Canaan		3-1-85
1.b. PROPERTIES OF ALPHA, BETA, GAMMA, X-RAYS & NEUTRONS PAGES 50-75	"		3-8-85
1.c. CONCEPTS OF RADIATION UNITS AND DOSE DETERMINATIONS PAGES 98-108			3-20-85
1.d. SHIELDING PAGES 115-127	"		3-20-85
1.e. BIOLOGICAL EFFECTS OF RADIATION PAGES 133-145	"		3-21-85
1.f. BACKGROUND RADIATION PAGES 150-159	"		3-21-85
1.g. RADIATION PROTECTION STANDARD PAGES 162-169	"		3-21-85
1.h. RADIATION DETECTION PRINCIPLES PAGES 207-231	"		3-21-85
1.i. HEALTH PHYSICS INSTRUMENTS PAGES 269-305	"		3-21-85
1.j. PERSONNEL MONITORING DEVICES PAGES 315-341	"		2-28-85
2 MANUFACTURER' OPERATING MANUAL	"		2-18-85
3 STUDY THE INSTALLATION BLUEPRINTS	"		3-20-85
4 TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS - PARTS 19, 20	"		3-21-85
5 H.M.A. REPORT NO. 78-4.8 TITLED "OPERATOR TRAINING FOR RADIATION STERILIZATION EQUIPMENT".	"		2-28-85
6 SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL	"		3-1-85
7 STUDY THE IN-HOUSE SPECIFICATIONS THAT RELATE TO THE OPERATION OF THE STERILIZER	"		2-28-85
8 STUDY PAST MAINTENANCE RECORDS	"		

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: S. BUNCE JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY	COBALT OFFICE	R. CASOR ← W.R. CASE	6/22/84 60 MINS
II MONITORS	COBALT OFFICE	W. R. CASE	7/11/84 1 1/2 HRS.
1. RATEMETER — ALSO DISCUSSED ROENTGEN, RAD, REM & MILLI REM (WRC)			
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b. SCALE READING			
c. CALIBRATION PROCEDURES			
III CONTROL CONSOLE	COBALT OFFICE	WRCASE	8/8/84 75 MINS
1. KEY SWITCHES (4)			
a. PURPOSE			
2. PILOT LIGHTS	COBALT OFFICE	WRCase	8/15/84 1 1/2 HRS.
a. DESCRIPTION			
b. PURPOSE			
3. RELAYS	COBALT OFFICE	WRCase	8/22/84 1 1/2 HRS.
IV OPERATOR SAFETY			
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: S. BUNCE JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS (CONT.)	COBALT OFFICE	W.R. Carr	8/22/84 1 1/2 HRS
VI EMERGENCY & SAFETY DEVICES			
1. EMERGENCY STOP CONTROLS			
2. POWER FAILURE			
3. MAZE DOOR INTERLOCK			
4. SOURCE STORAGE RACK			
5. SOURCE RACK GUIDE CABLE			
6. TEMPERATURE SENSING DEVICE			
7. CONVEYING SYSTEM			
8. POOL WATER LEVEL SWITCH (2)			
9. SOURCE HOIST			
10. SOURCE ALARM			
11. AIR PRESSURE			
12. START UP SAFETY DELAY TIMER			
13. SOURCE INTERLOCK			
VII NORMAL START-UP PROCEDURE	Cobalt office	W.R. Carr	8/29/84 1 1/2 hrs.
VIII NORMAL SHUTDOWN PROCEDURE			
IX CONTAMINATION DETECTION			
1. OZONE			
a. DETECTION			
b. MEASUREMENT			
c. TIME-DELAY			
2. LEAK TEST OF SOURCE	Cobalt Room Actual Source Wipe test	W.R. Carr J. Blanquart	9/26/84 1 1/2 hrs
3. LEAK TEST OF CALIBRATION SOURCE			
4. EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION ACCIDENT			
5. DECONTAMINATION PROCEDURE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: S. BUNCE JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
X CELL EXHAUST SYSTEM 1. PROCEDURE FOR CHANGING FILTER	Cobalt office	W.R.Carr	11/7/84 1 hr.
XI CHILLER 1. PURPOSE 2. CORRECT SETTING	COBALT OFFICE	W.R.Carr	10/10/84 45 mins.
XII DEIONIZER 1. PH OF WATER 2. PROCEDURE FOR CHANGING RESIN SACKS 3. CONDUCTIVITY METER	Cobalt Equipment Room	W.R. Carr	9/12/84 1.5 HRS.
XIII EMERGENCY CONDITION 1. PERSONNEL IN MAZE AT START-UP 2. MONITOR ALARM SIGNALS 3. MOMENTARY POWER FAILURE 4. PROLONGED POWER FAILURE 5. SAFETY PILOT ILLUMINATION 6. INTERAL CONVEYOR PILOT ILLUMINATION 7. AIR PRESSURE LIGHT ILLUMINATION 8. BOX ON CONVEYOR PILOT LIGHT 9. SOURCE RACK PILOT LIGHT ILLUMINATION 10. ONLY ONE SOURCE UP PILOT LIGHT ILLUMINATION	Supervisors office	W.R. Carr	3/11/85 1.0 HR
XIV MAINTENANCE 1. CHECKLIST	Cobalt office	W.R. Carr	11/14/84 1.3 hrs.
XV ADMINISTRATIVE PROCEDURES XVI CLEARLY UNDERSTAND THE PERSONS TO CONTACT WHENEVER THERE IS ANY TROUBLE WITH THE MECHANICAL OPERATION OF THE STERILIZER	COBALT OFFICE	W.R.Carr	11/20/84 1.3 hrs.

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: S. BUNCE JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
1. ATTEND A PERTINENT COURSE AT/FROM AN INSTITUTION	B-D CANAAN	ATOMIC ENERGY OF CANADA - YVES DOYLE	1 FEB 1985
2. WORK A MINIMUM OF FOUR (4) WEEKS AS AN OPERATOR TRAINEE	B-D CANAAN		11-21-84 TO PRESENT
3. DEMONSTRATE OPERATING PROFICIENCY	B-D CANAAN	WR. CASE	3-15-85

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I. Problem with the internal conveyor
High temperature
If not enough water in pool
If there's a problem in the source rack
If there's a jam outside, P101 or P102
Low air pressure

II. By the red buttons.
Safe - there's a problem with the safety condition - jam outside

Internal conveyor - problem with the a jam inside or one of the cylinders isn't working.

High temperature - means that the temperature sensing is sensing high temperature above 90°

Low air - means there is a compressor failure - cylinders are not getting enough air

Source rack - problem with the source rack itself - microswitches are not working properly

III. 1. Ratemeter - Shelley pointed to the ratemeter - it shows how much radiation the meter is getting.

a. Located in the back - Shelley pointed to it.

b. You can adjust it with a screwdriver - there are 2 adjustments - the alarm level and the ambient level.

c. In the maze.

d. You push the monitor test - Shelley pointed to the monitor test (the black button). You push this when the source is up.

2. Testing monitor - for operation you have to test that in order to go through the door into the maze. Question: What are you doing when you push that button? Shelley answered: You are testing to see if the monitor ratemeter is working.

3. This is to check to see if the circuits work.

4. This goes on when you check the monitor test button - when there's a power failure the memory light stays on. If there's an alarm condition that alarm will be on.

a. No you can't.

b. You should close all exits and entrance doors and then shut off all the air conditioning, shut off the exhaust, check the deionizer and you call the appropriate people, which is on the bulletin board. Shelley pointed to the Notification of Incident and Notice To Workers, Section 206 of the Energy Organization Act of 1974.

5. That means that you are ready to start the source up. Question: When does that light? Shelley replied: It lights when you turn the key switch on inside and come back and put chain across and closed the door.

III. 6. That means that there is a box right out here, P101, ready to go into the maze. Shelley was told that this was not right. She was told that: Position #1 is the monorail inside ready to accept and discharge a carrier from the monorail inside the maze.

7. Shelley pointed to the Reset pilot light. You push that after you've reset your power. Question: When does it light? If that pilot light is lit, what do you do? Shelley replied: Then you reset your power. You are resetting your console. I told Shelley that usually that will light after a power failure has occurred.

8. Shelley pointed to "Cycle Timer" - the specified amount of time that product has to be inside in order to receive a certain amount of dose.

9. Shelley pointed to "Overdose Timer" - you set it for a minute above your cycle timer. I asked Shelley: What is the reason for the overdose timer? Shelley replied: It times out and will shut the system down so that product does not receive too much radiation.

a. one minute

10. Shelley pointed to Exhaust Fan pilot light. It's to show that the exhaust fan is operating.

11. Shelley pointed to Filter Pump pilot light. It has a double switch and it's green where it says filter pump and shows that the pump is working. The upper portion of the light is water regeneration and tells you when you're supposed to change the resin sacs. Question: How do you know when to change the resin sacs, if that light is on, is there a meter telling you also that they need to be changed? Shelley replied: Yes, when goes above 10 micromhos.

12. Shelley pointed to the "Water Level" pilot light. It is green and tells that you have enough water in the pool to run the total heat source inside it. Question: If that water level goes out, what does that mean? Shelley replied: It's taking to make up water. Question: There's also a second pool float, what is that for? Shelley replied: That's for safety - if it hits that it will shut the source down or else give it another makeup or you can't get into the maze if that's on.

IV. You notify your supervisor and A.E.C.L. Question: Where would you find that information? Shelley replied: On the bulletin board -- Notification of Incident and Notice to Workers, Section 206.

V. 1. The person with the geiger counter.

2. The same person with the geiger counter.

VI. 1. When it is out of the water. If the source light is lit which is red. Question: What about the stored position or the safe position? Shelley replied: Down in the water, the green light is lit.

2. It means that the rack is sitting horizontally and it's making both microswitches for left and right.

3. It signifies that there's a problem with the rack and you're not sure - you don't know where the problem is. Question: What would you immediately look for? Shelley replied: It would mean that we had a leak - there's a problem with the microswitches so you could check against the survey samples. Question: Where would you find the survey? Shelley replied: On the wall in the office.

4. They are located inside the maze. They are on either side of the hoist - on the framework. (the source up pilot light)

The source down is located on top of the roof on the hoist.

5. Either there's a problem with the lights themselves or there's also a problem with the microswitches - again, check with the survey. Question: Suppose there isn't a problem with the lights or the microswitches, what could that mean? Shelley replied: You don't know where the source is. It could be anywhere inside.

a. You check again with the survey against the survey readings. Depending on what you find - if you find that there is radiation, notify the appropriate people and close all doors - secure the area.

VII. You have to go through a series of tests or operations before you can get through the door. Question: Suppose somebody went over and tried to open the door? Shelley replied: Then the door interlock would go off and it would make the source go down - can't go in then.

VIII. Pull the wire in there - safety cable and it shuts everything down.

IX. Shelley reset the overdose timer.
Turns off the machine.
Resets the power.
Now pushes the monitor test.
Now turns on the geiger counter, checking the batteries first.
Now checks against the source check to see if the geiger counter is working (it is).
Opens the door.
Shelley removed the safety chain from across the aisle.
Now makes the key switch to start up the machine.
The safety delay timer activated.
Shelley places the chain across the aisle.
Closes the door.
Proceeded to the console - placed the key in the machine switch and started the unit.
She is now setting a productalog chart for the proper time.
Now she is making the proper entry into the logbook.

We the undersigned agree that the Oral Exam was completed satisfactorily.

Test was administed by
Radiation Safety Officer
W. R. Case

W. R. Case

Test was witnessed by
R. G. Crook
Manager of Microbiological and
Sterilization Services

R. G. Crook 3/15/85

ITEM 7

NAME -- William R. Case

DATE OF BIRTH -- 4/6/44

EDUCATION -- 50 credits towards an A.S.

JOB TITLE -- Sterilization Supervisor --
Licensed Operator --
Radiation Safety Officer

TRAINING & EXPERIENCE

1) Completed a three day formal training course at Atomic Energy of Canada, Limited in November 1974.

   a) Principles and Practices of radiation protection

   b) Radioactivity measurements standardization and monitoring techniques and instruments

   c) Mathematics and calculations basic to the use and measurement of radioactivity

   d) Biological effects of radiation

2) Licensed by the NRC in December 1975 for the B-D Canaan Facility. ^{60}Cobalt -- 1,231,000 curies

3) Completed the training requirements.

ATOMIC ENERGY OF CANADA LIMITED

RADIOCHEMICAL COMPANY

Awards this certificate

to

Donald H. Coons SR.

for

Successful Completion of AECL-RCC

Radiation Protection Course for Industrial Irradiators

Tyrer L. Doyle
Instructor

February 1, 1985
Date

AECL ***Industrial Irradiators***

Atomic Energy
Of Canada Limited

L'Énergie Atomique
du Canada, Limitée

Radiochemical Company

Société radiochimique

413 March Road,
P.O. Box 13500
Kanata, Ontario,
Canada,
K2K 1X8

413 Chemin March,
C.P. 13500
Kanata, Ontario,
Canada,
K2K 1X8

Tel. (613) 592-2790
Telex. 053-4162

1985 February 22

File: F92108

Mr. Donald H. Coons, Sr.
Becton Dickinson
Route 7 and Graceway
Canaan, Connecticut
U.S.A. 06018

Dear Mr. Coons

Following the AECL-RCC Radiation Protection Course for Industrial Irradiators given at your facility, it is my pleasure to inform you that your results on the final exam were very good. Actually, your score was 76 out of 100.

In recognition of your active participation and excellent performance, you will find enclosed a Certificate of Successful Completion.

It was a pleasure to have you in my class and I hope to see you again soon.

If you have any questions regarding radiation, please do not hesitate to call.

Sincerely,

Yves L. Doyle

Y. Doyle,
Senior Radiation Physicist
Industrial Irradiation Division

/cpg
Encl.

cc: Mr. Bill Case

ITEM 7

AECL-RCC

RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

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SESSION #1 WELCOME ADDRESS (1/2 hour)

WELCOME
HISTORY OF NUCLEAR PHYSICS

SESSION #2 BASIC MATHEMATICS (1 hour)

USEFUL MATHEMATICS FOR CALCULATIONS AND MEASUREMENTS OF RADIOACTIVITY
GRAPH OF FUNCTIONS
SCIENTIFIC NOTATION
COUNTING STATISTICS

SESSION #3 THE ATOM (1/2 hour)

STRUCTURE OF THE ATOM
ISOTOPES AND NUCLIDES

RADIOACTIVITY (1/2 hour)

NATURALLY OCCURRING RADIOACTIVITY,
PRODUCTION OF RADIONUCLIDES
RADIOACTIVE DECAY
NUCLEAR FISSION
NUCLEAR FUSION
NUCLEAR REACTORS
ANEUTRONIC FISSION

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RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

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SESSION #4 RADIOACTIVE DECAY (1/2 hour)

- ALPHA PARTICLES
- BETA PARTICLES
- GAMMA RADIATION
- NEUTRONS
- HALF LIFE

SESSION #5 RADIATION QUANTITIES AND UNITS (1 hour)

- ACTIVITY - CURIE
- SPECIFIC ACTIVITY
- EXPOSURE - ROENTGEN
- ABSORBED DOSE - RAD
- DOSE EQUIVALENT - REM
- QUALITY FACTOR

SESSION #6 INTERACTION OF RADIATION WITH MATTER (1/2 hour)

- IONIZING RADIATION
- GAMMA RAYS
- X-RAYS
- PHOTOELECTRIC EFFECT
- COMPTON SCATTERING
- PAIR PRODUCTION

SESSION #7 BIOLOGICAL EFFECTS OF RADIATION, LOW DOSES (1 hour)

- A.L.A.R.A.
- GENETIC EFFECTS
- MUTATIONS
- THE PERCEPTION OF RISK
- CAUSED INCIDENCE
- LINEAR DOSE EFFECT THEORY
- THRESHOLD DOSE EFFECT THEORY

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SESSION #8 BIOLOGICAL EFFECTS OF RADIATION HIGH DOSES (1 hour)

- EFFECT OF RADIATION ON CELLS
- SOMATIC EFFECTS
- RADIOSENSITIVITY OF VARIOUS ORGANS
- ACUTE EXPOSURE
- EXTERNAL EXPOSURE
- EXTERNAL RADIATION
- INTERNAL RADIATION

SESSION #9 NATURAL BACKGROUND RADIATION (1/2 hour)

- COSMIC RADIATION
- RADIATION FROM NATURALLY OCCURRING RADIOACTIVITY (TERRESTRIAL, FOOD, AIR, WATER)

RADIATION FROM MAN-MADE SOURCES (1/4 hour)

- OCCUPATIONAL EXPOSURE
- MEDICAL EXPOSURE

DOSE LIMITS (1/2 hour)

- MAXIMUM PERMISSIBLE DOSE FOR RADIATION WORKERS
- DOSE LIMITS FOR POPULATIONS

SESSION #10 EXERCISES AND REVIEW (2 hours)

1. DEFINITIONS
2. HALF-LIFE
3. INVERSE SQUARE LAW CALCULATIONS
4. CALCULATE NATURAL BACKGROUND DOSE
5. DOSE LIMITS

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FOR INDUSTRIAL IRRADIATORS

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SESSION #11 RADIATION SHIELDING (2 hours)

- TRANSMISSION CURVES
- RELATIVE EFFECTIVENESS OF DIFFERENT MATERIALS
- HALF VALUE LAYERS
- TENTH VALUE LAYERS
- TIME
- DISTANCE
- MASS ATTENUATION COEFFICIENTS
- ENERGY ATTENUATION COEFFICIENTS
- BUILDUP FACTORS

SESSION #12 USNRC REGULATIONS (4 hours)

- TITLE 10, CHAPTER 1, CFR PART 19
- TITLE 10, CHAPTER 1, CFR PART 20
- TITLE 10, CHAPTER 1, CFR PART 21
- REGULATORY GUIDE 10.9
- CALIBRATION OF SURVEY METERS NRC GUIDELINE
- WIPE TEST
- WASTE DISPOSAL
- TRANSPORTATION

SESSION #13 ADMINISTRATIVE CONTROLS (2 hours)

- RECORD KEEPING
- NOTIFICATIONS OF INCIDENTS

SESSION #14 EMERGENCY PROCEDURES (2 hours)

- OVEREXPOSURE
- FAILURE OF SOURCE TO RETURN TO SAFE POSITION
- DAMAGE TO SOURCE PENCILS
- FIRE
- REPORT OF EXPOSURE
- LOW WATER
- CONTAMINATION

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FOR INDUSTRIAL IRRADIATORS

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MEASUREMENTS OF RADIATION

SESSION #15 TYPE OF INSTRUMENTS

- ION CHAMBER
- GEIGER
- PROPORTIONAL COUNTER
- SCINTILLATION DETECTOR
- FILM
- TLD
- POCKET DOSIMETERS
- L-118 (AECL)
- DL-2 (AECL)

SESSION #16 CALIBRATION OF INSTRUMENTS (1 hour)

- OUTSIDE SOURCE
- INSIDE
- REQUIREMENT

SESSION #17 OPERATION OF INSTRUMENTS/INSTRUMENT LIMITATIONS (1 hour)

- SATURATION
- LOWER DETECTABLE LIMIT
- RESPONSE TIME
- RANGE OF DETECTION

SESSION #18 SURVEY TECHNIQUES (2 hours)

- IRRADIATOR SURVEY
- CONTAMINATION
- WATER SAMPLING
- AIR SAMPLING

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FOR INDUSTRIAL IRRADIATORS

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SESSION #19 USE OF PERSONAL MONITORING EQUIPMENT (1-1/2 hours)

ACTUAL MEASUREMENTS BY STUDENTS
QUESTIONS AND ANSWERS

SESSION #20 EXERCISES AND REVIEW ON (2 hours)

REGULATIONS
ADMINISTRATIVE CONTROLS
EMERGENCY PROCEDURES
SHIELDING

SESSION #21 IRRADIATOR DESIGN (1 hour)

DESIGN PRINCIPLES
DIFFERENT TYPE OR IRRADIATOR

SESSION #22 IRRADIATOR SAFETY SYSTEM (1 hour)

REVIEW OF ALL SAFETY INTERLOCKS
OPERATION OF SAFETY INTERLOCKS
SHIELD INTEGRITY
CONTINUOUS MONITORING

SESSION #23 COBALT-60 FROM THE GROUND UP (1 hour)

THE MANUFACTURING OF COBALT-60 SOURCE
REVIEW OF DIFFERENT PRODUCTION STAGES AND EMPHASIS ON PRECAUTIONS AND TESTING TO ENSURE SEALED SOURCES INTEGRITY.
TRANSPORTATION OF COBALT-60
CERENKOV RADIATION
PHOTO ACTIVATION IMPOSSIBLE
OZONE PRODUCTION

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FOR INDUSTRIAL IRRADIATORS

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SESSION #24 RADIATION STERILIZATION (1 hour)

EFFECT OF RADIATION ON MICRO-ORGANISMS
REVIEW OF GOOD MANUFACTURING PRACTICES USING AAMI PROCESS CONTROL GUIDELINES

SESSION #25 DOSIMETRY FOR IRRADIATOR (1 hour)

REVIEW OF DIFFERENT DOSIMETER TYPES
WHICH DOSIMETER TO USE AND WHEN
DOSIMETER PLACEMENT
DOSIMETER READING
DOSIMETRY REPORT

SESSION #26 EXERCISES AND REVIEW (2 hours)

SHIELDING CALCULATION
TIME FOR LETHAL DOSE NEAR LARGE SOURCE
DOSE NEAR SMALL CALIBRATION SOURCE

SESSION #27 QUESTION PERIOD (1 hour)

SESSION #28 EXAM (3 hours)

SESSION #29 REVIEW EXAM (2 hours)
QUESTION PERIOD

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: Donald Coons JOB TITLE: STERILIZATION

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
REQUIRED READING:			
1 RADIATION SAFETY TECHNICIAN TRAINING COURSE			
1.a. BASIC INFORMATION PAGES 21-28	Cannan Ct.	D Coons	11-28-84
1.b. PROPERTIES OF ALPHA, BETA, GAMMA, X-RAYS & NEUTRONS PAGES 50-75	Cannan Ct.	D Coons	3-4-85
1.c. CONCEPTS OF RADIATION UNITS AND DOSE DETERMINATIONS PAGES 98-108	Cannan Ct.	D Coons	3-4-85
1.d. SHIELDING PAGES 115-127	Cannan Ct.	D Coons	3-4-85
1.e. BIOLOGICAL EFFECTS OF RADIATION PAGES 133-145			
1.f. BACKGROUND RADIATION PAGES 150-159			
1.g. RADIATION PROTECTION STANDARD PAGES 162-169	Cannan Ct.	D Coons	3-7-85
1.h. RADIATION DETECTION PRINCIPLES PAGES 207-231			
1.i. HEALTH PHYSICS INSTRUMENTS PAGES 269-305	Cannan Ct.	D Coons	3-8-85
1.j. PERSONNEL MONITORING DEVICES PAGES 315-341	Cannan Ct.	D Coons	3-11-85
2 MANUFACTURER' OPERATING MANUAL			
3 STUDY THE INSTALLATION BLUEPRINTS	Cannan Ct	D Coons	3-15-85
4 TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS - PARTS 19, 20	Cannan Ct	D Coons	3-11-85
5 HIMA REPORT NO. 78-4.8 TITLED "OPERATOR TRAINING FOR RADIATION STERILIZATION EQUIPMENT".	Cannan Ct.	D Coons	3-19-85
6 SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL			
7 STUDY THE IN-HOUSE SPECIFICATIONS THAT RELATE TO THE OPERATION OF THE STERILIZER			
8 STUDY PAST MAINTENANCE RECORDS			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: Donald Coons JOB TITLE: Sterilization

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY	COBALT OFFICE	R. CROOK & W. R. CASE	6/27/84 60 MINS
II MONITORS	COBALT OFFICE	WR CASE	7/11/84 1½ HRS
1. RATEMETER — Also DISCUSSED REM, ROENTGEN, RAD & MILLIREM			
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b. SCALE READING			
c. CALIBRATION & PROCEDURES			
III CONTROL CONSOLE			
1. KEY SWITCHES (4)	COBALT OFFICE	WRCase	5/4/84 30 MINS.
a. PURPOSE			
2. PILOT LIGHTS			
a. DESCRIPTION	Cobalt office	W.R. Case	8/15/84 1½ hrs.
b. PURPOSE			
3. RELAYS			
IV OPERATOR SAFETY	COBALT OFFICE	W. R. Case	8/25/84 1½ hrs.
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: Donald Coons JOB TITLE: Sterilization

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY	COBALT OFFICE	R. CROOK + W. R. CASE	6/27/84 60 MINS
II MONITORS	COBALT OFFICE	WR CASE	7/11/84 1½ HRS
1. RATEMETER — ALSO DISCUSSED REM, ROENTGEN, RAD + MILLIREM			
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b. SCALE READING			
c. CALIBRATION + PROCEDURES			
III CONTROL CONSOLE			
1. KEY SWITCHES (4)	COBALT OFFICE	WRCase	5/4/84 30 MINS.
a. PURPOSE			
2. PILOT LIGHTS			
a. DESCRIPTION	Cobalt office	W.R.Case	8/15/84 1½ hrs.
b. PURPOSE			
3. RELAYS			
IV OPERATOR SAFETY	COBALT OFFICE	W. R. Case	8/15/84 1½ hrs.
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: D Coon JOB TITLE: Sterilization Oper

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS (CONT.)	COBALT OFFICE	W. R. Case	8/22/84 1½ hr.
VI EMERGENCY & SAFETY DEVICES			
1. EMERGENCY STOP CONTROLS			
2. POWER FAILURE			
3. MAZE DOOR INTERLOCK			
4. SOURCE STORAGE RACK			
5. SOURCE RACK GUIDE CABLE			
6. TEMPERATURE SENSING DEVICE			
7. CONVEYING SYSTEM			
8. POOL WATER LEVEL SWITCH (2)			
9. SOURCE HOIST			
10. SOURCE ALARM			
11. AIR PRESSURE			
12. START UP SAFETY DELAY TIMER			
13. SOURCE INTERLOCK			
VII NORMAL START-UP PROCEDURE	COBALT OFFICE	W. R. Case	8/29/84 1½ hrs.
VIII NORMAL SHUTDOWN PROCEDURE			
IX CONTAMINATION DETECTION			
1. OZONE			
a. DETECTION			
b. MEASUREMENT			
c. TIME-DELAY			
2. LEAK TEST OF SOURCE	Cobalt Room Actual Source Wipe test	W.R. Case J. Blanquart	9/26/84 1½ hrs.
3. LEAK TEST OF CALIBRATION SOURCE			
4. EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION ACCIDENT			
5. DECONTAMINATION PROCEDURE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: D Coows JOB TITLE: STERILIZATION OPER.

