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RADIATION EXPOSURE RECORDS MANAGEMENT

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Abstract

Management of individual radiation exposure records begins at employment with the accumulation of data pertinent to the individual and any previous occupational radiation exposure. Appropriate radiation monitoring badges or devices are issued and accountability established. A computer master file is initiated to include the individual's name, payroll number, social security number, birth date, assigned department, and location. From this base, a radiation exposure history is accumulated to include external ionizing radiation exposure to skin and whole body, contributing neutron exposure, contributing tritium exposure, and extremity exposure. It is used also to schedule bioassay sampling and in-vivo counts and to provide other pertinent information. The file is used as a basis for providing periodic reports to management and monthly exposure summaries to departmental line supervision to assist in planning work so that individual annual exposures are kept as low as practical. Radiation exposure records management also includes documentation of radiation surveys performed by the health physicist to establish working rates and the individual estimating and recording his estimated exposure on a day-to-day basis. Exposure information is also available to contribute to Energy Research and Development Administration statistics and to the National Transuranium Registry.

Introduction

The HP Dosimetry group (personnel monitoring and bioassay) has processed approximately 4,000,000 personnel monitoring badges and analyzed more than 850,000 bioassay samples since 1952. This entails recording the basic result, making related calculations, recording values obtained, and maintaining those records. Thus, records management for the thousands of employees involved is an important and major task.

Discussion

Initially, all records were developed, recorded, filed, and accumulated manually. Since 1958, personnel exposure records have been and still are maintained by a combination of manual and computer efforts.

Initiation of an Employee Radiation History

An employee's radiation exposure record and management begins with his or her employment. Here the employees are asked whether they have performed any previous occupational work involving radioactive material. A Radiation Exposure History form (Fig. 1) is used to record this information. If the employee indicates a previous history of radiation exposure, a letter of request is sent to the appropriate organization to obtain the previous exposure history. This is done to ensure that the employee has not accumulated an amount equal to or greater than his age-rem dose [5(N-18)rems]; i.e., a total exposure of not more than 5 rems/year for each year past age 18. Information obtained upon employment is used by the HP Dosimetry group to establish the employee in a computer-based master file and to initiate an Individual Dosimetry File. This individual file (Fig. 2) is simply a manila folder established to accumulate documents and any pertinent information relating to the employee's internal and external exposure. Information includes the employee's name, payroll identification number, social security number, birth date, date employed, department, and location assigned. The information is obtained from the Plant Employment Report and the Introductory Slip (Fig. 3) prepared by the Employment office.

Accumulation of Exposure History

In addition to basic employee information, the computer master file (Fig. 4) maintains a program that produces bioassay sampling schedules (type sample and frequency of sampling), whole body/chest count schedules (type and frequency of count), storage of tritium sample results for monthly mrem-equivalent calculation, storage for each month's skin and penetrating exposure to ionizing radiation, storage of each month's tritium exposure for a current quarter, previous quarter, year and plant totals, and similar

* Information in this paper was developed during work under Contract AT(07-2)-1 with the U.S. Energy Research and Development Administration.

data for neutron exposure.

Radiation monitoring badges are issued as required using Change of Status (Fig. 5) and accountability is established by setting a flag in the computer master file to the appropriate badge change cycle (monthly or quarterly change). Computer printouts are provided on those personnel permanently badged. Badges must be accounted for at the end of the monitoring period to determine exposure accumulations that will be filed in the employee's history. Employees not permanently badged use a visitor badge and exposure is stored for the appropriate month in the computer master file. A flag is also set to indicate the employee has been monitored during the current year.

External exposure data from personnel monitoring badges (Fig. 6) are developed primarily by an automatic system (Fig. 7) that produces a teletype record and records the data on magnetic tape for storage in the computer master file. Neutron contribution to the total exposure is also maintained in the master file. The neutron badge is handled and read manually with input to the computer by a document, Personnel Exposure Data form (Fig. 8).

Tritium contribution to total whole body exposure is calculated monthly from bioassay samples analyzed during the month corresponding to the month personnel monitoring badges are worn (i.e., September tritium samples are used to calculate tritium contribution and added to exposure received by the September personnel monitoring badge). Tritium sample results are manually input to the computer master file using a Bioassay Tritium Data form that serves as a receiving report and computer input document (Fig. 9).

Data is collected from a variety of sources and input to a computer system either manually or automatically (Fig. 10).

Records management also includes documentation of radiation surveys (Fig. 11) performed by the health physicist to establish working rates and individual employee recording of his estimated exposure on a day-to-day basis (Fig. 12). Such records are permanently stored for retrieval as necessary.

Exposure Records and Reports

The computer master file is a basis for providing periodic reports to management and exposure summaries to the various operating areas to assist in planning work so as to keep individual annual exposures as low as practical.

A review of the master file (Fig. 4) shows that through appropriate programming, the following typical reports can be obtained.

- Badges processed
- Area (location) personnel summary
- Departmental personnel summary
- Cycle exposure summary (Fig. 13 shows a summary with data format.)
- Cycle statistics such as personnel receiving:
  - 300 mR or greater penetrating exposure
  - 1800 mrads or greater skin exposure
  - a prorated annual exposure or greater
- Bioassay master with sampling schedule and sample request labels
- Chest count schedules with request labels
- Annual summary that includes:
  - individual exposure history
  - highest skin exposure for current year
  