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
X CELL EXHAUST SYSTEM 1. PROCEDURE FOR CHANGING FILTER	Cobalt office	W. R. Case	11/2/84 1.0 HRS.
XI CHILLER 1. PURPOSE 2. CORRECT SETTING	COBALT OFFICE	W. R. Case	3/4/85 30 MINS.
XII DEIONIZER 1. PH OF WATER 2. PROCEDURE FOR CHANGING RESIN SACKS 3. CONDUCTIVITY METER	Cobalt Equipment ROOM	W. R. Case	9-12-84 1.0 hr.
XIII EMERGENCY CONDITION 1. PERSONNEL IN MAZE AT START-UP 2. MONITOR ALARM SIGNALS 3. MOMENTARY POWER FAILURE 4. PROLONGED POWER FAILURE 5. SAFETY PILOT ILLUMINATION 6. INTERAL CONVEYOR PILOT ILLUMINATION 7. AIR PRESSURE LIGHT ILLUMINATION 8. BOX ON CONVEYOR PILOT LIGHT 9. SOURCE RACK PILOT LIGHT ILLUMINATION 10. ONLY ONE SOURCE UP PILOT LIGHT ILLUMINATION	Cobalt office	W. R. Case	9/19/84
XIV MAINTENANCE 1. CHECKLIST	Cobalt office	W. R. Case	11/14/84 1.3 hr.
XV ADMINISTRATIVE PROCEDURES XVI CLEARLY UNDERSTAND THE PERSONS TO CONTACT WHENEVER THERE IS ANY TROUBLE WITH THE MECHANICAL OPERATION OF THE STERILIZER	COBALT OFFICE	W. R. CASE	11/20/84 1.3 hr.

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: D Coons JOB TITLE: STERILIZATION OPERATOR

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING.	DATE COMPLETED
1. ATTEND A PERTINENT COURSE AT/FROM AN INSTITUTION	B-D CANADA	ATOMIC ENERGY OF CANADA - YVES DOYLE	1 FEB 1985
2. WORK A MINIMUM OF FOUR (4) WEEKS AS AN OPERATOR TRAINEE	B-D CANADA		8-31-84 TO PRESENT
3. DEMONSTRATE OPERATING PROFICIENCY	B-D CANADA	W.R. CASE	3-12-85

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I. Stop safe, high temperature, exhaust system malfunction, low air, internal conveyor, source rack.

II. - Stop Safe condition exists when overdose timer times out.
- Internal conveyor - possible carrier jam or pistons do not complete cycle.
- High temperature - set at 150° and will shut down unit - temperature sensor located inside across from pool above head on west wall.
- Low air - Compressor failure/plugged filter/ plugged line.
- Source rack - doesn't make a contact on source - up switches would automatically send back into pool.
- Low Water level switch will shut it down.
Asked iif it would shut down on 1st float switch or second float switch. Donald replied - second pool float switch.
- Exhaust fan - if it shuts off for any reason it will automatically send source back down into water.

III. 1. Ratemeter - Donald pointed to meter.
   a. Monitor is located behind the console.
   b. Two adjustments - 1) ambient level and 2) alarm level. Alarm level set at 8 meaning 80% of scale.
   c. Sensor is located in Maze hallway.
   d. Pushing monitor test and pointing at pilot light.

2. It shows you that the monitor is working properly.

3. Could not answer - I explained to Donald that it is supposed to flicker to insure circuits are functioning.

4. Alarm/memory pilot lights - asked Donald if it is a split pilot light? Reply: Monitor test alarm/memory light will light. Memory light will stay lit to let you know if an actually alarm condition existed.
   a. No.
   b. Close off the area, notify the Radiation Safety Officer. Pointed out the emergency call list on bulletin board.

5. Pointed to light. When light is lit machine is ready to be started. Question: When does it light? Reply - After you turn switch inside (safety delay timer). Come out, stretch chain across wall, shut the door and then light lights.

III. 6. To let you know that the conveyor has a box on ready to go in. Answer not acceptable. -2
He then answered - Position 1 is when your conveyor is inside the cell ready to push off and push on a carrier.

7. Did not know. Asked Donald if a power failure occurred what does he have to do? His reply: Reset. -3

Simulated a power failure using power key switch - Reset light lit. Asked Donald what he should do now? He said reset and he reset using Power Key Switch - Acceptable

8. To set the dose of the product running through. Asked Donald where he got the times from? He replied - off the board on wall and pointed them out.

9. Set 1 minute greater than dose timer. When it times out it shuts machine down. Asked Donald why do we need overdose timer? He replied so product is not overdosed inside.

10. Pointed to pilot light - when light is on it is working.

11. Pointed out pilot light - lets you know water is being filtered from the pool. Asked why there was only one portion of light lit? He replied - split pilot light - upper light will light when conductivity meter reads greater than 10.

12. Pointed out water level light. When water level goes below float level.

IV. Reference Section 206 on Bulletin Board. Notify the proper personnel on list.

V. 1. Person with the meter.

2. Person with the meter.

VI. 1. Red light would be the source up. Source down would be the green light. Pointed out LS109 switch on source hoist. Pointed out micro for source up.

2. Right and left side of the cource rack. If one light is not lit, it means source rack is cocked.

3. Something is wrong. Take the worst of it - source is up - notify Radiation Safety Officer. Treat it as an emergency condition.
What else could you do? Do you have a meter? His reply was yes. What could you do with the meter? His reply - check to see if you were getting any readings. Howe would you know if the source was in a semi-exposed position? His reply was - meter would go off scale on scale 1. What did A.E.C.L. do upon completion of source loading? His reply - checked for readings with meter. Explained to Donald: - showed Donaldsurvey on wall - that he

VI. 3. (con't)

should check at different locations to see if his readings agree with survey. Explained to him if readings were half the value of what survey was, he could have a semi-exposed source rack.

-3 4. Up on roof in the hoist for source down, source up switches. Not acceptable. He then replied source up switches are in the maze near the ceiling right over top of source rack. Source down is in the hoist. Acceptable.

5. That the source is half-way in between the two up or down positions.

a. Notify Bill Case. Reference "Employees Take Notice - Section 206" (emergency call list).

VII. The interlock located on the maze door. Machine will not allow any one to open the door. Have to reset, monitor test, OK to enter light must be lit. I then said to Don, in other words, you have to go through the proper procedures to get into maze. He replied, yes.

VIII. Pull the cable on wall to shut machine down.

IX. -Reset overdose timer.
-Monitor test activated.
-OK to enter light now lit.
-Went to Maze inserted key switch and check of proper functioning of meter. Remove chain from aisle.
-Found conveyor not at position 1.
-Returned to console.
-Reset console by power switch.
-Turn machine switch to on - conveyor returned to position 1.
-Safety timer activated.
-Chain stretched across aisle.
-Key placed into machine switch and turned to start.
-Set productivity chart.
-Logged startup in logbook.

We the undersigned agree that the Oral Exam was completed satisfactory.

Test administered by
Radiation Safety Officer
W. R. Case

W. R. Case

Test witnessed by R. G. Crook
Manager of Microbiological and
Sterilization Services

[redacted] 3/12/85

ITEM 7

Name -- Adrian L. Co[redacted]a

Date of Birth -- 12-20-50

Education -- 30 credits towards an associate degree in Criminal Justice

Job Title -- Sterilization Technician

Duties:

General Function: Under the general supervision of the sterilization supervisor, performs technical duties in the radiation and ethylene oxide sterilization of products, utilizing various laboratory, monitoring and recording devices and in accordance with established procedures and regulations. Monitors and gathers data on the sterilization process and provides ready availability of materials and supplies used by the Sterilization Department.

Primary Duties: ^{60}Cobalt Radiation Facility

1) Operate and adjust radiation equipment including all necessary material handling.

2) Be familiar and to remain current and practice all procedures, regulations and policies concerning radiation safety as established by plant, corporate and governmental regulatory agencies.

3) To perform routine maintenance on equipment and to closely supervise work done by outside maintenance. Must be familiar with proper use of hand tools such as wrenches, electric drills, torches and soldering irons.

4) Be proficient in operation and maintenance of all types of radiation tests and detection equipment such as dosimeters, survey meters, etc. -- includes calibration.

5) Assist in various projects concerning radiation sterilization including experimental and engineering studies.

6) To run routine safety and operational checks on the facility and to oversee the compliance of mandatory safety requirements by visitors and non-departmental personnel.

7) To record pertinent data and file records, logs, and lot dispositions.

8) Instrument calibrations to NRC standards for other B-D facilities. Maintain records.

9) Requisition supplies and parts to maintain the facility. Keep inventory of critical parts.

Name -- Adrian L. Costa

Training

1) Three day Radiation Safety Course was given by Rod Chu of Atomic Energy of Canada Limited at Becton, Dickinson & Company, Canaan, Connecticut. Course outline attached.

2) In-house training on AECL type Ir 21 irradiator, given by William R. Case as per attached outline.

Name -- Adrian L. Costa

Experience

1) Four months on-the-job training on AECL type IR 21 irradiator at Becton, Dickinson & Company, Canaan, Connecticut. Irradiator source strength 1,499,400 curies.

2) Calibration of Berthold Rato /F instruments using a Gamma survey instrument calibration unit Model TO/571.

RADIATION PERSONNEL TRAINING

NAME: ADRIAN L. COSTA JOB TITLE: STERILIZATION TECHNICIAN

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED	
READ RADIATION SAFETY TECHNICIAN TRAINING COURSE	B-D CANAAN		8-15-80	
READ MANUFACTURER OPERATING MANUAL	B-D CANAAN		6-30-80	
READ SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL	B-D CANAAN		8-19-80	
READ TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS	B-D CANAAN		8-20-80	
STUDY INSTALLATION BLUEPRINTS	B-D CANAAN		7-18-80	
RADIATION TRAINING COURSE	BECTON-DICKINSON CANAAN, CONN.	ROD CHU A.E.C.L	8-13-80 8-14-80 8-15-80	
APPRENTICESHIP IN OPERATION OF GAMMA STERILIZER	B-D CANAAN	W.R. CASE	W/E 6 27 80 W/E 7 11 80 W/E 7 18 80	W/E 8/15/80
STUDY IN-HOUSE SPECIFICATIONS	B-D CANAAN		8-20-80	
STUDY PAST RECORDS	B-D CANAAN		7-16-80	
UNDERSTAND THE STERILANTS CONTRACT	B-D CANAAN	W R CASE	7-23-80	
DEMONSTRATE OPERATING PROFICIENCY - TEST	B-D CANAAN	W R CASE	8 21 80	

APPROVED BY [signature] 11/27/80

ATOMIC ENERGY OF CANADA LIMITED

RADIOCHEMICAL COMPANY

Awards this certificate

to

Ronald N. Love

for

Successful Completion of AECL-RCC

Radiation Protection Course for Industrial Irradiators

Yves L. Doyle
Instructor

February 1, 1985
Date

AECL *Industrial Irradiators*

Atomic Energy
Of Canada Limited

L'Énergie Atomique
du Canada, Limitée

Radiochemical Company

Société radiochimique

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Canada,
K2K 1X8

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C.P. 13500
Kanata, Ontario,
Canada,
K2K 1X8

Tel. (613) 592-2790
Telex. 053-4162

1985 February 22

File: F92108

Mr. Ronald N. Love
Becton Dickinson
Route 7 and Graceway
Canaan, Connecticut
U.S.A. 06018

Dear Mr. Love

Following the AECL-RCC Radiation Protection Course for Industrial Irradiators given at your facility, it is my pleasure to inform you that your results on the final exam were very good. Actually, your score was 71 out of 100.

In recognition of your active participation and excellent performance, you will find enclosed a Certificate of Successful Completion.

It was a pleasure to have you in my class and I hope to see you again soon.

If you have any questions regarding radiation, please do not hesitate to call.

Sincerely,

Yves F. Doyle

Y. Doyle,
Senior Radiation Physicist
Industrial Irradiation Division

/cpg
Encl.

cc: Mr. Bill Case

ITEM 7

AECL-RCC

RADIATION PROTECTION

FOR INDUSTRIAL IRRADIATORS

DRAFT

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SESSION #1 WELCOME ADDRESS (1/2 hour)

WELCOME
HISTORY OF NUCLEAR PHYSICS

SESSION #2 BASIC MATHEMATICS (1 hour)

USEFUL MATHEMATICS FOR CALCULATIONS AND MEASUREMENTS OF RADIOACTIVITY
GRAPH OF FUNCTIONS
SCIENTIFIC NOTATION
COUNTING STATISTICS

SESSION #3 THE ATOM (1/2 hour)

STRUCTURE OF THE ATOM
ISOTOPES AND NUCLIDES

RADIOACTIVITY (1/2 hour)

NATURALLY OCCURRING RADIOACTIVITY,
PRODUCTION OF RADIONUCLIDES
RADIOACTIVE DECAY
NUCLEAR FISSION
NUCLEAR FUSION
NUCLEAR REACTORS
ANEUTRONIC FISSION

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RADIATION PROTECTION

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SESSION #4 RADIOACTIVE DECAY (1/2 hour)

- ALPHA PARTICLES
- BETA PARTICLES
- GAMMA RADIATION
- NEUTRONS
- HALF LIFE

SESSION #5 RADIATION QUANTITIES AND UNITS (1 hour)

- ACTIVITY - CURIE
- SPECIFIC ACTIVITY
- EXPOSURE - ROENTGEN
- ABSORBED DOSE - RAD
- DOSE EQUIVALENT - REM
- QUALITY FACTOR

SESSION #6 INTERACTION OF RADIATION WITH MATTER (1/2 hour)

- IONIZING RADIATION
- GAMMA RAYS
- X-RAYS
- PHOTOELECTRIC EFFECT
- COMPTON SCATTERING
- PAIR PRODUCTION

SESSION #7 BIOLOGICAL EFFECTS OF RADIATION, LOW DOSES (1 hour)

- A.L.A.R.A.
- GENETIC EFFECTS
- MUTATIONS
- THE PERCEPTION OF RISK
- CAUSED INCIDENCE
- LINEAR DOSE EFFECT THEORY
- THRESHOLD DOSE EFFECT THEORY

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SESSION #8 BIOLOGICAL EFFECTS OF RADIATION HIGH DOSES (1 hour)

- EFFECT OF RADIATION ON CELLS
- SOMATIC EFFECTS
- RADIOSENSITIVITY OF VARIOUS ORGANS
- ACUTE EXPOSURE
- EXTERNAL EXPOSURE
- EXTERNAL RADIATION
- INTERNAL RADIATION

SESSION #9 NATURAL BACKGROUND RADIATION (1/2 hour)

- COSMIC RADIATION
- RADIATION FROM NATURALLY OCCURRING RADIOACTIVITY (TERRESTRIAL, FOOD, AIR, WATER)

RADIATION FROM MAN-MADE SOURCES (1/4 hour)

- OCCUPATIONAL EXPOSURE
- MEDICAL EXPOSURE

DOSE LIMITS (1/2 hour)

- MAXIMUM PERMISSIBLE DOSE FOR RADIATION WORKERS
- DOSE LIMITS FOR POPULATIONS

SESSION #10 EXERCISES AND REVIEW (2 hours)

1. DEFINITIONS
2. HALF-LIFE
3. INVERSE SQUARE LAW CALCULATIONS
4. CALCULATE NATURAL BACKGROUND DOSE
5. DOSE LIMITS

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SESSION #11 RADIATION SHIELDING (2 hours)

- TRANSMISSION CURVES
- RELATIVE EFFECTIVENESS OF DIFFERENT MATERIALS
- HALF VALUE LAYERS
- TENTH VALUE LAYERS
- TIME
- DISTANCE
- MASS ATTENUATION COEFFICIENTS
- ENERGY ATTENUATION COEFFICIENTS
- BUILDUP FACTORS

SESSION #12 USNRC REGULATIONS (4 hours)

- TITLE 10, CHAPTER 1, CFR PART 19
- TITLE 10, CHAPTER 1, CFR PART 20
- TITLE 10, CHAPTER 1, CFR PART 21
- REGULATORY GUIDE 10.9
- CALIBRATION OF SURVEY METERS NRC GUIDELINE
- WIPE TEST
- WASTE DISPOSAL
- TRANSPORTATION

SESSION #13 ADMINISTRATIVE CONTROLS (2 hours)

- RECORD KEEPING
- NOTIFICATIONS OF INCIDENTS

SESSION #14 EMERGENCY PROCEDURES (2 hours)

- OVEREXPOSURE
- FAILURE OF SOURCE TO RETURN TO SAFE POSITION
- DAMAGE TO SOURCE PENCILS
- FIRE
- REPORT OF EXPOSURE
- LOW WATER
- CONTAMINATION

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MEASUREMENTS OF RADIATION

SESSION #15 TYPE OF INSTRUMENTS

- ION CHAMBER
- GEIGER
- PROPORTIONAL COUNTER
- SCINTILLATION DETECTOR
- FILM
- TLD
- POCKET DOSIMETERS
- L-118 (AECL)
- DL-2 (AECL)

SESSION #16 CALIBRATION OF INSTRUMENTS (1 hour)

- OUTSIDE SOURCE
- INSIDE
- REQUIREMENT

SESSION #17 OPERATION OF INSTRUMENTS/INSTRUMENT LIMITATIONS (1 hour)

- SATURATION
- LOWER DETECTABLE LIMIT
- RESPONSE TIME
- RANGE OF DETECTION

SESSION #18 SURVEY TECHNIQUES (2 hours)

- IRRADIATOR SURVEY
- CONTAMINATION
- WATER SAMPLING
- AIR SAMPLING

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SESSION #19 USE OF PERSONAL MONITORING EQUIPMENT (1-1/2 hours)

ACTUAL MEASUREMENTS BY STUDENTS
QUESTIONS AND ANSWERS

SESSION #20 EXERCISES AND REVIEW ON (2 hours)

REGULATIONS
ADMINISTRATIVE CONTROLS
EMERGENCY PROCEDURES
SHIELDING

SESSION #21 IRRADIATOR DESIGN (1 hour)

DESIGN PRINCIPLES
DIFFERENT TYPE OR IRRADIATOR

SESSION #22 IRRADIATOR SAFETY SYSTEM (1 hour)

REVIEW OF ALL SAFETY INTERLOCKS
OPERATION OF SAFETY INTERLOCKS
SHIELD INTEGRITY
CONTINUOUS MONITORING

SESSION #23 COBALT-60 FROM THE GROUND UP (1 hour)

THE MANUFACTURING OF COBALT-60 SOURCE
REVIEW OF DIFFERENT PRODUCTION STAGES AND EMPHASIS ON PRECAUTIONS AND TESTING TO ENSURE SEALED SOURCES INTEGRITY.
TRANSPORTATION OF COBALT-60
CERENKOV RADIATION
PHOTO ACTIVATION IMPOSSIBLE
OZONE PRODUCTION

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SESSION #24 RADIATION STERILIZATION (1 hour)

EFFECT OF RADIATION ON MICRO-ORGANISMS
REVIEW OF GOOD MANUFACTURING PRACTICES USING AAMI PROCESS CONTROL GUIDELINES

SESSION #25 DOSIMETRY FOR IRRADIATOR (1 hour)

REVIEW OF DIFFERENT DOSIMETER TYPES
WHICH DOSIMETER TO USE AND WHEN
DOSIMETER PLACEMENT
DOSIMETER READING
DOSIMETRY REPORT

SESSION #26 EXERCISES AND REVIEW (2 hours)

SHIELDING CALCULATION
TIME FOR LETHAL DOSE NEAR LARGE SOURCE
DOSE NEAR SMALL CALIBRATION SOURCE

SESSION #27 QUESTION PERIOD (1 hour)

SESSION #28 EXAM (3 hours)

SESSION #29 REVIEW EXAM (2 hours)
QUESTION PERIOD

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: RON LOVE' JOB TITLE: STERILIZATION

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
REQUIRED READING:			
1 RADIATION SAFETY TECHNICIAN TRAINING COURSE 1.a. BASIC INFORMATION PAGES 21-28 1.b. PROPERTIES OF ALPHA, BETA, GAMMA X-RAYS & NEUTRONS PAGES 50-75 1.c. CONCEPTS OF RADIATION UNITS AND DOSE DETERMINATIONS PAGES 98-108			9-3-84
1.d. SHIELDING PAGES 115-127 1.e. BIOLOGICAL EFFECTS OF RADIATION PAGES 133-145 1.f. BACKGROUND RADIATION PAGES 150-159			9-7-84
1.g. RADIATION PROTECTION STANDARD PAGES 162-169			9-12-84
1.h. RADIATION DETECTION PRINCIPLES PAGES 207-231 1.i. HEALTH PHYSICS INSTRUMENTS PAGES 269-305			9-20-84
1.j. PERSONNEL MONITORING DEVICES PAGES 315-341			
2 MANUFACTURER' OPERATING MANUAL 3 STUDY THE INSTALLATION BLUEPRINTS			3-12-85
4 TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS - PARTS 19, 20			3-19-85
5 HIMA REPORT NO. 78-4.8 TITLED "OPERATOR TRAINING FOR RADIATION STERILIZATION EQUIPMENT". 6 SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL 7 STUDY THE IN-HOUSE SPECIFICATIONS THAT RELATE TO THE OPERATION OF THE STERILIZER 8 STUDY PAST MAINTENANCE RECORDS			3-19-85

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: RONALD LOVE JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY	COBALT OFFICE	R CROOM & W.R. CASE	6/27/84 60 MINS
II MONITORS	COBALT OFFICE	W.R. CASE	7/11/84
1. RATEMETER — DISCUSSED ROENTGEN, REM, RAD & MILLIRAD. WRC			1½ HRS
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b. SCALE READING			
c. CALIBRATION PROCEDURES			
III CONTROL CONSOLE	COBALT OFFICE	W.R. Case	
1. KEY SWITCHES (4)			
a. PURPOSE			
2. PILOT LIGHTS	Cobalt Office	W.R Case	8/15/84 1½ hrs.
a. DESCRIPTION			
b. PURPOSE			
3. RELAYS			
IV OPERATOR SAFETY	COBALT OFFICE	W.R. Case	8/22/84 1½ hrs.
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING R LOVE	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS (CONT.)	COBALT OFFICE	W. R. Carr	8/22/84 1 1/2 HRS.
VI EMERGENCY & SAFETY DEVICES			
1. EMERGENCY STOP CONTROLS			
2. POWER FAILURE			
3. MAZE DOOR INTERLOCK			
4. SOURCE STORAGE RACK			
5. SOURCE RACK GUIDE CABLE			
6. TEMPERATURE SENSING DEVICE			
7. CONVEYING SYSTEM			
8. POOL WATER LEVEL SWITCH (2)			
9. SOURCE HOIST			
10. SOURCE ALARM			
11. AIR PRESSURE			
12. START UP SAFETY DELAY TIMEIR			
13. SOURCE INTERLOCK			
VII NORMAL START-UP PROCEDURE	COBALT OFFICE	W R Carr	8-29-84 1 1/2 hr.
VIII NORMAL SHUTDOWN PROCEDURE			
IX CONTAMINATION DETECTION			
1. OZONE			
a. DETECTION			
b. MEASUREMENT			
C. TIME-DELAY	Cobalt Room Actual Source	W R Carr	9/24/84
2. LEAK TEST OF SOURCE	wipe test	J. Blanquart	1 1/2 hr.
3. LEAK TEST OF CALIBRATION SOURCE			
4. EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION ACCIDENT			
5. DECONTAMINATION PROCEDURE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: R. LOVE · JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
X CELL EXHAUST SYSTEM 1. PROCEDURE FOR CHANGING FILTER	Cobalt office	W.R. Case	11/7/84 1.0 HRS.
XI CHILLER 1. PURPOSE 2. CORRECT SETTING	COBALT OFFICE	W. R. Case	10/10/84 45 min
XII DEIONIZER 1. PH OF WATER 2. PROCEDURE FOR CHANGING RESIN SACKS 3. CONDUCTIVITY METER	COBALT EQUIPMENT ROOM	WRCase	9-12-84 1.0 HRS.
XIII EMERGENCY CONDITION 1. PERSONNEL IN MAZE AT START-UP 2. MONITOR ALARM SIGNALS 3. MOMENTARY POWER FAILURE 4. PROLONGED POWER FAILURE 5. SAFETY PILOT ILLUMINATION 6. INTERAL CONVEYOR PILOT ILLUMINATION 7. AIR PRESSURE LIGHT ILLUMINATION 8. BOX ON CONVEYOR PILOT LIGHT 9. SOURCE RACK PILOT LIGHT ILLUMINATION 10. ONLY ONE SOURCE UP PILOT LIGHT ILLUMINATION	COBALT OFFICE	WRCase	9/19/84 1.5 HRS.
XIV MAINTENANCE 1. CHECKLIST	Cobalt office	W.R. Case	11/14/84 1.3 HRS.
XV ADMINISTRATIVE PROCEDURES XVI CLEARLY UNDERSTAND THE PERSONS TO CONTACT WHENEVER THERE IS ANY TROUBLE WITH THE MECHANICAL OPERATION OF THE STERILIZER	COBALT OFFICE	W.R. CASE	11/20/84 1.3 HRS

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: R. LOVE JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
1. ATTEND A PERTINENT COURSE AT/FROM AN INSTITUTION	B-D CANADA	ATOMIC ENERGY OF CANADA YVES DOYLE	1 FEB 1985
2. WORK A MINIMUM OF FOUR (4) WEEKS AS AN OPERATOR TRAINEE	B-D CANADA		1-9-85 TO PRESENT
3. DEMONSTRATE OPERATING PROFICIENCY	B-D CANADA	W.R. CASE	3/14/85

02320

Ronald Love - 3/14/85 2:00 PM

79

I. Stop Safe
High Temperature
Low air pressure
Source rack
-1 Water level - not acceptable
Exhaust fan
One of the pumps not working properly
Too much product on the line - I asked if it was on the input or output line? Ron replied - output line.

II. 5 lights:

Stop Safe - stop and safe condition
Internal Conveyor light - internal conveyor jam
High temperature light - high temperature conditions
Low air pressure light - low air pressure
Source rack - problem with source rack

Asked Ron why you would have low air pressure? He replied that there could be a problem with compressor or broken air line.

III. 1. Ratemeter - pointed out the ratemeter - he explained that it is the monitor that tells you if its safe to go in, if the Cobalt is high or low.

I asked - what is actually measured? Ron replied - the amount of Cobalt in the air.

I asked - what is sensing Cobalt? Ron replied - the level of radiation that's in the air.

a. On the back of the console - Ron pointed out the single Cobalt radiation monitor.

b. Adjusted 2 ways: Alarm level adjustment and ambient level adjustment.

c. Above the pool.

d. The monitor test button.

2. Ron showed where the Monitor Test pilot light was on the console and shows whether or not the monitor is working or the vault is working.

3. It's located on the console and it ensures that the circuits are functioning properly.

-2 4. Located on the console and should only come on when the machine shuts down under alarm conditions. I asked Ron - when else will it come on? Is it a split pilot light or is it 2 pilot lights in one? Ron replied - yes it is - one is for an alarm conditioning and one is for the alarm memory. I asked Ron - will the alarm light extinguish when the alarm condition has ceased? Ron replied- No, that's to be reset. I asked Ron - Will the memory light extinguish after the alarm condition has stopped? Ron replied - No, not until you reset it.

III. 4. (con't)

I explained to Ron that the alarm light will extinguish as soon as the signal to the monitor has stopped - as soon as the alarm system is extinguished or stopped - the alarm light will go out. The memory light will remain lit to let you know that an alarm condition has occurred. Ron replied that he understood.

a. No.

b. Right down the proper information and get in touch with the proper authorities; Bill Case - Safety Officer, Dick Crook, Andy Rowjohn and A.E.C.L.

I asked where Ron would find this information. He replied that it could be found on the bulletin board. Ron pointed to the Section 206 Notification posted on the bulletin board.

5. It's a green light located on the the left-hand side of the console and when it is on it tells you that the machine is ready to be started by an operator.

I asked Ron - what has to occur before the "Machine Ready" light will come on? Ron replied - the overdose timer has to be reset on the machine or any problem that might have occured has to be straightened out before you can reset anything.

I asked - what has to take place before the light will light? Ron replied - Reset the machine, check your Monitor Test, go over and test your geiger against the door, open the door into the Maze and reset your alarm. Then come out and reset your machine. I asked - do you mean your safety timer alarm? Ron replied - yes. Ron continued - then you set your clock and start the machine.

I asked Ron - does the door have to be closed before the light is lit? Ron replied - yes.

6. It's a green light on the left-hand side of the console and it tells you the carrier is ready in position #1. Asked Ron what the carrier was? He replied - it holds the product - the monorail. I asked Ron where Position #1 was? He answered that the monorail has to be inside the Maze. Asked - at the interval conveyor? Ron's reply - yes.

7. It's a light on the left-hand side of the console and it tells you if the machine has been reset. Asked what color is it? Ron's reply - yellow. Asked Ron - When the machine is to be reset is the light lit? If the light is lit, what does that mean? Ron replied - the machine needs to be reset. Asked Ron - when will that light light? Ron replied - He did not know. I explained to Ron that the light will light when a power failure occurs and then when the power comes back on that light will light to tell you to reset the console. Ron understood. I asked Ron - How do you reset the console? Ron replied - the power switch.

III. 8. It's on the front of the machine, it's located on the left-hand side and it's to indicate the amount of time it takes to run a cycle - to time-out a cycle. I asked Ron to explain it further. Ron replied - If you have a cycle that's supposed to run 2 hours you would set the cycle timer for 120 minutes. I asked - For every 120 minutes, what would happen? Ron answered - It would time-out and you would have to reset your cycle time - you'd have to set it according to the cycle that's going in next. -2 I said: Let's say that our cycle time according to the board is 2 minutes and 20 seconds for 820's, what does that do for us? Ron replied: Every 2 minutes and 20 seconds the carrier would come out. I asked - why setting every 2 min. and 20 secs. - why not let the carrier come in and go right through the process? Ron replied - it would jam-up. I asked - For what other reason do we have the timer set? Ron - For the personnel - you have so much time to load a carrier, unload the carrier and you're ready. Asked Ron - And what other reason? For exposure time - to make sure it gets the right exposure, the right amount of radiation dose the product needs to be sterile.

9. It's on the left-hand side of the machine and it indicates how long the carrier can stay in the pool and how much of a dose the carrier can receive of Cobalt.

   a. Ron did not know. I replied - One (1) minute more than the cycle time. The cycle timer gives you the exposure time for stepping carriers to receive the proper dose. -3 The overdose timer is the timer set for one (1) minute greater than the cycle timer to prevent from overdosing the product. If our cycle timer is 2 mins., 20 secs. we set our overtime timer for 3 mins., 20 seconds. If there is an external jam or monorail malfunction it will shut the unit down in 3 minutes and 20 seconds, which is one (1) minute greater than the cycle timer.

10. Tells you exhaust fan is running.

11. A split pilot light indicating that the filter pump is functioning and the upper portion when lit indicates that the resin sacs need to be changed.

12. It's a green light on the front of the console and when the light is on it tells you the water level is okay. When the light is not on it tells you the water level is too low. Question to Ron: We have two water level floats, one is your normal level float, what is the 2nd water level float for? Ron replied: Water level -2 is too low. Question: Will anything happen when that water level float is below the 2nd float? Ron answered: The machine will shut down. I explained to Ron that it will prevent you from entering the door or opening the maze door. Ron replied: You will not be able to enter the door because there is not enough water to cover the source.

IV. Bill Case, Radiation Safety Officer. Question: Where do you find that information? Ron replied - On the bulletin board - Ron pointed out Notification of Incident and Notice to Workers, Section 206.

V. 1. The person carrying the geiger.

2. The person carrying the geiger.

VI. 1. By the readings on the geiger and the lights on the console. Ron was asked to point out the pilot lights and explain them. Ron replied:

Source down - green light - towards the center of the console more on the left hand side. When it is lit green, the source is down in a safe position.

Source up - red light - on the front of the console towards the left-hand side and when the light is lit it means that the source is up and it's not safe to enter.

2. That there is a problem - could be a bad microswitch or the source could be "hung-up". Ron was asked - Why is it a split pilot light? Ron answered -The split will tell you if the source if all the way up or not. If half of the pilot light is lit it means that it is half way up. Ron was told that this was not correct. -3

Ron was asked: There is something that tells you that the source is up - which is this pilot light? Ron answered - source up pilot light. Asked: Why is this a split pilot light? What has to happen to light this light? Ron answered: The source has to come all the way up. Question: So, why do we have a split pilot light? Ron answered: To tell you that the source is all the way up, it's hitting the microswitches.

3. Could be a bad microswitch, emergency condition.

4. Limit switches for the source down pilot light are located on the ceiling inside the maze, over the pool.

Limit switches for the source up pilot light are located on the hoist. Ron was told that this was wrong - the source up switches are located on the framework inside the maze and the source down pilot light switches are located on the hoist. -3

5. The source is caught in the center, we have a burnt out bulb or bad microswitch.

a. First come in and check the button - see if the light is working. If the light is working and you still have no light, contact the Safety Officer. Ron was asked: Where would you find that information? Ron replied: On the bulletin board - Section 206.

VII. The door should be locked so that nobody can come in. The door going into the room where the console is should be locked. Ron was asked: I'm in the office and I have the key and I put it in the switch will the door open? Ron replied: No, because you have to reset the console. And if anyone tries to get into the door the machine will shut down because there is a safety interlock. Before you can energize the interlock you have to go through your steps of resetting the console.

VIII. There's an emergency safety wire on the wall, you should pull it.

IX. Ron turned the machine switch off. Ron used the monitor test. He reset the overdose timer. He now checks the meter against the check source on the door. Ron inserted the key and opened the maze door. He placed the meter just inside and observed the geiger counter reading. Removed the chain from across the aisle and he now inserts the key into the safety delay timer. The safety delay timer will not activate. We then went back out to the office console. Ron is now looking for the reason why it won't start. Ron inserted the key into the power switch, pushed the monitor test, alarm condition occurred, removed the key from the key switch. **Ron was asked:** Why did the machine shut down? Ron replied: P101 was jammed. Ron is now trying to clear jam. Ron now turns the conveyor switch off and then back on - then pushes P101 receive. Now pushed the P101 to discharge. Now pushed the conveyor to start. Monorail is now back in position 1. Ron walked out of the irradiator. Ron activated the safety relay timer, placed the chain across the aisle and closes the door. Now key switch on to start the machine and now sets the producto log and source comes up.

We the undersigned agree that the Oral Exam was completed satisfactorily.

Test was administered by
Radiation Safety Officer
W. R. Case

WR Case

Test was witnessed by
R. G. Crook
Manager of Microbiological and
Sterilization Services

RGCrook 3/14/85

ITEM 8

Required training for individuals who will be operating the unit under the supervision of a"responsible individual".

Training will be given by a"responsible individual(s)".

All training records are to be maintained for a period of 3 years.

ITEM 8

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
REQUIRED READING: — 23.0 HRS			
1 RADIATION SAFETY TECHNICIAN TRAINING COURSE			
1.a. BASIC INFORMATION PAGES 21-28			
1.b. PROPERTIES OF ALPHA, BETA, GAMMA, X-RAYS + NEUTRONS PAGES 50-75			
1.c. CONCEPTS OF RADIATION UNITS AND DOSE DETERMINATIONS PAGES 98-108			
1.d. SHIELDING PAGES 115-127			
1.e. BIOLOGICAL EFFECTS OF RADIATION PAGES 133-145			
1.f. BACKGROUND RADIATION PAGES 150-159			
1.g. RADIATION PROTECTION STANDARD PAGES 162-169			
1.h. RADIATION DETECTION PRINCIPLES PAGES 207-231			
1.i. HEALTH PHYSICS INSTRUMENTS PAGES 269-305			
1.j. PERSONNEL MONITORING DEVICES PAGES 315-341			
2 MANUFACTURER' OPERATING MANUAL			
3 STUDY THE INSTALLATION BLUE PRINTS			
4 TITLE 10 - ENERGY CODE OF FEDERAL REGULATIONS - PARTS 19, 20			
5 H.I.M.A. REPORT NO. 78-4.8 TITLED "OPERATOR TRAINING FOR RADIATION STERILIZATION EQUIPMENT".			
6 SECTION 6 - CORPORATE QUALITY ASSURANCE MANUAL			
7 STUDY THE IN-HOUSE SPECIFICATIONS THAT RELATE TO THE OPERATION OF THE STERILIZER			
8 STUDY PAST MAINTENANCE RECORDS			

C4580

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS			
I FAMILIARIATION TOUR OF FACILITY - 1.0 HR			
II MONITORS - 1.5 HRS.			
1. RATEMETER			
a. ITS PURPOSE			
b. LOCATION OF MONITOR			
c. LOCATION OF SENSOR			
d. CHECK FOR PROPER FUNCTIONING			
2. BERTHOLD METER/EBERLINE GEIGER COUNTER			
a. PURPOSE			
b SCALE READING			
C. CALIBRATION PROCEDURES			
III CONTROL CONSOLE - 3.0 HR			
1 KEY SWITCHES (4)			
a. PURPOSE			
2. PILOT LIGHTS			
a. DESCRIPTION			
b PURPOSE			
3. RELAYS			
IV OPERATOR SAFETY - 0.5 HR			
1. KEY ATTACHED TO BERTHOLD METER/EBERLINE GEIGER COUNTER			
2. CHECK SOURCE			
V PNEUMATIC CYLINDERS 1.0 HR			
1. SEQUENCE OF OPERATION			
2. MAINTENANCE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING	LOCATION (PLANT, ETC.)	PERSON ADMINISTERING TRAINING	DATE COMPLETED
TRAINING SESSIONS (CONT.)			
VI EMERGENCY & SAFETY DEVICES - 1.5 HRS.			
1. EMERGENCY STOP CONTROLS			
2. POWER FAILURE			
3. MAZE DOOR INTERLOCK			
4. SOURCE STORAGE RACK			
5. SOURCE RACK GUIDE CABLE			
6. TEMPERATURE SENSING DEVICE			
7. CONVEYING SYSTEM			
8. POOL WATER LEVEL SWITCH (2)			
9. SOURCE HOIST			
10. SOURCE ALARM			
11. AIR PRESSURE			
12. START UP SAFETY DELAY TIMER			
13. SOURCE INTERLOCK			
VII NORMAL START-UP PROCEDURE 0.8 HRS			
VIII NORMAL SHUTDOWN PROCEDURE 0.8 HRS			
IX CONTAMINATION DETECTION 1.5 HRS			
1. OZONE			
a. DETECTION			
b. MEASUREMENT			
c. TIME-DELAY			
2. LEAK TEST OF SOURCE			
3. EMERGENCY ACTION FOLLOWING A SUSPECTED RADIATION ACCIDENT			
4. DECONTAMINATION PROCEDURE			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
X CELL EXHAUST SYSTEM - 1.0 HR.			
1. PROCEDURE FOR CHANGING FILTER			
XI CHILLER - 1.0 HR			
1. PURPOSE			
2. CORRECT SETTING			
XII DEIONIZER - 1.0 HR.			
1. PH OF WATER			
2. PROCEDURE FOR CHANGING RESIN SACKS			
3. CONDUCTIVITY METER			
XIII EMERGENCY CONDITION - 1.5 HRS			
1. PERSONNEL IN MAZE AT START-UP			
2. MONITOR ALARM SIGNALS			
3. MOMENTARY POWER FAILURE			
4. PROLONGED POWER FAILURE			
5. SAFETY PILOT ILLUMINATION			
6. INTERAL CONVEYOR PILOT ILLUMINATION			
7. AIR PRESSURE LIGHT ILLUMINATION			
8. BOX ON CONVEYOR PILOT LIGHT			
9. SOURCE RACK PILOT LIGHT ILLUMINATION			
10 ONLY ONE SOURCE UP PILOT LIGHT ILLUMINATION			
XIV MAINTENANCE - 1.5 HRS			
1. CHECKLIST			
XV ADMINISTRATIVE PROCEDURES 1.0 HRS			
XVI CLEARLY UNDERSTAND THE PERSONS TO CONTACT WHENEVER THERE IS ANY TROUBLE WITH THE MECHANICAL OPERATION OF THE STERILIZER 0.5 HRS			

REQUIRED TRAINING FOR A COBALT 60 OPERATOR

NAME: JOB TITLE:

NATURE OF TRAINING	LOCATION PLANT, ETC.	PERSON ADMINISTERING TRAINING	DATE COMPLETED
1. ATTEND A PERTINENT COURSE AT/FROM AN INSTITUTION (N/A FOR OTHER USERS)			
2. WORK A MINIMUM OF FOUR (4) WEEKS AS AN OPERATOR TRAINEE			
3. DEMONSTRATE OPERATING PROFICIENCY			

BECTON, DICKINSON & COMPANY

CANAAN PLANT

I Jan 78

OPERATOR TRAINING PROGRAM (Cobalt 60)

TEST QUESTIONS

OBJECTIVE

An oral test to determine whether or not a trainee has sufficient knowledge to operate the irradiator in an efficient and safe manner. The operator should have a knowledge of what sources he should refer to for specific information regarding the operation of the irradiator. Test is to be given by the Radiation Safety Officer and/or the Sterilization Supervisor.

I. Under what conditions will the unit shut down?

II. How do you determine the shutdown?
(Have the trainee point out the pilot lights on the console and explain).

III. Have the trainee point out the pilot light on the console.
Explain:

1. Ratemeter

   a) Where is the monitor located?
   b) How is it adjusted?
   c) Where is the sensor located?
   d) How do you check the sensor for proper functioning?

2. "Monitor Test" pilot light

3. "Monitor Check" pilot light

4. "Alarm/Memory" pilot light

   a) If alarm light is lit, can you open the maze door?
   b) If an alarm condition exists, what procedures should an operator take?

5. "Machine Ready" pilot light

6. "Position"#1" pilot light

7. "Reset" pilot light

8. "Cycle Timer"

9. "Overdone Timer"

   a) How many more minutes should the overdone timer be set using the cycle timer time as a reference?

10. "Exhaust Fan" pilot light

11. "Filter Pump" pilot light

12. "Water Level" pilot light

IV. In case of an emergency or a discovery of any deviation or defect which could possibly present a substantial safety hazzard, who is notified?

V. 1. Who is the first person to enter the irradiation maze?

2. Who is the last person out of the irradiation maze?

VI. 1. How do you determine when the source is in the up or stored position?
(Have trainee point out the pilot light).

2. When in the up position, what does the split pilot light indicate?

3. When the source up and source down pilot lights are both lit, what does this signify?

4. Where are the limit switches located for the source down pilot light and the source up pilot light?
(Have trainee point out the limit switches).

5. If neither the source up or source down pilot light is lit, what does this signify?

a) If this condition exists, what procedures should an operator take?

VII. Irradiation is in an operating mode. There is more than one key for the key switches. What is to prevent someone from using the spare key to open the maze door?

VIII. Trainee and John entered the maze. John had the ratemeter, started the safety timer, left the maze and closed the door behind him. Trainee was left in maze. What immediate action should Trainee take?

IX. Have Trainee start the unit. Observe that he uses all safety procedures.

ITEM 9

The source when stored is lowered into eighteen feet of water. The source when raised is located in the center of the source pass mechanism. Refer to figure 1 of attached sheets.

Warning lights are posted outside the control room door and maze door.

To prevent operating personnel exposure to ozone a time delay has been placed into the electrical circuit. When the source is placed into the stored position, radiation warning lights extinguish, closing circuit to time delay. When preset time has elapsed the circuits are completed lighting the "Ok To Enter" lamp on console and allowing the cell door to be opened.

There is an audible and visual alarm located inside the maze that is activiated when the start-up safety delay timer is activated.

Reference check sheets that are completed on a daily, weekly, monthly, semi-annual and annual basis for safety system check.

ITEM 9, ~~13, 13A, 13B, 13C, 13D~~

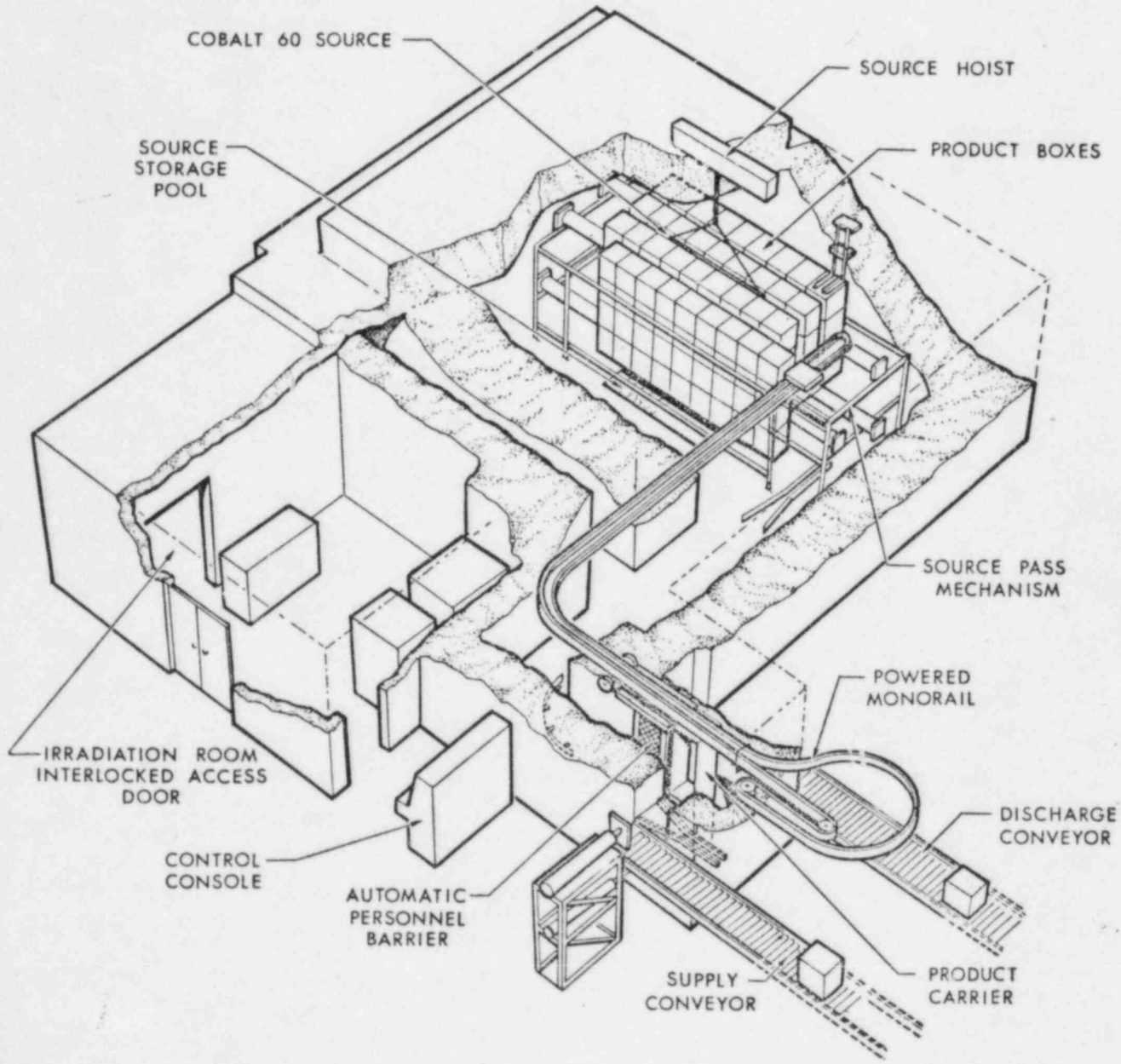


FIGURE 1

J6000-J6500

PART 1

DESCRIPTION

The general layout of the facility is shown on A.E.C.L. drawing A02687 or A04708. The type J-6000 and J-6500 Irradiator is a self-contained unit surrounded by a ventilated concrete biological shield. The J-6000 machine is designed to sterilize by irradiation medical products in fibreboard product boxes 18.0 in. (45.7 cm.) wide, 36.0 in. (91.4 cm.) high, and 18.0 in. (45.7 cm.) in length. Maximum box weight is 65.0 lb. (29.5 kg) assuming a product density of 0.30 gm/cc, and the minimum box weight is 10.0 lb. (4.5 kg) assuming a product density of 0.05 gm/cc. The tolerance on box outside dimensions is plus or minus 0.12 in. (3.17 mm). Under no circumstances should a box be processed in the irradiator which exceeds this tolerance.

The J-6500 machine is designed to sterilize by Irradiation medical products in fibreboard product boxes 19.0 in. (43.3 cm.) wide, 36.0 in. (91.4 cm.) high and from 16.0 in. (40.6 cm.) to 23.0 in. (58.5 cm.) in length. The tolerance on the maximum box dimensions are plus or minus 0.12 in. (3.17 mm). Maximum product density is 0.30 gm/cc, and minimum product density of 0.05 gm/cc. In selecting product box sizes, consideration must be given to the stability of a moving unit on conveyors. The boxes in the irradiator must be of one size only.

IRRADIATOR BUILDING

The irradiator building comprises that area deliniated on A.E.C.L. drawing A02687 or A04708. E-1 The building is constructed above ground from standard density concrete (2.36 g/cc.) and is attached to the main plant. The reinforced concrete biological shield is designed to reduce radiation levels to not more than 0.25 m.r.h. on all accessible surfaces when a 1,500,000 ~~1,000,000~~ curie Cobalt 60 radiation source is utilized.

The building is served by the main plant heating (and/or air conditioning), electrical power, compressed air, water, drainage and sprinkler facilities.

BIOLOGICAL SHIELD

The biological shield is designed such that either no personnel receive more than 10 m.r. during any 40 hour week, or that the maximum dose rate does not exceed 0.25 mr/hr.

With the source in the irradiating position the shield provides shielding in all proximate areas as indicated on A.E.C.L. Drawing No. A02687 or A04708. The following areas have been taken into consideration.

a) Control Area — the average radiation field inside the control area does not exceed 0.25 m.r.h. The maximum field in any small area does not exceed 2.5 m.r.h.

b) Roof — this is a restricted area.

c) Equipment Room — this is a restricted area.

d) External Areas.

VENTILATING REQUIREMENTS

The irradiation room requires ventilation facilities capable of providing 20 air changes per hour.

PNEUMATIC REQUIREMENTS

The irradiator requires pneumatic facilities with a minimum capacity of 35.4 cubic feet per minute free volume of air based on free air at 7.0 atmospheres. A 7.5 HP compressor with a reservoir of 20 cubic feet capacity is recommended.

ELECTRICAL REQUIREMENTS

The irradiator requires a 220 volt, 3 phase and 110 volt, 1 phase, 50 or 60 cycle supply with a minimum capacity of 5.0 K.V.A. Transformers will be supplied to reduce local voltages available to the above.

STORAGE POOL

A water filled pool is provided in the floor of the irradiation room for storage and replenishment of the Cobalt 60 source pencils. When the source is in the storage position radiation fields inside the irradiation room will not exceed 0.25 m.r.h.

The water in the pool is continuously circulated through a mixed resin bed demineralizer and activated carbon purifier. Pool walls are constructed with poured concrete of minimum density 147 lb. cubic foot (2.36 gm/cc.).

To prevent seepage of pool water into the surounding earth a waterproof membrane is provided on the exterior pool walls with an industrial tile lining on the interior.

PRODUCT BOXES

Medical products are transported through the irradiator in ~~corrugated fibreboard containers (boxes)~~ IN ALUMINUM CARRIERS. ~~Two boxes are taped together for irradiation operations~~. The strength and rigidity of the box must be comparable to that stipulated in Rule 41 of the Uniform Freight Classification for the following minimum grade of material to ensure trouble free operation of the product conveying systems:

J-6000 PRODUCT BOX SPECIFICATIONS

a) External Dimensions — fixed product box sizes are; 18.0 in. (45.7 cm.) wide, 36.0 in. (91.4 cm.) in height, Box length 18.0 in. (45.7 cm.).

b) Weight — 65.0 lb. (29.5 Kg) assuming a product density of 0.30 gm/cc. or a minimum of 10.0 lb. (4.5 Kg) assuming a product density of 0.05 gm/cc.

c) Box Design Criteria — a single box unit of typical dimension 18.0 in. (45.7 cm.) x 18.0 in. (45.7 cm.) x 36 in. (91.4 cm.) must be capable of withstanding a uniform and centrally located side load of 400 lb. (182 Kg) without causing deflection, distortion or other damage to the box unit; side load to be applied via a flat metal surface over an area of 18 in. (45.7 cm.) x 18 in. (45.7 cm.).

d) Box Tolerance — external dimensions maintained to within plus or minus 0.12 in. 3.18 mm.).

J-6500 PRODUCT BOX SPECIFICATIONS

a) External Dimensions — variable product box sizes are; 19.0 in. (43.3 cm.) wide, 36.0 in. (91.4 cm.) in height, and from 16.0 in. (40.6 cm.) to 23.0 in. (58.5 cm.) in length.

b) Product Density — maximum density of 0.30 gm/cc. and minimum density of 0.05 gm/cc.

c) Box Design Criteria — a single box unit of typical dimension 18.0 in. (45.7 cm.) x 18.0 in. (45.7 cm.) x 36.0 in. (91.4 cm.) must be capable of withstanding a uniform and centrally located side load of 400 lb. (182 Kg) without causing deflection, distortion or other damage to the box unit; side load to be applied via a flat metal surface over an area of 18 in. (45.7 cm.) x 18 in. (45.7 cm.).

d) Box Tolerance — external dimensions maintained to within plus or minus 0.12 in. 3.18 mm.).

ATTACHMENT A

Cobalt 60 Source

Aluminum sheets of 1/8 inch material were installed to form a shroud separating the source from the product conveyors to prevent the product totes from interfering with the source rack and to prevent pencils from jamming between product and conveyors.

PRODUCT CONVEYOR SYSTEM

The product conveyor system automatically transports the boxes into and out of the irradiation chamber. The unirradiated product is stored on the accumulating input storage conveyor which is adjacent to the load-unload station. The input conveyor is 15.0 feet (4.57 m.) in length and has a storage capacity for 10 product boxes.

On a signal from the master timer, ~~a double box unit (two boxes stacked and taped together one on top of the other) are~~ A ALUMINUM CARRIER IS fed onto the top level of the source pass conveyor. A product box pair is then ejected from the bottom layer of the source pass conveyor into the lower shelf on the maze carrier.

The source pass conveyor consists of two layers of box support beds, pneumatic "pushers" and end transfers, and an elevator mechanism. The incoming product is discharged onto the upper layer support bed and irradiated product is discharged onto the lower shelf of the maze carrier.

The carrier returns through the maze to discharge irradiated products to the accumulating output storage conveyor. This conveyor is 15.0 feet (4.57 m.) in length.

The product boxes are conveyed about the vertical plaque source by means of the pneumatic pushers and end transfer devices. Box movement is intermittent with the cycle time determined by the master timer.

SOURCE PASS MECHANISM

When a product box reaches the end of the first pass by the source it is transferred to the inner passage on the same layer and its direction is reversed. On completion of the second pass the product box is transferred to the opposite side of the source plaque on the same layer and its direction is again reversed. On completing the third pass the product box is transferred to the fourth pass and its direction is again reversed.

When the product reaches the end of the fourth pass the box is lowered on a pneumatic elevator to the lower source pass mechanism layer where it is transferred onto the fifth pass. The product continues to move intermittently through the sixth, seventh and eighth passes on the lower level. On completing the eighth pass the product box is discharged into the maze carrier for transport out to the discharge storage conveyor.

CONTROL OF ACCESS

ROOF OF IRRADIATION BUILDING

The roof is accessible only by ladder. There is a steel ladder secured to the main building wall up to the roof of the maze. A radiation hazard sign will also be displayed in this area. Use of the ladder is restricted by a ~~fixed chain.~~ DOOR THAT SWINGS OPEN. DOOR IS FULL LENGTH OF LADDER AND IS LOCKED AT THE TOP OF THE LADDER.

COBALT 60 SOURCE

Each source "pencil" is made up of 16 Cobalt 60 "slugs" each 0.63 cm. dia. by 2.54 cm. long, doubly encapsulated and heliarc welded in type 316 ELC stainless steel tubing. Overall pencil dimensions are 17.78 in. (45.16 cm.) long with a body diameter of 0.38 in. (0.96 cm.) and solid stainless steel end caps 0.437 in. (1.11 cm.). (Refer A.E.C.L. Specifications C110, C177 and C188).

Source pencils are housed in modular frames to form a plaque source. The plaque frame contains 6 modules with each module handling up to 42 pencils; a maximum plaque capacity for 252 pencils.

CONTROL CONSOLE

A two sectioned control console is provided. The console is located in the control area close to the control area door, ~~and viewing window~~.

The left hand section (or panel) includes the following controls and indicators:

1. Monitor "Meter" — an edge mounted ratemeter to indicate radiation levels inside the irradiation room with the source in the down (or safe) position.

ATTACHMENT B

L-118 MONITOR

REVISED TEST PROCEDURE

This test procedure is to be used in conjunction with the modifications carried out under "Warning Notice IND-81-2."

This procedure is to be performed monthly. This test is in addition to the L-118 test source procedure now in effect which is to be continued.

The test procedure to be used is as follows:

i) From "Source Down" position, start source up.

ii) Push and hold pushbutton. Alarm should start during source movement and needle on meter should move to the 'Red' condition.

iii) Keep pushbutton depressed until source has completed full travel and is in the "Source Up" position plus an additional thirty (30) seconds.

iv) Remove finger from pushbutton. Alarm should stop and needle should return to normal.

WARNING Any variance from the above indicates an abnormal condition and AECL-CP should be contacted at (613) 592-2790 - Supervisor, Installation & Service.

2. Monitor "Alarm" and "Memory" – a split pilot light to indicate a) when radiation levels inside the irradiation room exceed the permissible limit and b) after an alarm condition has ceased or been rectified the "Memory" pilot light will remain illuminated until the "Reset" button has been actuated.

   An alarm horn, which is wired in parallel with the "Alarm" pilot light, will emit a loud piercing signal if an alarm condition occurs. The critical level in the alarm circuit will normally be set at 80% of the full scale ratemeter deflection, about 8 times the normal background level.

3. Monitor "Check" – a pilot light to indicate a steady "on" or "off" condition as well as momentary (normal) pulsing. The "Check" light will pulse to show that the ratemeter circuits are functioning.

4. Monitor "Test" – an illuminated push button switch. When the switch is actuated an alarm condition is induced into the ratemeter circuit to verify that the meter circuit is functioning correctly.

5. "Reset" – an illuminated push button switch to reset the monitor after an alarm condition.

6. "Power" – a three position keyswitch with an "off", "on", and a spring loaded "reset" position to control the power supply to the unit.

7. "Control" – a three position keyswitch with an off, on, and a spring loaded "start" position. This switch controls both the source hoist and conveyors for automatic machine operation.

8. "Machine On" – a pilot light to indicate that the machine is running automatically.

9. "Machine Ready" – a pilot light to indicate that the safety delay timer in the irradiation room has not "timed out" and the machine is ready for operation.

10. "Carrier in Position No. 1" – a pilot light to indicate that the product box carrier is in the correct position to commence machine operation.

11. "Box On Conveyor" – a pilot light to indicate that a product box is available on the supply conveyor.

12. Master "Timer" – a key operated timer to control the machine cycle period.

13. "Exhaust Fan" – a pilot light to indicate that the exhaust fan is functioning.

14. "Water Regenerate and Filtration Pump" – a split pilot light to indicate a) that the deionizer plant requires regeneration and b) the filtration pump is functioning.

15. "Water Level" – a pilot light to indicate that the water in the pool is being replenished.

16. "Safety" – a pilot light to indicate that either a) the emergency cable has been pulled, b) the emergency button at the load/unload station has been actuated, c) the emergency push button on the control console has been actuated, or d) the door interlock circuit has been tripped. e) safety timer

17. "Internal Conveyor" – a red pilot light to indicate that the source pass conveyor has malfunctioned.

18. "High Temperature" – a red pilot light to indicate that the temperature sensing probe inside the irradiation room has detected a significant rise in temperature.

19. "Low Air Pressure" – a red pilot light to provide a visual indication that air pressure in the system has dropped below the required level.

20. "Source Rack" – a red pilot light to indicate that source rack operation is faulty.

21. "Source" – a three position keyswitch with an "off", "on" and spring loaded "start" position. This switch controls the source hoist mechanism without machine conveyor operation.

22. "Source Down" – a green pilot light to indicate that the source is in the fully down (or safe) position.

23. "Source Up" – a split red pilot light to indicate that the source rack is in the irradiate position and that the plaque is horizontal.

Note:

With reference to items 22 and 23 above it should be noted that both the red "Source Up" and the green "Source Down" pilot lights will be simultaneously illuminated for any intermediate source position. Individual red or green lights will indicate that the source is fully up or down.

24. "Emergency Stop" – a red push button switch is located on the left control panel. Use of this switch will cause the product conveying mechanisms to automatically shut down and the source will be lowered immediately.

25. "Box Counter" – an impulse counter is located on the left control panel to record twice the number of completed source pass mechanism cycles. During normal (automatic) operations an irradiated double product box is discharged and an unirradiated double box enters the facility on completion of one full cycle. For record purposes, Serial No. of each box may be arranged to correspond with the box counter.

The right hand section (or panel) includes the following pneumatic cylinder position indicators and conveyor controls:

1. "P. 101, Receive" – a pilot light to indicate that cylinder P. 101, at the load/unload station, is in the receive position.

2. "P. 102, Receive" – a pilot light to indicate that pneumatic cylinder P. 102, at the load/unload station, is in the receive position.

3. "P. 101, Discharge" – a pilot light to indicate that pneumatic cylinder P. 101, at the load/unload station, is in the discharge position.

4. "P. 102, Discharge" – a pilot light to indicate that pneumatic cylinder P. 102, at the load/unload station, is in the discharge position.

5. "Carrier In" – a pilot light to indicate the direction of carrier movement on the monorail between the load/unload and source pass mechanisms. The "in" direction is towards the source pass mechanism. It becomes a push button switch used to move the carrier towards the internal mechanism during "manual" conveyor key switch operation.

6. "Carrier Out" – a pilot light to indicate the direction of carrier movement on the monorail between the source pass and load/unload mechanisms. The "out" direction is away from the source pass mechanism. It becomes a push button switch used to move the carrier away from the internal mechanisms during "manual" conveyor key switch operation.

Note:

Reference items 5 and 6; only one of the specified pilot lights will be illuminated at any one time. "Manual" operation by the keyswitch and pushbutton will not affect the cycling of the "in" or "out" pilot lights. The lights will only indicate carrier movements during automatic operations. It should be noted that the pilot lights do not indicate the actual position of the carrier but only the position that the carrier must assume for automatic operations.

7. "Conveyors" – a three position keyswitch with and "off", "manual", and spring loaded "automatic" position. This switch controls conveyor operations, without source elevation, during machine maintenance procedures.

8. "P. 1 to P. 15 (inclusive) Receive" – fifteen illuminated push button switches. These switches are used during maintenance operations to move the designated source pass mechanism cylinders from the discharge into the receive position. Actuated only when the conveyor keyswitch is in the "manual" position.

9. "P. 1 to P. 15 (inclusive) Discharge" – fifteen illuminated push button switches. These switches are used during maintenance operations to move the designated source pass mechanism cylinders from the receive position into the discharge position. Actuated only when the conveyor keyswitch is in the "manual" position.

ATTACHMENT D

Air Supply

The air supply to the source hoist is directed through a three-way valve inside the maze entrance door. The valve is operated by a chain which is stretched across the passage and secured to a hook on the opposite wall. In this condition air is allowed to flow to the source hoist. When the operator enters the cell, he disconnects the chain and this mechanically prevents air from reaching the source hoist.

ATTACHMENT C

Pool Water Level

A second water level switch will operate below the normal level control. Should the water level drop below the level of this switch, there would be a visual and audible alarm and the door lock would be prevented from opening.

EMERGENCY AND SAFETY DEVICES

Emergency Stop Controls

An emergency control cable is positioned along two walls in the irradiation room and extends throughout the maze. Emergency push buttons are also located at the load/unload station and on the control console. If either of these controls is actuated the conveyors will stop and the source will be lowered.

Power Failure

In the event of a power failure the source rack will be lowered automatically at a rapid but controlled rate. This will prevent overexposure of the product. If the failure is of a momentary (up to 30 seconds) duration the source will return to the exposed position on resumption of the power supply. The machine will then continue to operate normally.

Maze Door Interlock

A door interlock is provided on the maze door which prevents access into the irradiation room during irradiator operations. The interlock solenoid is of the normally engaged type and continuously rated. The solenoid must be energized with the "Maze Door" keyswitch before the room is accessible. A mechanical interlock release is provided inside the maze to permit personnel to leave if the door shuts accidentally.

A microswitch mounted in the door latch ensures that the unit is only operable when the door is closed and locked. Overall control of the door interlock is maintained with the "Power" keyswitch on the control console.

Source Storage Rack

A storage rack, with a capacity to store all the source modules, is provided for use in the pool. This permits the source rack itself to be periodically raised for examination as required.

Source Rack Guide Cable

If the source rack should jam, the tension on the guide cable can be relieved from outside the irradiation room to permit the rack to be freed.

Temperature Sensing Device

A temperature sensing and control unit, mounted with its probe inside the irradiation room, will detect a significant rise in temperature, lower the source, and stop the machine.

Conveying System

If the conveying system does not complete its cycle within a present time interval of 135 seconds (approx.) the machine will automatically shut down.

Pool Water Level

The water in the pool is automatically maintained within preset levels by a switch controlling a water make-up line. If the level drops below the lower limit a caution light illuminates on the control console. The "Water Level" caution light advises the operator that water replenishment is required. A raw water meter measures the amount of make-up water being automatically introduced into the storage pool.

Source Hoist

If the source plaque does not complete the transition source "off" position/source "on" position within 60 seconds (approx.) the machine will shut down automatically.

Source Alarm

While the source is in motion an audible alarm will signal continuously. Pilot lights on the control console will indicate the position of the source.

Air Pressure

Failure of the compressed air system will shut down the conveyor system and lower the source. A pilot light on the control console will provide a visual indication of pneumatic failure.

Start-up Safety Delay Timer

A 90 second timer controlled by the "Safety" delay keyswitch installed inside the irradiation room, must be actuated with the "Power" key before irradiation operations can commence. This ensures that the operator enters the room and checks for

the presence of personnel and eliminates the possibility of personnel being inadvertently shut inside the irradiator.

Source Interlock

The source interlock will drop out 90 seconds after the "Safety" keyswitch is actuated. If any emergency device is actuated while the source interlock procedure is being carried out, the operator must return to the control console and reset the machine before repeating the start-up procedure. The operator cannot open the maze door from the outside unless the source is fully down (or safe) and there is a positive safe reading indicated by the irradiation room monitor.

03572

Revised 3/6/85

VICTOREEN MONITOR

The Model 808A "Vamp" Victoreen Monitor is a self-contained radiation monitor which measures gamma radiation level over a three-decade range, and presents an audible and visual alarm at a set point within this range. The range is 0.1 m r/hrs to 100 m r/hrs. Its accuracy is ±15% of actual intensity. Sensor is located at the carrier exist door.

CALIBRATION

Calibration is to be performed annually by one of the listed service companies.

1. Eberline Instrument Corporation
   312 Miami Street
   West Columbia, South Carolina 29169
   803-796-3604
   License Number 155 AM #10
   South Carolina
   Department of Health
   South Carolina D.H.E.C.
   Bureau of Radiological Health
   Calibration procedures attached

2. Nuclear Diagnostic Laboratory
   1000-T Lower S.
   Peekskill, New York 10566
   914-737-7330
   License Number 1059-1422
   State of New York Instrument Calibration Number
   Calibration procedures have been filed with the N.R.C.

3. Health Physics Associates Ltd.
   3304 Commerical Avenue
   Northbrook, Illinois 60062
   License Number 12-09160-01
   Calibration procedures have been filed with the N.R.C.

DWG. NO.
E-02-01-016-C
SH 1 OF 1

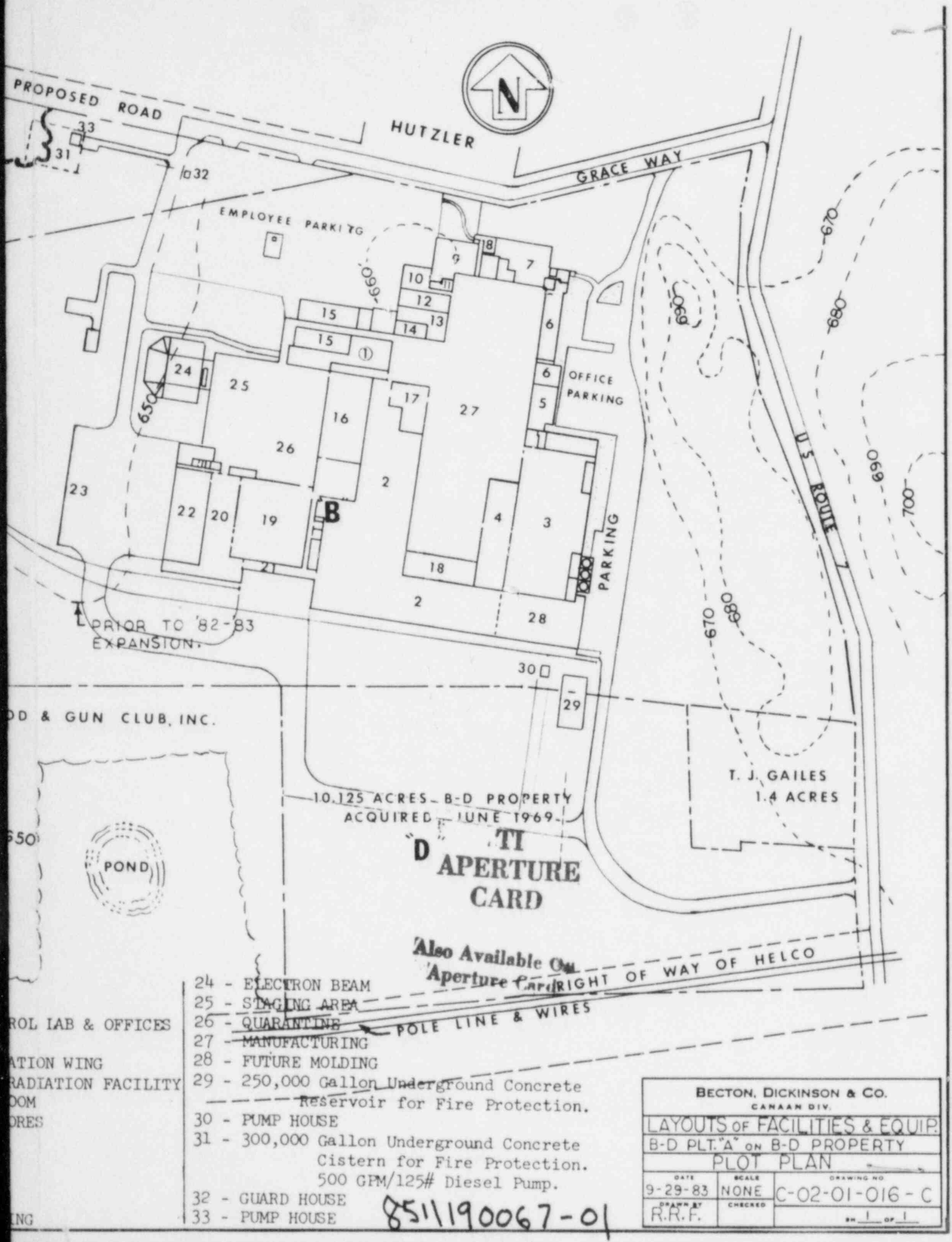
IDC19

"A" = 42.5 ACRES (WOODED)
"B" = 8.29 " (CLEARED)
"C" = 11.82 "
"D" = 10.125 "

TOTAL B-D LAND = 72.735 ACRES

NOTES:

1 - WATER TOWER 100,000 Gal. for fire protection.
2 - WAREHOUSE
3 - MOLDING
4 - TOOL ROOM
5 - CAFETERIA
6 - MAIN OFFICES
7 - ENGINEERING & HUMAN RESOURCES
8 - FIRST AID
9 - STERILIZATION LAB. & OFFICES
10 - CARPENTRY SHOP
11 - LABEL ROOM
12 - PARTS VAULT
13 - QUALITY CONT
14 - MAINTENANCE
15 - ETO STERILIZ
16 - COBALT 60 IR
17 - BOX MAKING R
18 - SECONDARY ST
19 - CASE PACK
20 - SHIPPING
21 - RECEIVING
22 - TRUCK DOCKS
23 - TRAILER PARK



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ITEM 9

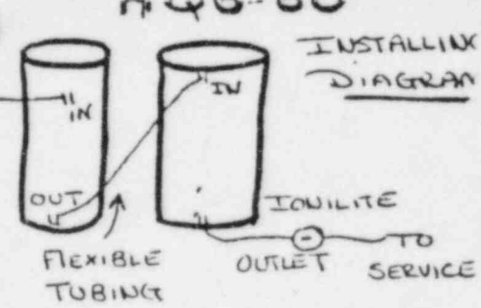
AQ6-60

PRACTICAL PRODUCTS OF SCIENTIFIC RESEARCH

CRYSTALAB

INCORPORATED

612 CAPITOL AVENUE, HARTFORD, CONN. 06106 • (203)527-3215



INSTALLATION DIAGRAM

INSTALLATION AND OPERATING INSTRUCTIONS FOR THE CRYSTALAB AQ6-30 DEMINERALIZER

SPECIFICATIONS

Mounting: Free standing on floor or with shelf supports
Dimensions: 10-1/2" W X 9" D X 34" H
Weight: Approximately 20 lbs.
Fittings: 3/8" NPT inlet and outlet with 3' lengths
3/8" O.D. Polyethylene Tubing
Operating pressures: Maximum 125 psi
Maximum water temperatures: 100°F
Flow rates: Normal service - 90 GPH maximum
Recirculated systems - 180 GPH Maximum

LOCATION

The AQ6-30 is a free standing unit and can be installed directly on the floor or a supporting platform for elevated installations. Unit should be located near point of use to avoid long runs of piping and, if practical, near a drain or sump, since cartridge changes require that it be drained. A bucket can be used if no drains are available. Units equipped with Ionilite or Ionimeter will require electrical outlets (110V 60 Cycle).

INSTALLATION

1. Remove unit from shipping container and place in position. To be sure that unit is easily accessible, allow at least six (6") inches of space behind and on each side; and at least two (2') feet of head room above unit. (Cartridges are removed from the top.)

2. Two (2) pieces of flexible tubing are supplied with this unit and should be connected to the inlet and outlet. Connect inlet tubing to cold water supply line. If no shut-off valve is located in this line near the unit, one should be installed to facilitate cartridge replacements. Connect outlet tubing to supply line of equipment in which the purified water will be used. This line should also have a shut-off valve.

IMPORTANT

Unit to be connected to cold water only. If water pressure exceeds 125 pounds per square inch, a pressure regulator will be required in the inlet line to prevent demaging the unit.

3. To install cartridges into unit, proceed as follows:

   A. Loosen the four (4) hand knobs from the top of the column. Lightly tap the underside of the top cover to break "O" ring seal, work it off the column, and set it aside. CAUTION: Only a gentle tap is required.

   B. Place cartridge bags in column in accordance with instructions enclosed with them. IMPORTANT: Install cartridge into unit with the arrows on side of cartridge bags pointing downward or unit will not operate properly.

   C. Replace cover on column and tighten hand knobs evenly and firmly.

4. Close vent and drain cocks.

5. Before operating, unit should be tested at full pressure for leaks.

   IMPORTANT: Apply a thin coat of silicone lubricant, or other non-petroleum based lubricant, to "O" rings at least once a year to keep "O" rings in proper condition.

6. To place unit in operation, proceed as follows:

   A. Open inlet valve.

   B. Open drain cock only until water comes through. This procedure allows column to fill with water.

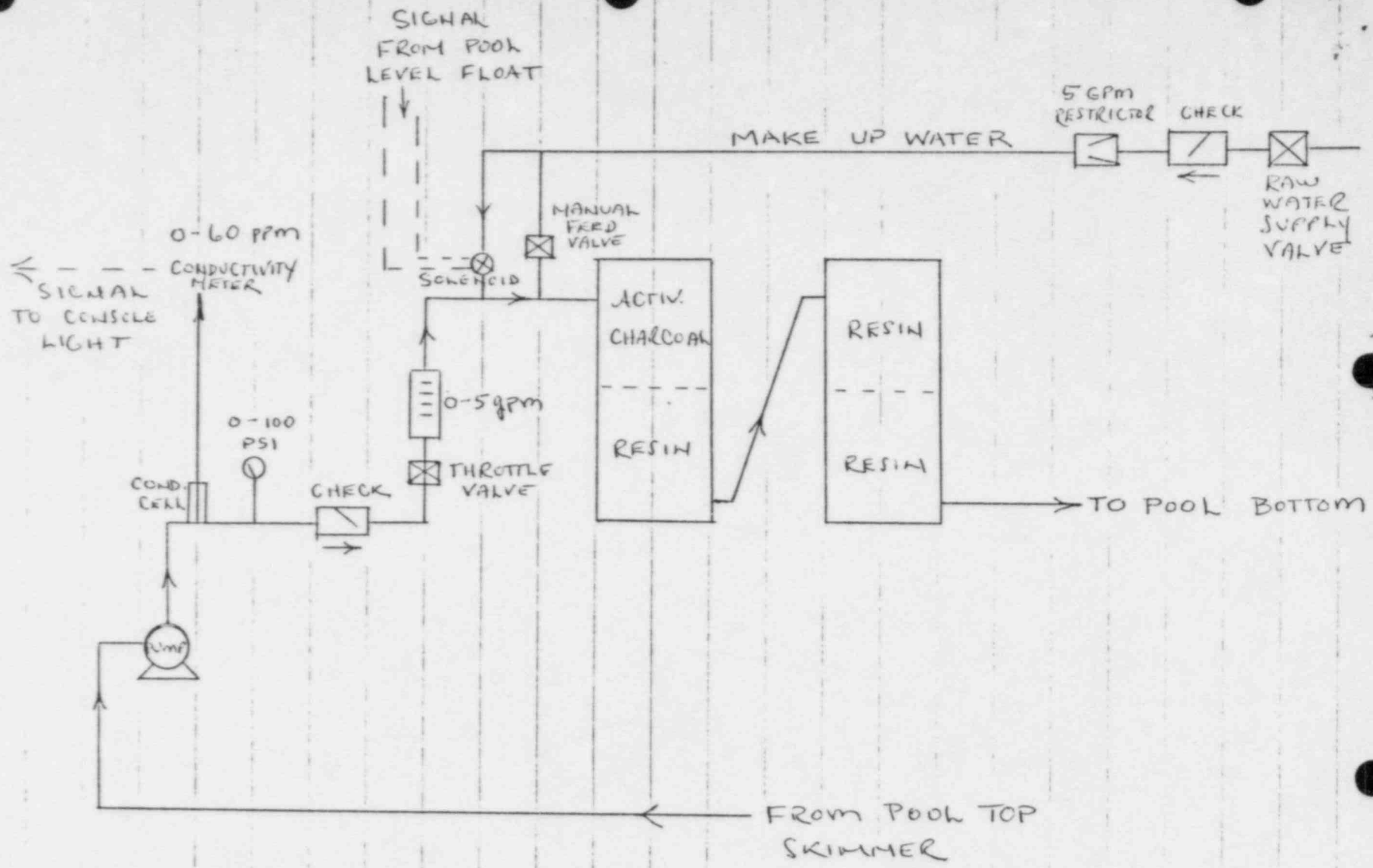
   C. Close drain cock and then open valve to equipment supply line.

7. Connect power cord of purity monitor. NOTE: Ionilite will remain on until clean water from cartridges displaces the impure water left in the line and at the bottom of the unit. Purity monitors will read high for a few gallons or so of operation. This is normal, and if the small amount of impure water is objectionable, run unit with discharge to drain for a few minutes. (Drain cock can be used for this purpose before being placed in service.)

CARTRIDGE REPLACEMENT

When Crystalab IONILITE glows red or when impurity levels in the effluent water reaches the maximum allowable level, the filter cartridges should be changed as follows:

1. Unplug power cord of conductivity monitor and shut off inlet and outlet water valve to isolate unit.
2. Open drain cock to relieve pressure. Then open vent cock. If no drains are available, allow unit to drain into a pail.
3. After unit half drained, remove used cartridges and replace with new ones, following the instructions outlined in sections 3 through 7 of the installation instructions.


SIGNAL FROM POOL LEVEL FLOAT
5 GPM RESTRICTOR
CHECK
MAKE UP WATER
RAW WATER SUPPLY VALVE
MANUAL FEED VALVE
0-60 PPM
CONDUCTIVITY METER
SIGNAL TO CONSOLE LIGHT
SOLENOID
ACTIV. CHARCOAL
RESIN
RESIN
RESIN
0-5 GPM
0-100 PSI
COND. CELL
CHECK
THROTTLE VALVE
TO POOL BOTTOM
PUMP
FROM POOL TOP SKIMMER

OPERATING PARAMETERS AND SPECS

Flow: 5 GPM

Press: 72 lbs/in^2

1) Flow manually set at throttle value.

2) Selenoid value in make up water line operated by signal from float switch in pool. Pump shuts off during this sequence.

3) Conductivity meter preset for proper concentrations. Light on console lights when conductivity rises above set level. Meter may be read manually also.

7076 Multi-Range Electrolytic Conductivity Monitor with Digital Readout

C2.2114-DS

- **Low-cost digital-display expanded-scale readability for industrial electrolytic conductivity measurements**
- **Multi-range instrument (X1, X10, X100)**
- **Conductance or resistance ranges**
- **Built-in calibration check switch**
- **Automatic temperature compensation on all ranges to assure accuracy under varying process conditions**
- **Standard alarm can initiate control action**
- **Signal lights indicate high or low alarm conditions**
- **Standard isolated voltage-output signals for remote recording or auxiliary devices**
- **Optional plug-in isolated current-output module**
- **Designed to meet Class I, Division 2, Groups B, C and D requirements when hermetically sealed relays are specified**
- **NEMA 3R and NEMA 12 corrosion-resistant, rain-resistant, outdoor, weather-proof, dust-proof plastic case**
- **Panel-, pipe- or wall-mounting**
- **Designed to meet OSHA requirements**

The 7076 Electrolytic Conductivity Monitor is an inexpensive instrument especially designed to provide low-cost accurate measurement and/or control of conductivity or resistivity in industrial processes with continuous digital display. The value (micromhos or ohms) is indicated by a 3½ digit, seven-segment easy-to-read LED display . . . numerals are a nominal half-inch high.

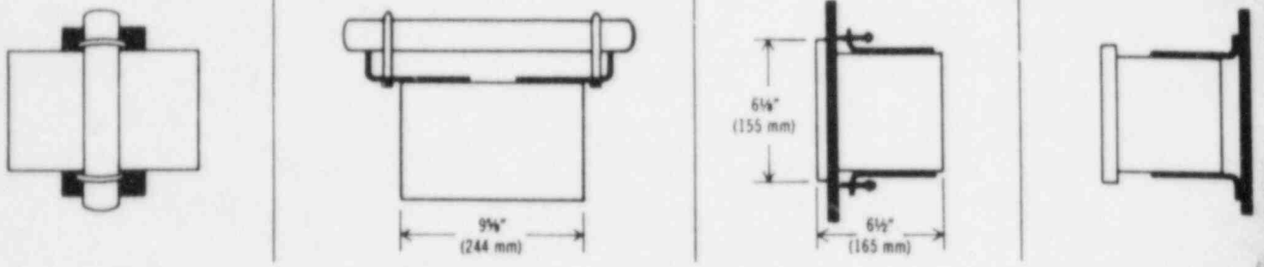
Used with 4973, 4905, 4909 and 4800-Series conductivity cells, the 7076 Monitor provides high standards of reliability and operating convenience in the measurement of electrolytic conductivity in process solutions ranging from high-purity water to concentrated inorganic chemicals. It can be used for such diverse applications as pharmaceutical and chemical processing, pulp and paper processing, cation and anion exchangers, cooling-tower control, reverse osmosis, boiler-water blow-down, condenser tube-leak detection and rinse-tank control.

One independently-set alarm/control relay can operate an external alarm or initiate control action. Red or green signal lights on the front panel indicate when a high- or low-alarm condition has been reached; graduated knobs permit setting the high and low limits. Hermetically sealed relays can be specified, to meet Class I, Division 2, Groups B, C and D requirements.

Two standard output signals proportional to the input — 0 to 1 and 0 to 10 volts — can be used as inputs to most recorders, or such auxiliary devices as a 7080 Alarm/Control Module or an 099230 Isolated-Output Module. An optional plug-in circuit card can provide a proportional current output, with six selectable ranges.

The instrument is housed in a NEMA 3R and NEMA 12 plastic case which is corrosion-resistant, rain-resistant, dust-proof and suitable for outdoor use. Universal mounting hardware — to permit wall, pipe or panel-mounting — is included with the Monitor.

LEEDS & NORTHRUP
A UNIT OF GENERAL SIGNAL



Mounting Styles

Every 7076 Monitor comes complete with hardware for panel, wall, or pipe mounting — and an optional portability kit lets you take the monitor to the process.

Pipe Mounting — Suspended below horizontal pipe, or attached to vertical pipe on right side left side, or rear. Two angle brackets and two "U" bolts do the job.

Panel Mounting — Same two angle brackets mount the monitor in 8⅞" × 5¾" (225 × 146 mm) panel cutout.

Wall Mounting — Reverse the angle brackets and mount the monitor on any flat surface.

Portable — Part No. 324284 portability kit includes handle, feet, power cord and cord bracket. (Monitor weighs only 5 lb.)

Applications

Pharmaceutical and Chemical — Most pharmaceutical and chemical processes require close control of the chemical additions. When conductivity measurement is required, digital accuracy and readability are assets, assuring systems efficiency and conservation of costly raw materials. The wide versatility of the 7076 Monitor — measuring ranges from 0-0.2 micromho to 0-200,000 micromhos — makes it an important tool for process control.

The 4973-, 4905-, 4909- and 4800-Series conductivity cells are all compatible with the 7076 Monitor. The 4973 cells are available in four cell constants (0.01, 0.1, 1.0 and 10) and feature a rugged, corrosion-resistant Victrex* polyethersulfone (PES) body. Fast-responding, built-in automatic temperature compensation is standard. The cells can be dipped into a tank, or screwed into a ¾" NPT pipe tee.

The 4905 cells should be used when other cell constants are required, or where a 1" NPT pipe thread is needed for installation. If a removal device is required, the 4909 cells can be used for most ranges.

Paper Industry — The 7076 Monitor can be used for control of the white-liquor addition in digester applications when the caustic in the black liquor reaches a preset minimum control point. Either 4801-Series or 4905-Series cells can readily withstand the corrosive effects of the black liquor.

Cation and Anion Exchangers — With the 7076 Monitor, digital readout and multi-range capability make the instrumentation of anion, cation and mixed-bed exchangers relatively easy and inexpensive. The multi-range capability permits the installation of one basic instrument at any stage of demineralization or deionization. Since the Monitor can measure ranges from 0-0.2 micromho to 0-20 micromhos with only one cell constant, there is no need for a variety of monitor or cell constants.

The 4973 cell is especially applicable to demineralizer and ion-exchange applications — may be used to measure the inlet to the resin beds, various levels in the beds, and the outlet of the ion exchanger. With its rugged PES body, the cell is inert to all regeneration acids and bases, and will perform accurately and consistently for years, with no maintenance requirement except occasional cleaning.

The 4905-, 4909- and 4800-Series cells may also be used.

Reverse Osmosis — Many new reverse-osmosis systems perform significantly better, since advanced technology has provided even greater efficiencies. The 7076 Monitor has the accuracy and readability required to match the improvements in membrane technology in the newer, larger units. The range of 0-20, 0-200 and 0-2000 micromhos, using a 1.0 cell constant, makes this Monitor especially suitable for this application.

The 4973 cell, with automatic temperature compensation, can operate over all the water ranges encountered in reverse-osmosis applications. Mounted in the inlet or the outlet of the unit, this cell can function efficiently and accurately at the working pressures of most units.

The multi-range feature of the 7076 Monitor and the variety of cell constants available in the 4973 cell combine to provide an excellent measuring and control "package" for any reverse-osmosis system.

*Tradename of Imperial Chemical Industries, Ltd.

Boiler-Water Blowdown — The 7076 Monitor provides excellent multi-range capability for continuously monitoring all levels of boiler-water condensate, which vary in range depending on the type of boiler and the treatment used. Its triple-range expanded-scale accuracy and readability eliminate the need for non-linear ranges, permitting the 7076 to be used over conductivity ranges from 0-0.2 to 0-20 micromhos with one cell constant, and ranges up to 0-200,000 micromhos with various cell constants.

The 7076 Monitor, connected to a 4973 cell with its built-in automatic temperature compensator, can control the dissolved-solids level to achieve maximum operating efficiency, as recommended by the boiler manufacturers, and insure the equipment warranty.

Condenser-Tube Leak Detection — The 7076 Monitor, connected to a 4973 cell located in the condensate line, assures continuous monitoring of the boiler condensate for fast and accurate detection of a condenser-tube failure. The alarm/control contacts of the 7076 Monitor can be used to signal the operator, or take direct control action. Excellent readability of the instrument and the multi-range feature assure easy, accurate set-point adjustment.

Cooling Towers — Cooling-tower measurements are easy and inexpensive with the 7076 Monitor. Accurate blow-down control can be achieved with excellent readability of the conductivity value, and good water and chemical efficiency. Typical ranges of 0-1000, 0-2000 and 0-5000 micromhos can now be covered by one monitor without even changing a switch.

The 7076 Monitor (with a 4973 or 4905 cell) can systematically open a drain valve at a predetermined set point to remove a high concentration of solids, and also allow new water to enter. The 7076 Monitor can combine with a 7075-3 pH Receiver to form a high-precision, low-cost cooling-tower control system which will prevent potential scale build-up and cut maintenance costs.

Rinse-Tank Control — The wider conductivity ranges of the 7076 Monitor permit its use for monitoring and controlling the rinse water in plating-rinse tanks, in applications well above the maximum conductivity levels found in conventional equipment.

The 7076 Monitor (with 4973- 4905- or 4800-Series cells) may also be used in concentration systems for metal or acid recovery. Selection of the proper range for the chemical solution is simplified by the range-change capability of the Monitor.

Improved efficiency in rinse-tank operations can result in direct savings, depending on the reduction in water usage. Minimized parts rejection can result in further savings.

Specifications

Ranges — Conductance: from 0-0.2 to 0-200,000 μmhos. Resistance: from 0-200,000 ohms to 0-20 megohms.

Readout — 3½ digit, seven-segment, nominal ½-inch-high LED display.

Limit of Error — Digital meter: 0.05% ±1 digit. Output: 0.3% of range.

Stability — Better than 0.05% of range per month.

Humidity Effect — Negligible at 95% relative humidity over the ambient temperature range.

Response Time — 1 second for 90% of step change.

Ambient Temperature — −10 to 50 C (14 to 122 F).

Ambient Temperature Effect — 0.04% of range per degree over the ambient temperature range.

Line-Voltage Effect — 0.005% of range per 1% change in line voltage.

Output — Isolated recorder outputs, 0-1 and 0-10 volts simultaneously; standard on all models.

Circuitry — Solid-state feedback-stabilized amplifier for drift-free operation, designed to minimize RFI effect.

Measuring Frequency — 75 Hz or 320 Hz. Higher frequency is used for high conductance ranges, to reduce polarization of electrodes.

Function Switch — Five-position. "Zero" reads zero on digital readout; "Check" measures internal precision resistors for calibration check. On the 7076-1, "Low", "Medium" and "High" select the conductivity ranges to measure the cell and compensator. On the 7076-5, "20 M", "2 M" and "200 K" select the resistance ranges to measure the cell and compensator.

Alarm/Control — Standard single alarm, for high or low deviation, with setter located on front panel. Set with screwdriver or coin to prevent accidental displacement. 0-20 scale with 40 divisions for easy alarm setting. Red and green lights indicate above and below set-point process conditions. Alarm is SPST, connected in failsafe alarm mode.

Contact Rating: 3 A on 120 V a-c or 28 V d-c; 1.5 A on 240 V a-c, inductive load.

Hysteresis (Deadband): 2% of full scale.

Repeatability: 0.25% of full scale.

Setting Accuracy: 1% of full scale.

Electrical Classification — General purpose, or — when hermetically sealed relays are specified — Class I, Division 2, Groups B, C and D.

Isolated Current Output — Provided by plug-in card with six field-selectable outputs. Outputs, with maximum load resistance at ±10% of nominal line voltage, are: 0-16 mA (1300 ohms); 4-20 mA (1000 ohms); 0-20 mA (1000 ohms); 5-25 mA (850 ohms); 0-40 mA (450 ohms); 10-50 mA (330 ohms).

Temperature Compensation — Automatic compensation is standard; fixed compensation is available.

Power Requirements — 100 V ±10%, 120 V ±10%, 220 V ±10%, or 240 V ±10%, 50-60 Hz, 14 VA.

Electrical Connections — Two ¾" conduit openings in bottom of case; barrier terminal board inside.

Case — Gray, NEMA 3R and NEMA 12 corrosion-resistant, rain-resistant, outdoor, dust-proof Noryl* plastic case.

Dimensions FRONT PANEL: 9⅝" (w) × 6⅛" (h) × ¾" (d) (244 × 155 × 19 mm). OVERALL DEPTH: 6½" (165 mm). PANEL CUTOUT: 8⅜" (w) × 5¾" (h) (225 × 146 mm).

Weight — 5.5 lb (2.5 kg).

**Tradename of General Electric Company.*

How to Order

Specify complete catalog number with appropriate suffixes:

A B C D E

7076-□-□□□-□□□-□□□-□□□

Suffix A. Type

Conductivity Monitor	1
Resistivity Monitor	5

Suffix B. Range

Conductivity Multi-Range	200
Resistivity Multi-Range	300

Suffix C. Power Requirements

100 V ±10%, 50-60 Hz	100
120 V ±10%, 50-60 Hz	120
220 V ±10%, 50-60 Hz	220
240 V ±10%, 50-60 Hz	240

Suffix D. Alarm and Current Output

Standard Alarm, General Purpose	001
Standard Alarm, Division 2 Rating*	031
Standard Alarm, General Purpose, plus Isolated Current Output	201
Standard Alarm, Division 2 Rating, plus Isolated Current Output*	231

Suffix E. Tagging

None	000
1 Metalcal Label, 15 Characters Max. on Each of Two Lines (Specify Legend)	205
1 Linen Tag, 23 Characters Max. on Each of Six Lines (Specify Legend)	206
1 Aluminum Tag, 15 Characters Max. on One Line (Specify Legend)	207
1 Stainless Steel Tag, 25 Characters Max. on Each of Three Lines (Specify Legend)	208

Options 031 and 231 include alarms with hermetically sealed relays to meet Class I, Division 2, Groups B, C and D rating.

Ranges and Temperature Compensators

Monitor				Cell and Temperature Compensator							
						Automatic Temperature Compensator***					
							4973 Cells		4800, 4902, 4905, 4909 Cells		
	Range	Range Switch Position	Monitor Suffix "B"*	Constant	Cell Constant Suffix**	Reference at 25 C	Range Suffix†	Temperature Range	Range Suffix†	Temperature Range	Temperature Compensator, Ohms at 25 C
Conductance	0-0.2 μmho/cm 0-2.0 μmho/cm 0-20 μmho/cm	Low Medium High	200	0.01	001	0.055 μmho	300	0-100 C	NA	NA	NA
						0.1 μmho	302	0-100 C	070	0-60 C	8000
						0.5 μmho	304	0-100 C	014	0-60 C	8000
						2.0 μmhos	306	0-100 C	071	0-60 C	8000
	0-2 μmhos/cm 0-20 μmhos/cm 0-200 μmhos/cm	Low Medium High	200	0.1	01	20 μmhos	306	0-100 C	071	0-60 C	8000
	0-20 μmhos/cm 0-200 μmhos/cm 0-2000 μmhos/cm	Low Medium High	200	1.0	1	200 μmhos	306	0-100 C	072	0-60 C	8000
	0-200 μmhos/cm 0-2000 μmhos/cm 0-20,000 μmhos/cm	Low Medium High	200	10.0	10	2000 μmhos	306	0-100 C	072	0-60 C	8000
	0-2000 μmhos/cm 0-20,000 μmhos/cm 0-200,000 μmhos/cm	Low Medium High	200	50.0	50	20,000 μmhos	NA	NA	072	0-60 C	8000
Resistance	0-200 K ohms 0-2 megohms 0-20 megohms	200 K 2 M 20 M	300	0.01	001	18 megohms	300	0-100 C	NA	NA	NA
						18 megohms	302	0-100 C	NA	NA	NA
						2 megohms	304	0-100 C	014	0-60 C	8000
						0.5 megohm	306	0-100 C	071	0-60 C	8000

*Specify as Suffix B of Monitor catalog number.
**Specify as Suffix A of conductivity-cell catalog number.
***For a fixed temperature compensator, 8000 ohms at 25 C, order Part Number 411456.
†Specify as temperature compensator suffix of conductivity cell.

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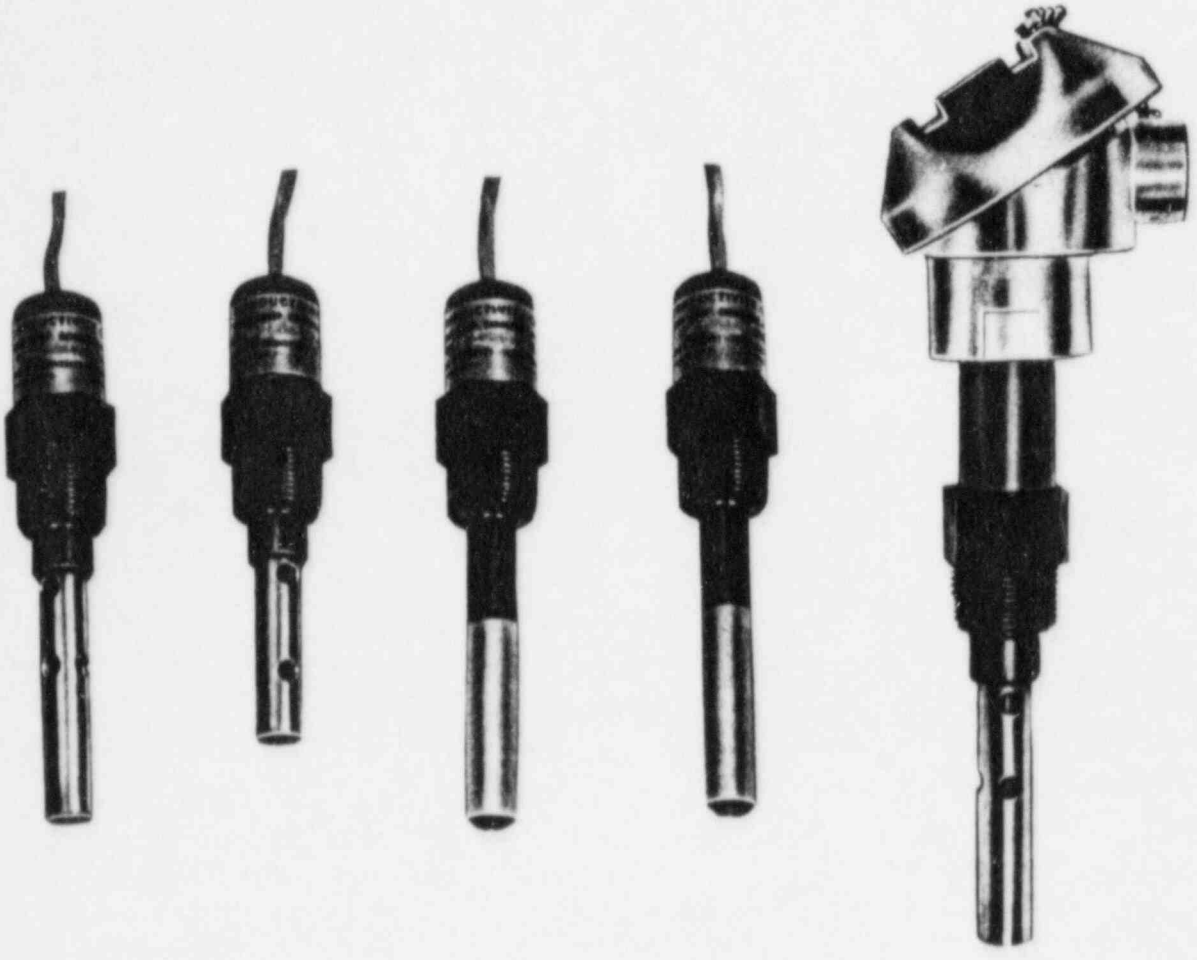
4973-Series Electrolytic Conductivity Cells

D2.2115-DS



4973 Cells: 0.01- and 0.1-constant, with titanium electrodes (left); 1- and 10-constant, with graphite electrodes and Teflon guards (center); 4973 Cell with Universal Junction-Box Head (right).

The 4973-Series Cells are ruggedly constructed for reliable, continuous measurements of electrolytic conductivity in industrial water processes at temperatures up to 150 C and pressures up to 250 psig.

They are applicable to such measurements as the effluents of distillation equipment; anionic, cationic, and mixed-bed ion exchangers; monitoring and controlling the washing of electronic components; plating rinse-tank control; boiler-water condensate; boiler hot-well measurements; and cooling-tower blowdown.

The cells feature PES (polyether sulfone) construction for high corrosion resistance, with electrodes of titanium (for 0.01 and 0.1 cell constants) or high-density carbon (for 1.0 and 10.0 cell constants).

The 4973 Cell can be equipped with an integral leadwire cable either 7′ (2.1 m) or 20′ (6.1 m) long, or with an Aluminum Universal Head for terminal connections mounted directly on the cell, with leadwire cable separately ordered.

For *insertion* applications, the ¾" NPT male thread permits permanent installation in a pipe or tank; the cell can also be used as a laboratory dip-type for batch sampling.

For *flow* applications, the cell can be installed directly into a process stream, or used with a separately-ordered ¾" pipe tee, or a 1" pipe tee and a 1"-to-¾" reducing bushing, in a by-pass stream. The cells have been designed to keep the electrodes and the temperature compensator immersed in the stream flow even when a reducing bushing is used, assuring that the cell will respond quickly and accurately to changes in both solution concentration and temperature.

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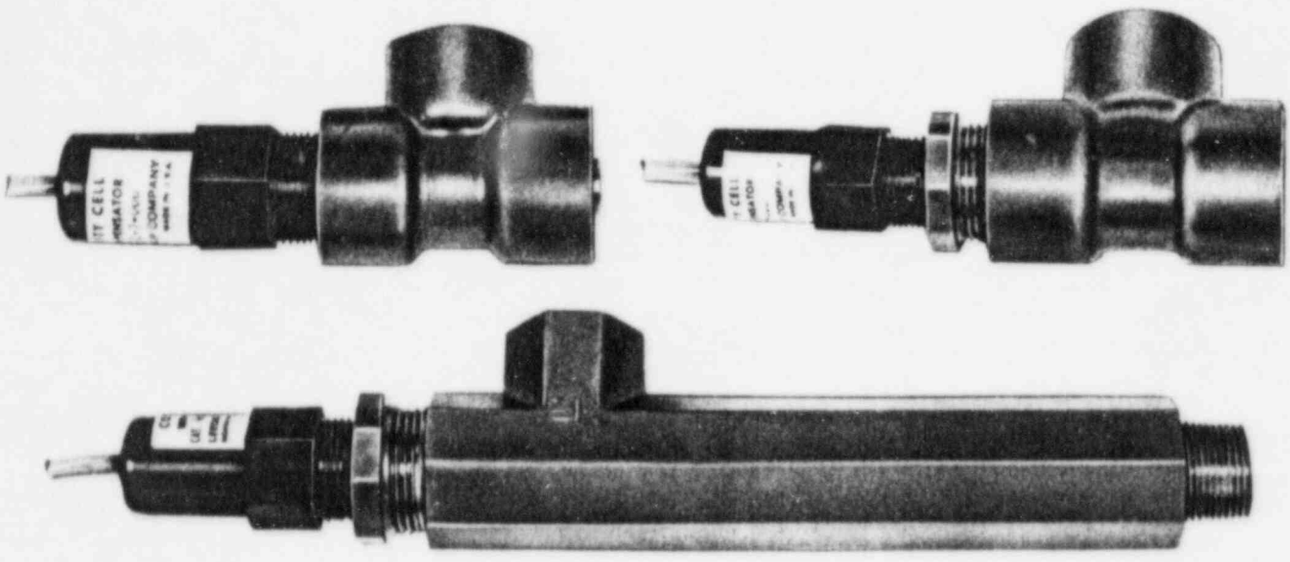

Top left: 4973 Cell inserted in standard ¾" pipe tee. Top right: 4973 Cell with 020962 PVDC Reducing Bushing, inserted in standard 1" pipe tee. Bottom: 4973 Cell with 020962 Reducing Bushing mounted in 276127 PVDC Flow Chamber. (PVDC fittings are limited to 100 C.)

Specifications

Function — Designed for insertion and flow applications.

Automatic Temperature Compensator — Supplied on all cells.

Cell Constant — 0.01, 0.1, 1.0 and 10 cm^{-1}.

Maximum Temperature Limit — 150 C (302 F) at rated pressure.

Maximum Pressure Limit — 250 psig (1724 kPa) at rated temperature.

Insertion — ¾" NPT male thread for schedule 40 and 80 pipe.

Insertion Depth — 4⅛" (105 mm) from solution end of ¾" NPT male thread.

Wetted Parts — Cell body: PES (polyether sulfone). Electrodes: 0.01 and 0.1 constant, titanium; 1.0 and 10.0 constant, high-density graphite with Teflon guard.

Electrical Connections — Integral PVC-covered non-shielded 18-gauge 3-conductor cable, 7' (2.1 m) or 20'(6.1 m) long, as specified. If more than 20' are required, specify the Universal Junction-Box Head and the required length of 834059 Cable. (Head has ¾"NPT conduit connection.) For a separate Junction Box, specify Part Number 316274, and appropriate length of 834059 Cable.

Weight — 0.5 lb (0.2 kg).

How to Order

Specify Catalog Number and appropriate suffixes from the table below.

A B C D

4973-□□□-□□□-□□-□□□

	Description	Suffix
Suffix A: Cell Constant	0.01 0.1 1.0 10	001 01 1 10
Suffix B: Automatic Temperature Compensator	Integral Automatic Temperature Compensator included. For suffix, see range listing for Monitor or Speedomax Recorder.	□□□
Suffix C: Terminal Connection	Integral Leadwire, 7' Long Integral Leadwire, 20' Long* Aluminum Universal Junction-Box Head Mounted on Cell*	7 20 1
Suffix D: Tagging	None 1 Metalcal Label, 15 Characters Max. on Each of Two Lines (Specify Legend) 1 Linen Tag, 23 Characters Max. on Each of Six Lines (Specify Legend) 1 Aluminum Tag, 15 Characters Max. on One Line (Specify Legend) 1 Stainless Steel Tag, 24 Characters Max. on Each of Three Lines (Specify Legend)	000 205 206 207 208

**For distance greater than 20 feet, specify Universal Junction-Box Head integrally mounted on cell, and appropriate length of 834059 Cable.*

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INTRODUCTION

York Research Corporation was retained by Becton Dickinson for the purpose of air analysis at their Canaan, Connecticut plant. The parameters measured were NO, NO_2, NO_x and O_3. The source was a Cobalt-60 radiation device used for sterilization purposes. The following locations were tested for the presence of these gases. (See Figure 1)

1. Control Room
2. Exhaust duct from source area measured before the filters
3. Source Area
4. Exhaust duct from Source Area measured after the filters (approximately four feet from roof of the building)

TEST METHOD

A Dasibi Model 1003-AH ozone analyzer was used to measure ozone concentrations. The operation of this instrument is based upon the measurement of the absorption of ultra-violet light by ozone.

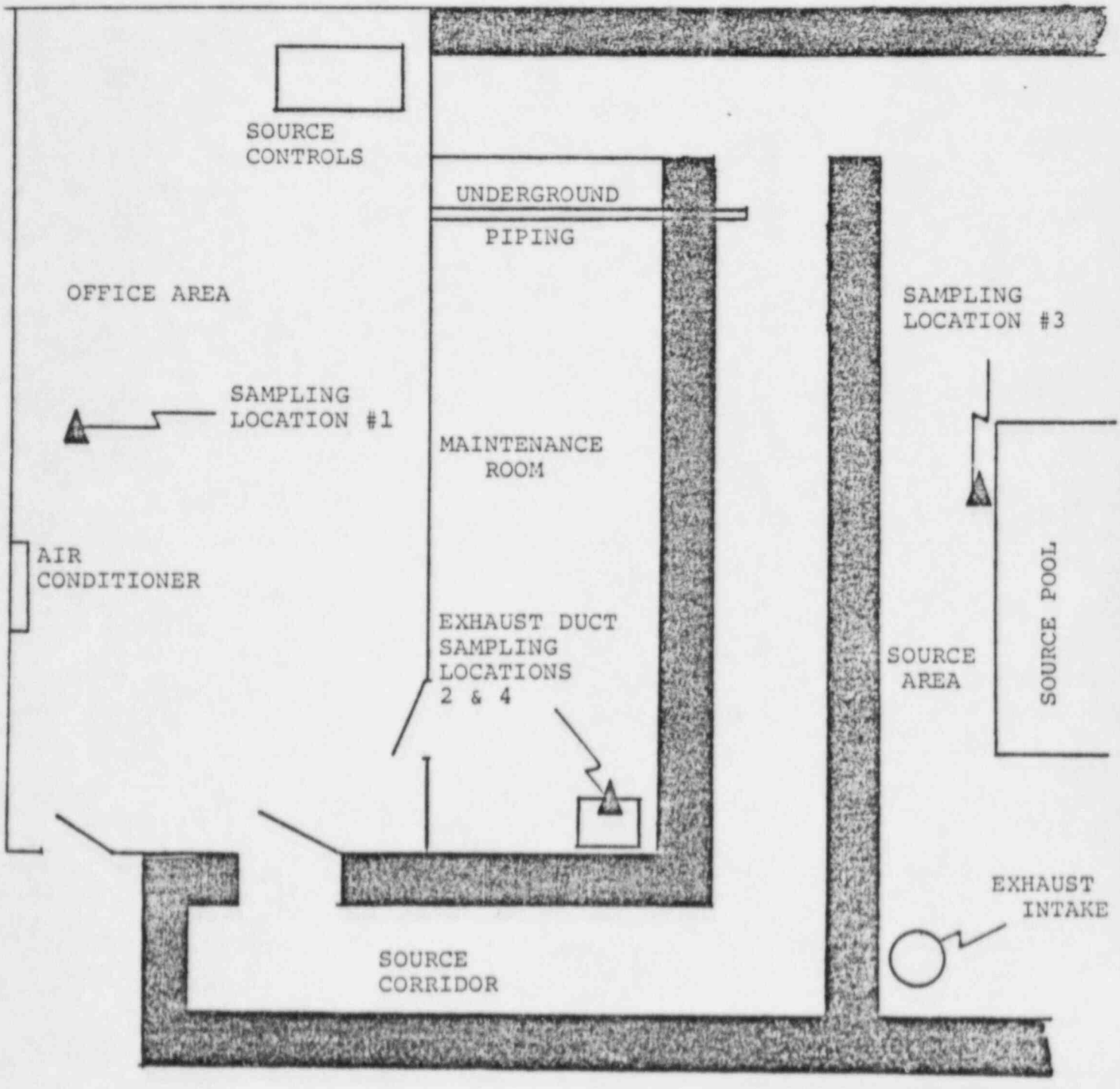
In the Dasibi Ozone Monitor a uv light is generated by a low-pressure, mercury vapor lamp. This lamp emits its strongest line at 2536.52 anstroms which coincides with the region of maximum light absorption of ozone. By measuring the amount of light absorbed by the sampled gas, the ozone concentration can be determined.

To measure continuous NO, NO_2, NO_x, a model 8440 Monitor Labs Analyzer was used. The Model 8440 uses the chemilumenescent reaction of nitric oxide and ozone to measure nitric oxide concentrations. Nitrogen Dioxide is measured by converting it quantitatively to nitric oxide and then determining the nitric oxide by the chemilumenescent method.

Both instruments were calibrated at York prior to monitoring at Beckton Dickinson. During the actual monitoring, the instruments were kept in the Control Room - Maintenance Room Area while the teflon sample lines were run to the sampling locations shown in Figure 1.

FIGURE 1

SAMPLING LOCATIONS



Data were recorded on strip charts and these values appear in the following results section as part per million by volume.

The Occupational Safety and Health Administration (OSHA) has established exposure or Threshold Limit Values (TLV) for these gases. These limits, expressed as 8 hour time weighted averages, are contained in 29 CFR 1910 and are listed below:

NO	25.0 ppm
NO_2	5.0 ppm
O_3	0.1 ppm

The concentrations found in the source area 5 minutes after the source was submerged are listed below. Fifteen minutes after the source was submerged the concentrations became minimal.

	5 minute	15 minute
NO	0.0 ppm	0.0 ppm
NO_2	0.8 ppm	0.0 ppm
O_3	0.5 ppm	0.0 ppm

The values within the control room do not indicate that excessive values would be found.

RESULTS

TABLE 1

CONTROL ROOM

10 MINUTE AVERAGES

CONCENTRATIONS (PPM)

TIME (EDT) 6/2/79	NO	NO_2	NO_x	O_3
1500				
10	.08	.05	0.13	0.00
20	.07	.04	0.11	0.00
30	.05	.13	0.18	0.00
40	.04	.11	0.15	0.00
50	.04	.09	0.12	0.00
1600	.03	.06	0.09	0.00
10	.03	.05	0.08	0.00
20	.03	.04	0.07	0.00
30	.03	.03	0.06	0.00
Average	.04	.067	0.11	0.00

TABLE 2

EXHAUST DUCT BEFORE FILTERS

10 MINUTE AVERAGES

CONCENTRATIONS (PPM)

TIME (EDT) 6/2/79	NO	NO_2	NO_x	O_3
1700	0.0	0.60	0.60	0.60
10	0.0	0.60	0.60	0.70
20	0.0	0.60	0.60	0.70
1730	SOURCE DOWN			
1935	SOURCE UP			
1940	0.0	0.10	0.10	0.30
50	0.0	0.30	0.30	0.50
2000	0.0	0.40	0.40	0.70
10	0.0	0.45	0.45	0.75
20	0.0	0.50	0.50	0.75
30	0.0	0.50	0.50	0.75
40	0.0	0.50	0.50	0.75
50	0.0	0.50	0.50	0.75
2100	0.0	0.50	0.50	0.75
10	0.0	0.50	0.50	0.75
20	0.0	0.50	0.50	0.75
30	0.0	0.50	0.50	0.75
40	0.0	0.50	0.50	0.75
50	0.0	0.50	0.50	0.75
2200	0.0	0.50	0.50	0.75
10	0.0	0.50	0.50	0.75
20	0.0	0.50	0.50	0.75
30	0.0	0.50	0.50	0.75
40	0.0	0.50	0.50	0.75
50	0.0	0.50	0.50	0.75
2300	0.0	0.50	0.50	0.75
10	0.0	0.50	0.50	0.75
20	0.0	0.50	0.50	0.75
30	0.0	0.50	0.50	0.75
40	0.0	0.50	0.50	0.75
2340	SOURCE DOWN			
AVERAGE	0.0	0.48	0.48	0.71

TABLE 3

SOURCE AREA

10 MINUTE AVERAGES

CONCENTRATIONS (PPM)

TIME (EDT) 6/3/79	NO	NO_2	NO_x	O_3
0900	SOURCE UP			
10	0.0	0.50	0.50	1.00
20	0.0	0.80	0.80	1.15
30	0.0	0.95	0.95	1.75
40	0.0	1.05	1.05	1.30
50	0.0	1.10	1.10	1.35
1000	0.0	1.10	1.10	1.30
10	0.0	1.15	1.15	1.32
20	0.0	1.15	1.15	1.35
30	0.0	1.20	1.20	1.30
40	0.0	1.20	1.20	1.35
50	0.0	1.20	1.20	1.35
1050	SOURCE DOWN			
1132	SOURCE UP			
40	0.0	0.60	0.60	0.75
50	0.0	1.00	1.00	1.25
1200	0.0	1.25	1.25	1.32
10	0.0	1.25	1.25	1.36
20	0.0	1.25	1.25	1.35
30	0.0	1.25	1.25	1.32
40	0.0	1.25	1.25	1.35
50	0.0	1.25	1.25	1.35
1251	SOURCE DOWN			
AVERAGE	0.0	1.14	1.14	1.26

TABLE 4

EXHAUST DUCT AFTER FILTERS

10 MINUTE AVERAGES

CONCENTRATIONS (PPM)

TIME (EDT) 6/3/79	NO	NO_2	NO_x	O_3
1305	SOURCE UP			
1320	0.0	0.60	0.60	0.55
30	0.0	0.70	0.70	0.72
40	0.0	0.70	0.70	0.70
50	0.0	0.70	0.70	0.70
1400	0.0	0.70	0.70	0.70
10	0.0	0.65	0.65	0.70
20	0.0	0.65	0.65	0.70
30	0.0	0.65	0.65	0.70
AVERAGE	0.0	0.67	0.67	0.68

ITEM 9/8

SHIELDING CALCULATIONS

The biological shield for the Type J-6000 and J-6500 Irradiator is shown on Drawing A02687 and A04708. The shield is designed to attentuate the radiation from a 300,000 and a ~~1,000,000~~ 1,500,000 curie Cobalt 60 plaque source within the design levels shown in Table 1. The radiation leakage levels were selected on the basis that under normal working conditions no person in the vicinity of the irradiator receives more than an average of 10.0 mrem per week or a maximum of 500.0 mrem per year. This is the exposure level recommended by the International Commission on Radiological Protection (1) for members of the public. Atomic energy workers (operators or control technicians) may receive 10 times this amount (5.0 mrem per year).

PRIMARY SHIELDING

The transmission of Cobalt 60 gamma radiation in concrete is shown in Figure 1. The dose rate from 1 curie point source of Cobalt 60 is 1.3×10^3 mr/hr and varies inversely with the square of the distance. Concrete thickness for the primary shielding were determined by calculating the max. dose rate outside the shielding wall for a point source and correcting for source geometry and absorption within the source plaque. Some sample calculations are given below.

1. Maximum field outside external wall parallel to source plaque:
   Concrete thickness = 57.0 in. (144.8 cm.)
   Transmission = 1.13×10^{-8}
   Distance from source plane to exterior surface of wall = 139.0 in. (353.1 cm.)
   Dose rate due to point source of 1,000,000 curies of Cobalt 60 =
   $1.3 \times 10^3 \times 1.0 \times 10^6 \times \left(\frac{39.37}{139}\right)^2 \times 1.13 \times 10^{-8}$
   = 1.18 mrh

   Self absorption factor and geometry factor for transforming point source calculation to that for a 36.0 in. (3.14 cm.) x 60.0 in. (152.4 cm.) plaque source = 0.65
   Maximum dose rate = 0.77 mrh
   This is below the design level of 2.0 mrh maximum.

2. Maximum field on roof:
   Concrete thickness = 57.0 in. (144.8 cm.)
   Transmission = 1.93×10^{-7}

Assume point source at centre of source plaque
Distance from source to roof = 119.0 in. (302.3 cm.)
Dose rate due to point source of 1,000,000 curies of Cobalt 60
$= 1.3 \times 10^3 \times 1.0 \times 10^6 \times \left(\frac{39.37}{119}\right)^2 \times 1.93 \times 10^{-7}$
= 27.4 mr/hr

Self absorption and geometry factor for vertical source plaque = 0.20
Maximum dose rate = 5.5 mrh
This is below the design level of 15.0 mrh maximum.

MAZE DESIGN

Accurate calculations of the dose rate and energy spectrum at points along a concrete maze are difficult to perform. At present detailed calculations of the dose attenuation in concrete mazes have been confined to two-legged concrete ducts (2). The amount of work required for detailed calculations for mazes with more than one right-angle bend becomes prohibitive and maze designers must either rely on measurements to determine dose rates at the entrance of a maze with several legs or must make order of magnitude estimates using purely empirical formulae.

Maze entrances for industrial irradiators designed by A.E.C.L. are based on both calculations and measurements. The radiation incident upon the maze walls due to singly-scattered radiation is calculated by dividing the scattering areas into small segments and calculating the amount of singly-scattered radiation from each segment. The dose rate from the small scattering area A (Figure 2) is given by:

$$D = \frac{D_o \; a(E_o, \theta_o, \theta, \phi) \; A \cos\theta}{r_1^2 \, r_2^2}$$

where

$a(E_o, \theta_o, \theta, \phi)$ is the differential dose albedo,

A is the area of the scattering surface,

D_o is the dose rate at one unit length from the source,

E_o is the initial energy of the gamma rays from the source.

Values of the differential dose albedo, $a(E_o, \theta_o \; \theta \; \phi)$ have been calculated by Roso (3) using the Monte Carlo method. Using the Roso data, Chilton and Huddleston (4) developed the following semi-empirical equation for the differential dose albedo

$$a(E_o, \theta_o, \theta, \phi,) : \frac{C(E_o)\, K(\theta_s)\, 10^{26} + C^1(E_o)}{1 + \cos \theta_o / \cos\theta}$$

where $C(E_o)$ and $C^1(E_o)$ are constants for a given energy
$K(\theta_s)$ is the Klein-Nishina differential energy scattering coefficient,

θ_s is the angle through which the radiation is scattered and is given by $\cos\theta_s = \sin\theta_o \sin\theta \cos\phi - \cos\theta_o \cos\theta$.

For Cobalt 60 gamma rays, E_o = 1.25 Mev
$C(1.25\ \text{Mev}) = 0.0665$
$C^1(1.25\ \text{Mev}) = 0.107$

The calculated values of the differential dose albedo for Cobalt 60 gamma rays have been verified by measurements at A.E.C.L. The energy of the singly-scatered radiation is given by

$$E = \frac{E_o}{1 + \frac{E_o}{0.511}(1-\cos\theta_s)}$$

The required thicknesses of the maze walls required to attentuate the singly-scattered radiation of energy, E, to below the design levels are calculated and corrections for lower energy multiply-scattered radiation are made using information obtained from measurements of the radiation fields in and around mazes built by A.E.C.L.

For maze walls where no singly-scattered radiation is incident and the maximum radiation energy is due to doubly-scattered radiation, an estimate of the incident doubly-scattered dose rate is obtained by calculating the scatter from one surface to another surface and then to the maze wall. The energy of the gamma rays impinging on the second area is assumed to be the energy of a gamma ray having one Compton scatter at the centre of the first area and going to the centre of

the second area. For the second scatter the parameters $C(E_0)$ and $C'(E_0)$ are approximated by $C(E_0) = 0.0561\ E_0^{0.574}$ and $C'(E_0) = 0.0122\ E_0^{-0.683}$. Again, corrections for lower energy multiply-scattered radiation are made from measurement data.

Detailed measurements of radiation fields inside mazes have been performed by A.E.C.L. for two shielded room facilities in Ottawa, the irradiator at St. Hilaire, Quebec, and the Ethicon Medical Products Sterilizing Irradiator in Somerville, New Jersey. In addition, surveys of the exterior radiation fields were performed on numerous other industrial irradiators built by A.E.C.L. These extensive measurements confirm that the recommended maze shielding provides adequate protection.

REFERENCES

(1) "Recommendations of the International Commission on Radiological Protection", (Adopted September 17, 1965), ICRP Publication 9, London; Pergammon Press 1966.

(2) J. M. Chapman and C. M. Huddleston, "Dose Attentuation In Two-Legged Concrete Ducts for Various Gamma-Ray Energies", Nuclear Science and Engineering, **25**, 66 (1966).

(3) D.J. Raso, "Monte Carlo Calculations on the Reflection and Transmission of Scattered Gamma Rays", Nuclear Science and Engineering, **17**, 411 (1963).

(4) A. B. Chilton and C. M. Huddleston," A Semi-empirical Formula for Gamma Rays on Concrete", Nuclear Science and Engineering, **17**, 419 (1963).

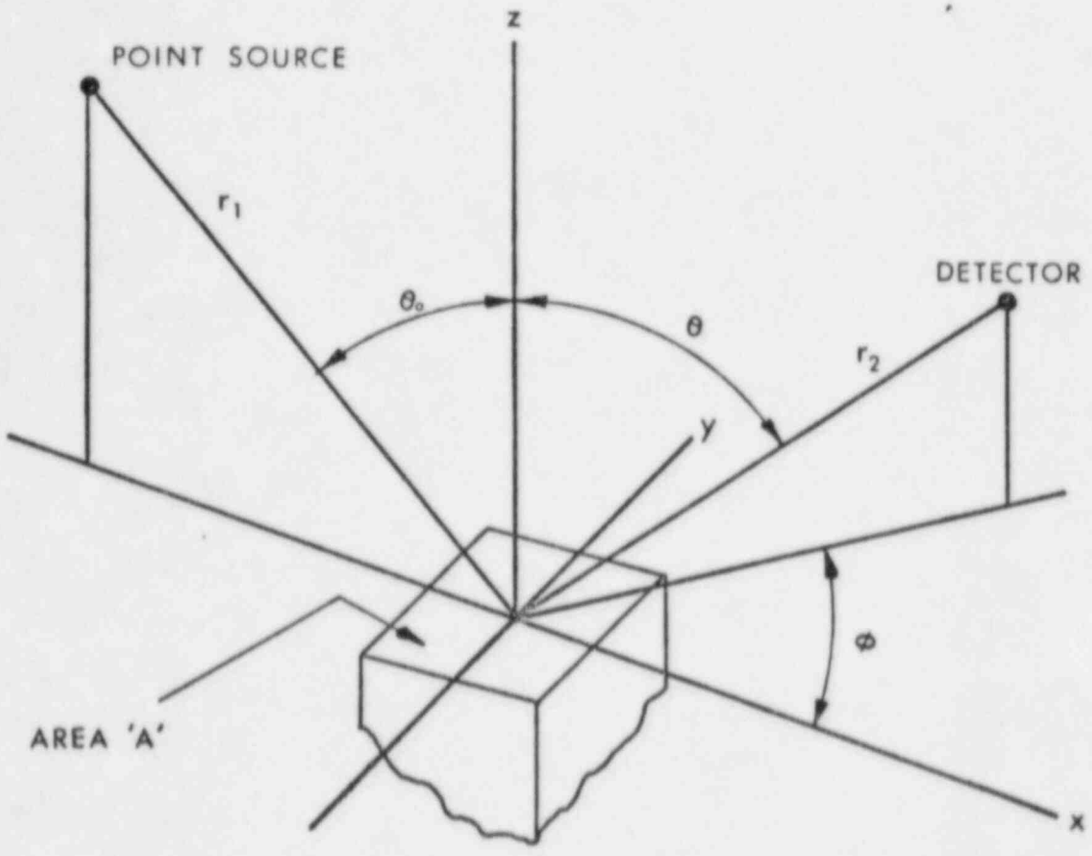


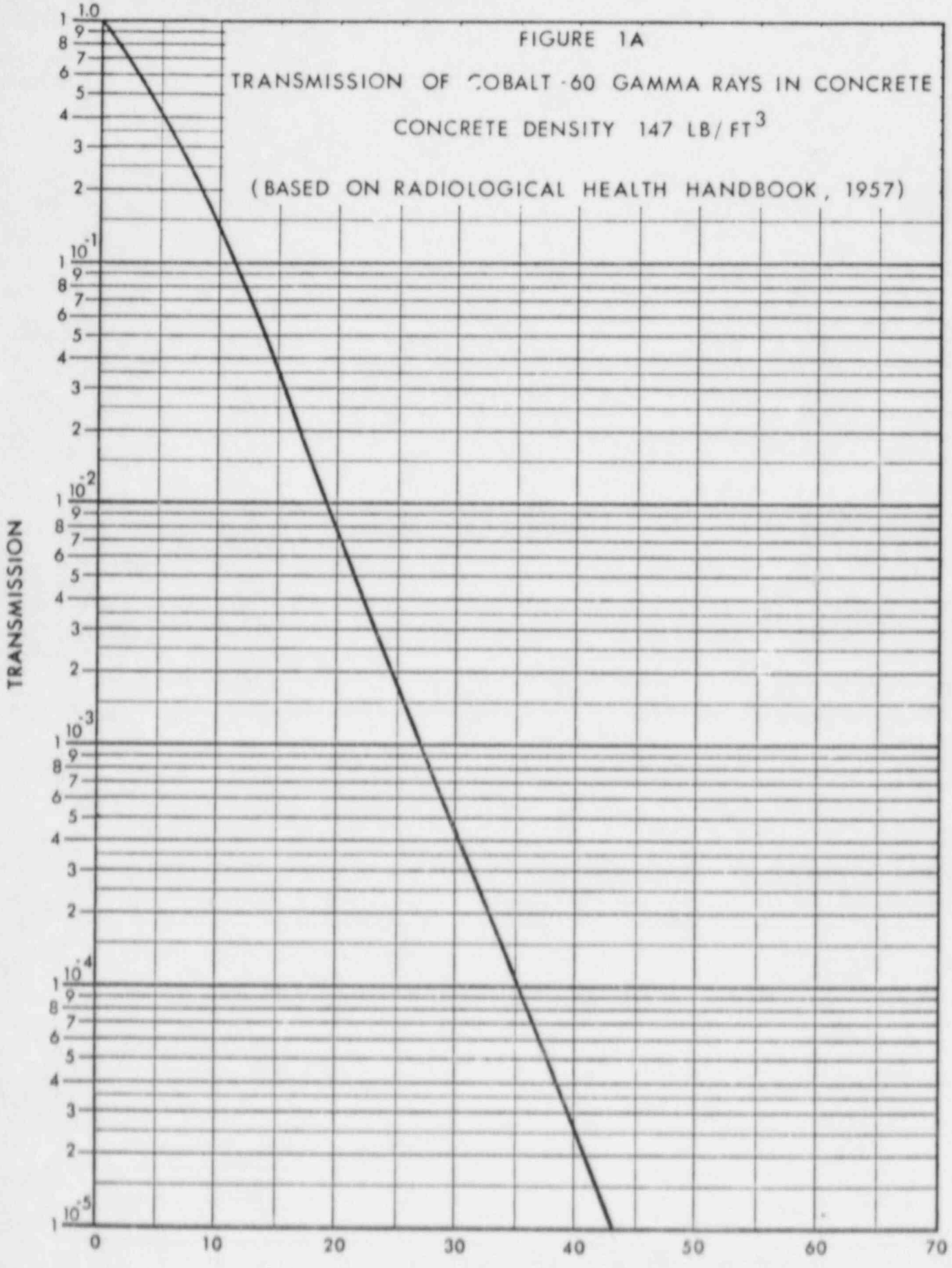
FIGURE 2
SCATTERING OF GAMMA RAYS
FROM SURFACE

FIGURE 1A

TRANSMISSION OF COBALT-60 GAMMA RAYS IN CONCRETE

CONCRETE DENSITY 147 LB/FT^3

(BASED ON RADIOLOGICAL HEALTH HANDBOOK, 1957)



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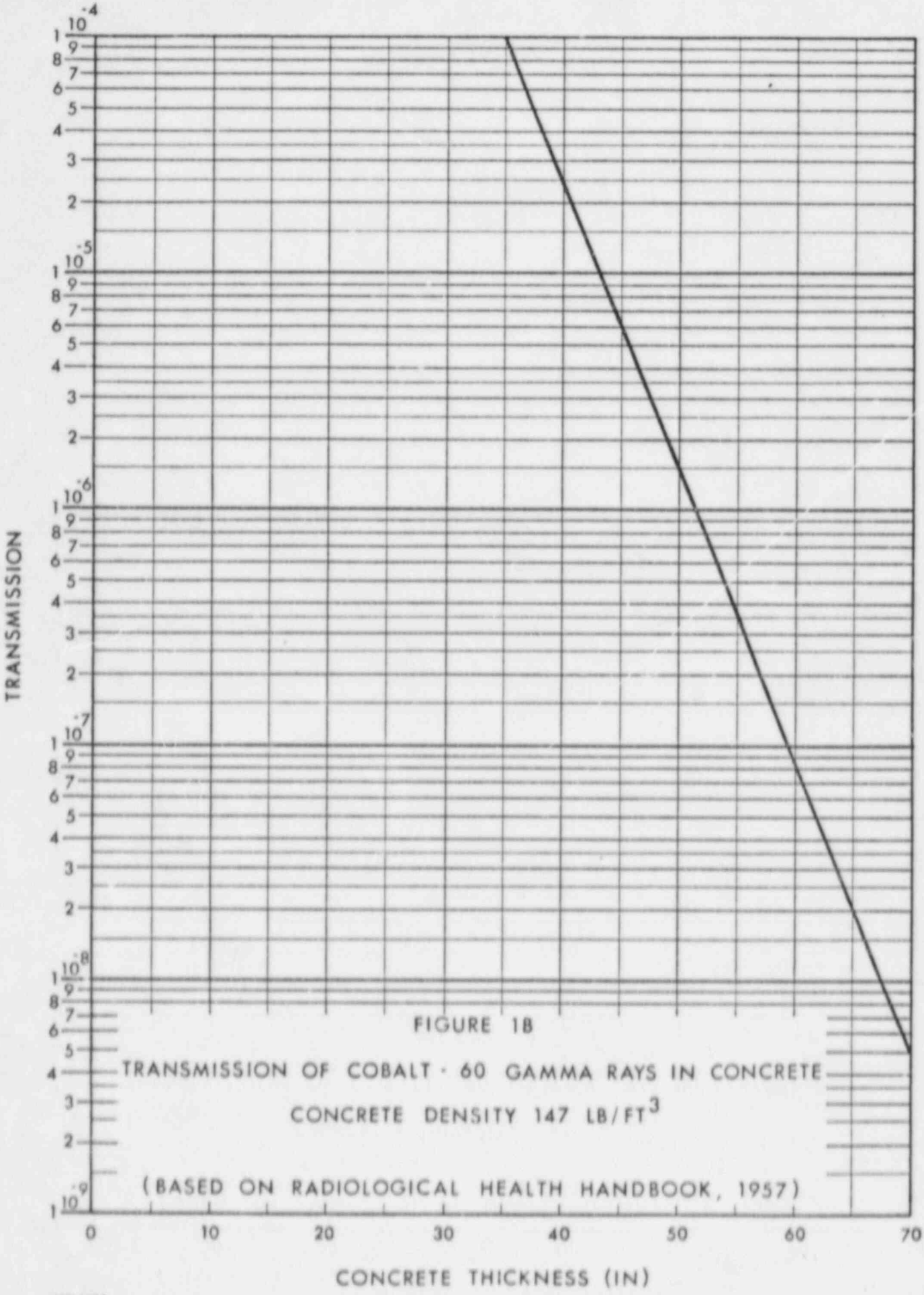

FIGURE 1B

TRANSMISSION OF COBALT - 60 GAMMA RAYS IN CONCRETE

CONCRETE DENSITY 147 LB/FT^3

(BASED ON RADIOLOGICAL HEALTH HANDBOOK, 1957)

ITEM 10.01

Amended 1/1/85

PERSONNEL MONITORING DEVICES

Radiation Dosimetry Report is received on a monthly basis. The information contained in the report is as follows:

A. Participant identification number

B. Participant name

C. Social Security number

D. Dosimeter type

E. Exposure type

F. Exposure to Badge (in millirems)

G. Cumulative totals -- (in millirems) for the quarter, year to date and permanent

H. Birth date

I. Number of Badge reported to date

J. Number of reports for present quarter

K. Inception data of permanent total

03572

ITEM 10.2

A survey meter will be operable at all times that can measure up to one (1) roentgen per hour. Instruments will be calibrated so that readings are ±20% of the actual values over the range of the instrument. A Certificate of Calibration shall be filed for each instrument traceable to the National Bureau of Standards, documenting the data of calibration. A calibration sticker shall be affixed to the calibration meter showing either the date of last calibration or the due date of the next calibration.

ITEM 10.2

CALIBRATION OF INSTRUMENTS BY SERVICE COMPANY

Calibration is to be performed at intervals not to exceed 12 months by one of the listed service companies.

1. Eberline Instrument Corporation
   312 Miami Street
   West Columbia, South Carolina 29169
   803-796-3604
   License Number -- 155 AM #10
   South Carolina
   Department of Helath
   South Carolina D.H.E.C.
   Bureau of Radiological Health
   Calibaration procedures attached

2. Nuclear Diagnostic Laboratory
   1000-T Lower S.
   Peekskill, New York 10566
   914-737-7330
   License Number -- 1059-1422 State of
   New York Instrument Calibration Number
   Calibration procedures attached

3. Health Physics Associates Ltd.
   3304 Commerical Avenue
   Northbrook, Illinois 60062

   License Number -- 12-09160-01
   Calibration procedures have been filed with the N.R.C.

Ultra Dell Case

AUG 16 1982

SETUP AND CALIBRATE

I. ELECTRONICS CHECKOUT

A. Connect a variable low voltage power supply to the instrument in place of the batteries with a milliammeter in series with + lead. Connect an electrostatic voltmeter from the high voltage lead to battery (-).

1. With 3 ±.05 volts applied, battery current must not exceed 27 mA; the high voltage must be between 875 and 925 volts.

2. With 2 ±.05 volts applied, battery current must not exceed 25 mA; the high voltage must not change more than 10 volts from the Step A.1 voltage nor drop below 875 volts.

3. The BATT check must read at the line with from 1.85 to 2.2 volts applied.

B. Connect a Mini Pulser to the detector connector. Set the battery supply at 2.5 volts.

1. Input sensitivity must be less than 10 millivolts. (3-foot cable)

2. Verify functioning of RESET, RESPONSE AND PHONE output.

II. CALIBRATION WITH MP-1 PULSER (Use this procedure only if the instrument is sold without a HP-270 probe.)

A. Calibrate to true count rate on X.01, X0.1, X1.0, X10 using the cpm scale.

1. Set MP-1 to 200,000 cpm for X10 scale.

2. Set MP-1 to 20,000 cpm for X1.0 scale.

3. Set MP-1 to 2,000 cpm for X0.1 scale.

4. Set MP-1 to 200 cpm for X.01 scale.

B. Calibrate the X100 scale per step III.A.

III. CALIBRATION WITH HP-270 PROBE

A. Calibrate X1, X10 and X100 ranges at 3/4 of full scale in a gamma field. Calibration must be within ±5 percent of field.

B. Remove the HP-270 probe from the instrument and attach an MP-1 pulser.

1. Set the MP-1 to 20,000 cpm. Switch the instrument to the X1 scale and note the reading.

2. Switch the MP-1 to 2,000 cpm and the instrument to the X0.1 scale. Adjust calibration to the point noted in Step B.1.

3. Switch the MP-1 to 200 cpm and the instrument to the X0.01 scale. Adjust calibration to the point noted in Step B.1.

IV. SAMPLE CHECKS (10 percent of run or six instruments, whichever is larger)

A. Saturation

The instrument must not saturate below 1000 R/hr on any range.

B. Linearity

Check instruments in a gamma field at 1/4, 1/2 and full scale on the X100, X10 and X1 scales.

1. On the X100 scale no reading shall differ from the field by more than 10 percent of full scale.

2. On the X10 scale no reading shall differ from the field by more than 15 percent of full scale.

3. On the X1 scale no reading shall differ from the field by more than 8 percent of full scale.

APPENDIX I

CALIBRATION OF SURVEY METERS

A. In-House Procedure

1. Don whole body, wrist badges and self-reading pocket dosimeter (zeroed). Check dosimeter frequently during procedure. If reading exceeds 150 mrem, cease work and complete on following day.

2. Turn over HIGH RADIATION AREA sign on door to calibration room and close door.

3. Remove calibrator to be used from storage cabinet and place on calibration stand. Plug Cs calibrator into 110 outlet and make electrical connection to red light over door.

4. Check batteries on instrument to be calibrated and replace if low.

5. Adjust zero if applicable.

6. Pick two calibration points on each scale approximately 1/3 and 2/3 full scale and refer to appropriate chart on wall to determine the distances required and record on calibration worksheet.

7. Place centerline of instrument chamber or probe over line on movable platform and move platform to desired distance from source.

8. Unlock and expose source.

9. Record readings on worksheet for each point chosen. DO NOT STAND IN BEAM AREA (yellow line on floor) UNLESS ABSOLUTELY NECESSARY TO READ METER.

10. Determine if meter response is within ±10% for each point. If it is, store and lock source and place in cabinet.

11. Should adjustment be necessary and the meter is capable of adjustment, PERFORM AS MUCH WORK AS POSSIBLE OUT OF BEAM AREA OR WITH SOURCE IN STORED POSITION.

12. Adjust meter to as close to ±10% on a low range, bearing in mind the direction the meter was off on the other ranges.

13. Recheck and record the other points, readjust as necessary to ±10%. Record final reading on all points. Store

and lock source and place in cabinet.

14. Indicate on calibration certificate the maximum error noted if greater than 10%, and draw up calibration curve.

15. Place calibration sticker on meter, if error is less than 20%.

B. Field Procedure

1. Notify appropriate regulatory agency of proposed use and record in notification log.

2. Make sure source has an up-to-date leak test (within six months) and that leak test sticker on calibrator is intact.

3. Verify that source is locked.

4. Survey calibrator (should read less than 50 mR/hr on any surface).

5. Make sure DOT Yellow II labels on calibrator are legible.

6. Bring the following equipment:

   a. Whole body & wrist badges
   b. Self-reading dosimeter (zeroed) and charger
   c. Survey Meter (calibrated within the past six months)
   d. Calibration data sheets, survey diagram sheets, blank calibration certificates and stickers
   e. Rope and radiation signs
   f. Extension cord
   g. Hand truck
   h. Copy of license and procedures manual
   i. Attenuator Set

7. At job site determine an appropriate location to perform calibration. It should be an out-of-the-way area or one which may be conveniently cleared of personnel. If possible, a shielded room such as an X-Ray or isotope exposure room should be used.

8. Connect calibrator to 110 outlet.

9. Survey exposure area. Record any radiation level in excess of normal background (Note: If at all possible, attempt to have radiation level reduced to normal background before proceeding.)

10. Clear area of any personnel and expose source. STAND BEHIND CALIBRATOR WHEN EXPOSING OR STORING SOURCE.

11. Survey entire area, record results and post at the

2 mR/hr line.

12. Follow procedure A4 thru A6 above.

13. Using built-in tape measure, mark points selected on floor with marking pen. Use attenuators and appropriate attenuator factors in determining points in order to reduce source to instrument distance where necessary to avoid beam interaction with surrounding walls, equipment, etc.

14. Expose source and record meter readings at each point.

15. Store source and determine if meter reads within ±10% calculated value, taking into account previously noted background radiation levels if significant.

16. If adjustment is necessary, PERFORM AS MUCH WORK AS POSSIBLE WITH SOURCE STORED, following A12 thru A14 above.

17. Place calibration sticker on each meter and provide customer with a certificate for each, if error is less than 20%.

18. Lock source and survey. Remove posted radiation area signs.

19. Check dosimeter frequently during operation and record final dosimeter reading on survey diagram.

20. Load all equipment in vehicle and return to plant or next job site.

Item ~~15d~~ 10.4

Attached are check sheets that are performed on a daily, weekly, monthly, quarterly, semi-annual and annual basis.

PROCESS CONTROL DESCRIPTION

BECTON, DICKINSON AND COMPANY

ITEM COBALT^{60} TOTE INSPECTION PROGRAM LINE-UP NO.	Pg 1
OPERATION OP. NO.	REVISION
WRITTEN BY R. G. Crook Approved by: R. G. Crook	ISSUE DATE: 1-8-82
OPERATION All totes (carriers) used to transport product into, through and out of the irradiation cell. Co^{60} or Electron Beam.	

Frequency: Weekly

Responsible Department: Cobalt operators

Procedure: On a weekly basis at least 25 previously not inspected totes (carriers) will be examined for the following characteristics:

1. Security of the attachment of the fiberglass bottom to the tote. Must be secure on all four sides, minimum 2 fastening devices/side.

2. Integrity of all welded seams and joints, basic box and reinforcing bands: No loose sections of bands greater than 4 inches between corners and no free ends on the bands. No tote seams open.

3. No bent, torn, or cracked corners. All four sides must be intact, no holes, cracks or punctures; dents not to exceed 1" in depth, each side shall be not more than 1" out of parallel top to bottom or 1/2" corner to corner.

Actions:

1. If carriers meet inspection criteria for continued use, a log entry against the tote I.D. number shall be made by the inspector. If the tote is found unacceptable it shall be so noted on the tote I.D. number logs. The tote marked/tagged "Not to be used until repaired," a list of tote I.D. numbers requiring repair will then be provided to the facility supervisor. The facility supervisor will initiate work orders to repair or replace the totes. When repairs have been completed, reinspection will be conducted. If satisfactory an entry against its I.D. number in the log shall be made indicating OK to return to production use, or date a replacement unit was accepted.

Note: I.D. numbers shall be assigned upon initial receipt and inspection; the numbers shall be engraved/stamped on an internal surface of the carrier, in as protected a location as is practical and be readily readable.

ATTACHMENT G

Revised 8-20-82

DAILY CHECK SHEET

CANAAN COBALT FACILITY

Date_____

_____
Signature of person completing the check

_____1. Cell exhaust operating.

_____2. Water pump operating. No leaks.

_____3. Dosimeter reader calibrated.

_____4. "High radiation" lights working.

_____5. Conveyor loading schedule checked.

_____6. Spore controls ordered for next day.

_____7. Dosimeters from previous night read.

_____8. Chiller operating, correct setting, 68 - 72°F.

_____9. Oil level in air-line lubricator exhaust bowl, drain if necessary.

____10. 90 second Timer check. Actual seconds_____.

____11. Cell door interlock operational check.

____12. Conductivity:

_____ Before Demineralizer

_____ After Demineralizer

Change resin saqs if reading is 10 micromhos or greater.

ATTACHMENT G

Revised 8-20-82

WEEKLY CHECK SHEET

CANAAN COBALT FACILITY

W/E_____

Date check completed	Signature of person completing check
_____	_____

_____1. Film badges changed.

_____2. pH of pool -- reading_____

_____3. Pool float switch -- check for proper functioning -- pump should shut off and city water should enter Demineralizer.

_____4. Change Bristol chart -- file in specified folder.

_____5. Air line leak check (in cell).

_____6. Cylinder air leak check.

_____7. Check daily check sheets for previous week for outstanding discrepancies.

_____8. Rapistan side-transfer cable check.

_____9. P103 & P104 doors -- check for tightness of door bracket bolts and cylinder rod nut, and proper opening and closing.

____10. Inspect Carriers per Process Control Description entitled, "Cobalt^{60} Tote Inspection Program."

ATTACHMENT G

Revised 8-20-82

MONTHLY CHECK SHEET

CANAAN COBALT FACILITY

MONTH _____

Date check completed	Signature of person completing check
_____	_____

_____1. Zero productalog (2nd of month).

_____2. Monthly efficiency report.

_____3. Check resin beds & air filters with G-M Counter.

Resin bed reading_____ Air filter reading_____

_____4. Safety cable check.

_____5. "Stop" button check.

_____6. High-Temp. sensor check. Water Temp._____

_____7. Check source-hoist cables for fraying.

_____8. Clean out pool skimmer. Check hose.

_____9. Air flow check on Manometer.

_____10. G.P.M. level of pool filter check (over 2.5 G.P.M.)

_____11. Rebuild 1 cylinder. Replace 1 in cell.

_____12. Cylinger speed check.

_____13. Monitor test using check source.

_____14. Battery check on dosimeter charger.

_____15. Battery check on Mini-Mite.

_____16. Check power-failure time delay (15-25 sec.).
Actual _____min.

_____17. Low air switch check.

_____18. Check shut down alarm operation.

_____19. Check lights for pool & exhaust system.

_____20. L-118 Monitor -- Reference L-118 Monitor Revised Test Procedure.

_____21. Check Abnormal Water Level Switch for visual & audible alarm.

ATTACHMENT G

QUARTERLY CHECK SHEET

CANAAN COBALT FACILITY

QUARTER
ENDING _____

Date check completed	Signature of person completing check
_____	_____

_____1. Air exhaust pre-filter change.

_____2. Lubricate monorail chain. Check belt for wear.

_____3. Spare parts inventory.

_____4. Manually lube all cylinder rods.

_____5. Time cycle & time interval between cycles.

ATTACHMENT G

Revised 12-14-83

SEMI-ANNUAL CHECK SHEET

CANAAN COBALT FACILITY

Date completed	Signature of person completing check
_____	_____

_____1. Rapistant belt & roller adj. check.

_____2. Change absolute filter in exhaust.

_____3. Leak test on source -- fill out proper leak test survey form and file in proper folder.

_____4. Leak test on calibration source -- Send to Tech. Operations -- file leak test form when received in proper folder.

_____5. Lube and inspect exhaust motor.

_____6. Clean cell mirror -- semi-annual or as needed.

_____7. Check monorail speed.

_____8. Clean A/C filters and screens.

_____9. Sweep out cell.

____10. Calibrate Survey Meters_____.

____11. Check Survey Meter against test source upon completion of calibration -- Reference Procedure.

AMENDED ____12. Check Manual Fire Suppression System for proper functioning.

ATTACHMENT G

Revised 8-20-82

ANNUAL CHECK SHEET

CANAAN COBALT FACILITY

Date completed	Signature of person completing check
_____	_____

_____1. Conveyor gear box lube check.

_____2. Source hoist check for oil.

_____3. Source hoist check for air leaks.

_____4. Graphite source-pass side transfer rollers.

_____5. Check relays for pitting and buzzing.

_____6. Connecticut registration.

_____7. Microswitch check -- Ensure both switches are functioning.
Check for shorts.

_____8. Calibrate Bristol Recorder. Mini-Mite reading_____

Bristol Recorder reading_____

_____9. Calibrate Mini-Mite.

_____10. Vacuum pool.

_____11. Calibrate Pocket Dosimeters (Victoreen and Digi Dose).

_____12. Personnel Report and Monitoring Report for NRC.

03572

Item 10.4

On the Maze entrance door there is a sign reminding personnel to wear their badge. The sign is worded, "PERSONNEL MONITORING REQUIRED" - (red letters-yellow background).
Sign dimensions - 12" x 4".

Step-by-step procedure for start-up and shut-down is posted at the console, "Basic Operating Instructions". Each operator has been given a copy of Part 2, entitled "Operation" of the Instruction Manual. This gives a step-by-step instruction, also, for start-up and shut-down. Ensures that enty controls such as our ratemeter is functioning properly, Ozone delay timer, safety delay timer are in operating condition. Key attached to meter insures operator has in his possession a meter before entering cell. Meter is checked against a test source at the door.

Radiation surveys are completed by A.E.C.L. personnel upon completing a source loading.

List of emergency conditions are posted at the console such as Personnel in maze or irradiation room at start-up, source rack pilot light illuminates and the associated corrective actions.

03572

ITEM 124

EMERGENCY SHUT-DOWN PROCEDURE

In an emergency the machine can be immediately shut down as follows:

1. At the Load/Unload Station, Control Console or Maze – depress the emergency stop button or pull the emergency cable at these locations. The radiation source will be lowered and the conveyor system will stop immediately, irrespective of the stage attained in the machine cycle, and the "Safety" pilot light on the control console will illuminate.

   When the radiation source is in the "safe" position, check that the irradiation room monitor is back in operation. If the radiation level is normal, press the "Monitor Test" button and hold until the monitor alarms. The alarm signal will continue until shortly after the button is released. The "Monitor Test" pilot light will remain illuminated until the maze door is opened. All emergency procedures must be entered in the Log Book which is provided with this manual.

Note:

a) The irradiation room monitor is automatically cut out when the source is in the "on" (or irradiate) position.

b) The maze door can only be opened by the

operator when the source is fully down and no alarm condition exists.

c) The first time each day that the operator is required to open the maze door, the portable monitor must be checked against the test source to ascertain that the audible alarm is functioning.

2. After an emergency shutdown, the irradiator should be started up as per "start-up after emergency or inadvertent shut-down".

INADVERTENT SHUT-DOWN

During operation a number of conditions or occurrences may cause irradiator shut-down at any stage. In this event the cause will be indicated by a red shut-down pilot light on the control console. In order to restart the machine it will be necessary for the operator to rectify the fault and then proceed as per "start-up after emergency or inadvertent shut-down".

The red shut-down pilot light will remain illuminated until the fault is rectified and the "Power" key is turned to the "reset" position in the "Power" keyswitch and released.

The following is a list of typical shut-down conditions with their associated rectification procedures.

TO OPEN MAZE DOOR

1. At the Control Console – check that the source is in the safe position. This will be indicated by the "Source Down" pilot light.
2. At the Control Console – Insert the "Power" key in the "Power" key switch and turn through the "On" position to the "Reset" position and release.
3. At the Control Console – check that the monitor "Read-out" on the console is functioning and that the indicated radiation level is normal. The monitor "Check" pilot light should be flashing at all times. If the reading is not normal or an alarm is indicated, leave the facility as described in this manual under Contamination Detection.
4. At the Control Console – Press the "Monitor Test" button and hold until the monitor alarms.

   Note: The "Monitor Test" pilot light will remain illuminated until the maze door is opened.
5. At the Control Console – remove the "Power" key from the key switch taking care not to turn the machine off.
6. At the back of the Control Console – check the portable hand monitor against the test source to ascertain that the audible alarm is functioning correctly.
7. At the Maze Door – insert the "Power" key into the "Maze Door" key switch and open the door.
8. In the Maze – if a noticeable increase in monitor crackle rate is evident on entering, leave the room and notify the department supervisor immediately. The supervisor will check the radiation levels with a survey instrument and will notify Atomic Energy of Canada Limited, or their Agent, of unusual conditions or incidents. If conditions are normal proceed as required.

HAND OPERATION OF UNIT

(Maintenance or Inspection Purposes)

1. At the Maze Door – proceed as detailed under heading To Open Maze Door.
2. At the Control Console–check that the "Power" key switch is in the "On" position.
3. At the Control Console – insert the "Power" key into the "Conveyor" key switch and turn into the "Manual" position.

   IMPORTANT: DO NOT TURN THE KEY SWITCH INTO THE "AUTOMATIC" POSITION.
4. At the Control Console – Operate the pneumatic cylinders as desired by pressing the appropriate push buttons.

Cylinders can be timed with a stop watch by checking the appropriate pilot lights on the control panel during cylinder operation. For example: With cylinder P. 1 in the receive position, press the "P. 1 Discharge" push button. As the cylinder begins to move from receive to discharge the receive light will extinguish. Both receive and discharge pilot lights will remain extinguished until the cylinder assumes the discharge position. When the cylinder has assumed the discharge position the discharge pilot light will illuminate. Cylinder stroke time can thus be determined from cylinder pilot light operation. Care must be exercised during hand cylinder operation to ensure that the cylinders are free to move without obstruction from product boxes.

CARRIER MOVEMENT

Carrier movement under hand control can be conducted by merely depressing the "Conveyor In" or "Conveyor Out" switches. Unlike cylinder operation the switches must be held in position during carrier movement.

Caution: Do not operate cylinder P. 1 unless the carrier is fully in Position 1 or completely clear of Position 1. Conversely the carrier must be fully in the load/unload position before cylinders P. 101 or P. 102 are operated. These cylinders can of course be operated if the carrier is completely clear of the load/unload station. It will be obvious that the carrier could be damaged by moving cylinders if this precaution were not taken.

AUTOMATIC OPERATION OF MACHINE

(Maintenance or Inspection Purposes)

1. At the Maze Door — Proceed as detailed under heading "To Open Maze Door".
2. At the Load/Unload Station or Source Pass Mechanism — To operate the machine with product boxes it is necessary to check that all boxes either in the load/unload station or at the source pass mechanism are in their proper positions.
3. At the Control Console — Check that the "Power" key switch is in the "On" position.
4. At the Control Console — Insert the "Power" key in the "Conveyor" key switch and turn the key into the "Manual" operation position.
5. At the Control Console — Check that all pilot lights on the maintenance control panel are green.
6. At the Control Console — Check that the green "Pos. No. 1" pilot light is illuminated. If the carrier is not at its correct position at the internal conveyor, turn the "control" key switch to the "on" position only and the carrier will automatically go to it's correct position, including going through a "load/unload" operation if required. Remove the key from the "control" keyswitch.

   Caution: It is extremely important that the operator must not start the machine for automatic maintenance operation with the carrier in a position other than the one indicated by the green "Pos. No. 1" pilot light on the control console. The white "conveyor in" and "conveyor out" pilot lights indicate the direction the CARRIER SHOULD MOVE for automatic operation and NOT NECESSARILY WHERE THE CARRIER ACTUALLY IS.

   Serious damage could occur if automatic operation were attempted while the carrier was at the load/unload position, when the control panel "conveyor in" pilot light indicates that the carrier should be at the internal conveyor Position No. 1 for start-up.

   In this case the machine would be out of sequence, the load/unload station would commence to discharge and receive boxes from the carrier as the carrier attempts to correct its position by returning to internal conveyor Position No. 1. This would cause serious interference between the carrier and the cylinders.
7. At the Control Console — Turn the "Power" key in the "Conveyor" key switch through the

"manual" position into the "Automatic" position and release. The machine will now assume automatic operation. For operation of the machine without product boxes the switch at the load/unload station which indicates that there is a box on the conveyor must be actuated manually for each machine cycle.

START UP AFTER EMERGENCY OR INADVERTENT SHUT-DOWN

"Safety"

An emergency shut-down has occurred via the emergency button at the load/unload or the emergency cable located inside the maze and irradiation room or an attempt has been made to gain access into the irradiation room by force.

1. At the Control Console — Reset the machine controls by turning the "power" key into the "reset" position on the "power" key switch. The key will return to the "on" position. Resetting the machine will clear all the inadvertent shut-down condition pilot lights on the control panel and these lights will now be extinguished.
2. At the Control Console — Remove the "power" key from the "power" key switch taking care to leave the switch in the "on" position.
3. At the Maze Door — Proceed as detailed under heading "To Open Maze Door".
4. Ascertain the cause of the emergency condition and rectify the fault.

   Important: Do not attempt to alter the position of machine components before restarting.
5. In the Irradiation Room — Actuate the "Safety-Delay" switch with the "Power" key. This will start the 90 second safety delay timer.
6. In the Irradiation Room — Leave the room (at a normal walking pace) closing the maze door on the way out.
7. At the Control Console — Insert the "Power" key into the "Machine" key switch and turn the key clockwise to the "on" position. Leave in this position until the carrier arrives at "Pos. No. 1". Now turn the key through the "On" position to the "Start" position. Release the key and it will return to the "On" position and the "Machine On" pilot light should now be illuminated. The source alarm bell will signal until the source reaches the irradiate position and the "Source Up" pilot light will illuminate. The product conveying systems will then resume operations automatically.
8. At the Control Console — Make a complete entry in the Log Book.

"HIGH TEMPERATURE"

A machine shut-down has been caused by the detection of temperatures above normal in the irradiation room.

1. For the resumption of operations proceed as detailed under heading "Safety".

"LOW AIR PRESSURE"

A machine shut-down has been caused by a failure in the pneumatic system.

1. For the resumption of operations proceed as detailed under heading "Safety".

"SOURCE RACK"

A machine shut-down has been caused by a malfunction in source rack operation; the source rack has not assumed the fully exposed position in the preset time period.

1. Before resuming operations the operator must notify the facility supervisor of the conditions existing at the unit. Subject to supervisor approval the operator can then proceed as detailed under heading "Safety".

"INTERNAL CONVEYOR"

A machine shut-down has occurred due to a malfunction in the internal conveyor system or maze

conveyor system or the machine has "timed out" because of no box being available on the load/unload station. See the following procedures which are detailed under headings "Internal Conveyor Malfunction" and "Internal Conveyor Timed Out" before resuming operations.

INTERNAL CONVEYOR MALFUNCTION OR MAZE CONVEYOR MALFUNCTION

In the event of an internal conveyor malfunction or maze conveyor malfunction which would indicate a box jam, or limit switch malfunction, the following procedure for the resumption of operations should be adopted:

1. At the Maze Door — Proceed as detailed under heading "To Open Maze Door".
2. Ascertain the cause of machine shut-down.
3. Should it be necessary to actuate a cylinder in order to rectify the malfunction, it is important to make sure that the various cylinder positions are not changed from those they assumed at machine shut-down. It is important for the operator to familiarize himself with the operating sequence of the source pass mechanism cylinders as described in Part 3 of this manual under heading "Pneumatic Cylinder Operating Sequence").

   Each cylinder operation is dependent upon the completion of preceding cylinder movements. For example, cylinders P. 1 and P. 15 actuate simultaneously when discharging and loading the maze carrier. If either of these cylinders does not complete its' stroke and actuate their respective discharge position limit switch the cycling sequence will stop. The succeeding cylinders in the operating sequence require actuation and completion of preceding cylinder movements before they can function. Therefore, if a given cylinder does not complete its' stroke and actuate its' respective discharge or receive limit switch (whether this is caused by a faulty switch or a box jam) the cylinder operation sequence will stop, the timer will run out and the machine will shut down. In rectifying the problem (by clearing the jam and allowing the cylinder to complete its' stroke, or by adjusting or replacing the respective limit switch), the operator must not change the position of the cylinder pushers from that in which they were found when the unit shut down. It may be necessary to actuate a given cylinder employing the hand operation method to rectify the problem but the operator must return the cylinder pusher to the position which it had attained or was attempting to attain when the shut down occurred.
4. After rectifying the malfunction, operation can be resumed by proceeding as detailed under heading "Safety".

SUPPLY CONVEYOR EMPTY OR DISCHARGE CONVEYOR FULL

1. At the Maze Door — Proceed as detailed under heading "To Open Maze Door".

   Note: On entering the maze the carrier will be found at the load/unload station. The internal conveyor will have completed its' cycle and all cylinder indicating lights P. 1 through P. 15 will be green. The "Box On" "Position No. 1", "Machine Ready" and "Machine On" pilot lights will not be illuminated. The clock timer will be at 0 time.
2. After rectifying the storage conveyor shut-down, operation can be resumed by proceeding as detailed under heading "Safety".

"SOURCE" KEY

The "Source" key which is provided by Atomic Energy of Canada must be kept in a safe place under lock and key at the site for the use of A.E.C.L. personnel only. At no time will the operating personnel be permitted the use of this key.

PRODUCT BOX LOADING PROCEDURES

1. At the Maze Door — Porceed as detailed under heading "To Open Maze Door".

2. At the Storage Conveyor — Load the storage conveyor with a minimum of ten (10) dummy product box units.

3. Obtain the "Timer" key from the plant supervisor.

4. At the Control Console — Insert the "Timer" key into the "Timer" key switch and turn the key counter-clockwise to the desired timer setting

   Note: The minimum timer setting on this timer is six minutes. In other words, the black hand of the timer must be in the black portion of the timer setting scale.

5. At the Control Console — Insert the "Power" key into the "Power" key switch and turn to the "Reset" position and release.

6. At the Control Console — Cylinders P. 1 through P. 15 pilot lights must be green.

7. Remove "Power" key from the "Power" key switch making sure that the key switch is in the "On" position.

8. At the Control Console — Insert the "Power" key in the "Conveyor" key switch and turn the key into the "Manual" operation position.

9. At the Control Console — Using hand operation move the carrier into the "Pos. No. 1" position at the internal conveyor.

10. At the Control Console — Turn the "Power" key to the "Off" position in the "Conveyor" key switch. Then turn the key into the "Automatic" position and release. The machine will now assume automatic operation.

11. At the Control Console — When the mechanism is completely loaded with dummy boxes turn off the machine by turning the "Power" key to the "Off" position in the "Conveyor" key switch.

12. At the Inlet Storage Conveyor — Load inlet storage conveyor with product to be irradiated.

13. At the Control Console — Start up machine as as per paragraph "Normal Start-up Procedures".

TO UNLOAD UNIT

1. At the Inlet Storage Conveyor — Load inlet storage conveyor with a minimum of ten (10) dummy product box units and allow the machine to run under normal conditions with the source up until the first dummy box is discharged onto the discharge storage conveyor. At this time the internal conveyor will be full of dummy box units.

2. At the Control Console—Shut down the machine as per paragraph "Normal Shut Down Procedures".

   Note: It may be necessary to clear the internal conveyor mechanism of product boxes for maintenance work. The operator must open the maze door as detailed under heading "To Open Maze Door" and manually remove the dummy product boxes from the source pass conveyor.

ITEM 10.4

NOTIFICATION OF INCIDENT

Immediately the Licensed Operator shall notify the personnel as listed on the attached sheet (Notice to Workers). If for a reason the Licensed Operator is not able to contact the Radiation Safety Officer, the Licensed Operator will contact by telephone the ATomic Energy of Canada, Limited, Ottawa, Canada, 613-592-2790 of any incident involving any source of radiation which may have threatened to cause a radiation hazard.

ITEM 10.4

Revised 2/24/85

NOTICE TO WORKERS

Pursuant to Section 206 of the Energy Reorganization Act of 1974, the following procedures are to be followed in the event of a discovery of any deviation or defect which could possibly present a substantial safety hazard.

1. An entry describing the failure or derect is to be made in the irradiator log book by the Licensed Operator.

2. Notification is to be given immediately to the following persons in the order given:

   a. Sterilization Supervisor and Licensed Operator

      William R. Case — Ext. 220 or 413-274-6004

   b. Licensed operating personnel

      Adrian L. Costa — Ext. 284 or 203-542-5040
      James R. Blanquart — Ext. 284 or 413-743-3747

   c. Manager, Microbiological and Sterilization Services

      Richard G. Crook — Ext. 214 or 203-379-8614

   d. Plant Manager

      Andrew P. Rowjohn — Ext. 254 or 203-824-0857

   e. Corporate Safety Director

      C. W. Jordan — 201-967-3754 or 914-496-4125

3. Within 24 hours, the above personnel must meet (by phone, if necessary) to evaluate the deviation to determine if a substantial safety hazard exists.

4. If it is determined that a safety hazard exists, a responsible individual or a designated back-up, must send a written report to the N.R.C. within 48 hours (including weekends and holidays). Copies are to be sent to the Plant Manager and the responsible officer assigned by the Corporation.

Item ~~15d~~ 19.5

LEAK TEST PROCEDURES -- COBALT ^{60} SOURCE

1) Check that the radiation source is in the submerged ("safe") position.
2) At the control console remove the "Power" key from the "Power" key switch leaving the key switch in the "on" position.
3) At the control console press the "Monitor Test" button and hold until monitor alarm sounds.

   Note: The "Monitor Test" pilot light will remain illuminated until the maze door is opened.
4) At the maze door check the portable hand monitor with the test source.
5) At the maze door insert the "Power" key into the "maze door" key switch, open the door and enter the room. If a noticeable increase in monitor "crackle" rate is evident on entering, leave the room and notify the Sterilization Supervisor immediately.
6) Using suitably sized pads of styrofoam perform wipe tests on the exposed surfaces of the capsules.
7) Allow excess water to drain from the wipes.
8) Count the wipes by placing in contact with a geiger counter operating in a background field of no more than 0.25 m.r.h.
9) If the counter indicates contamination on the test sample exceeding 0.005 microcuries suspend operations and immediately advise Atomic Energy of Canada, Limited.

   Using the Red Scale on the Berthold meter:

   a) 400 counts/minute = .05 microcuries
   b) Take background reading
   c) Take gross reading from styrofoam pad
   d) Net reading = background reading minus gross reading
   e) Net wipe reading in counter/minute times .05 microcuries divided by 400 counter/minute equals actual microcuries.

10) If the counter indicates contamination on the test sample exceeding .05 microcuries suspend operations and immediately notify the N.R.C.

Item 11

Disposal of all sealed sources wll be in accordance with paragraph 20.30 (a) of 10 CFR Part 20. ATomic Energy of Canada Limited shall remove all sealed sources.

SHARON HOSPITAL

SHARON, CONNECTICUT 06069

JAMES H. BATES, CHAIRMAN OF THE BOARD
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PAUL W. STERNLOF
PRESIDENT
CHIEF EXECUTIVE OFFICER

March 8, 1985

Cynthia Cantele, R.N.
Becton Dickinson and Company
Grace Way
Canaan, CT 06018

Dear Mrs. Cantele:

David Kurish, M.D., plant physician at Becton Dickinson and Company, asked that I send you a letter indicating the hospital's willingness to accept for treatment, Becton Dickinson and Company employees exposed to radiation.

Please accept this letter as assurance that the Sharon Hospital is willing to accept for care and treatment any employee at Becton Dickinson and Company in need of medical attention including those employees exposed to radiation.

Sincerely,

James E. Sok
Executive Vice President

JES/clk
cc: P. Sternlof
C. Weeks
D. Kurish

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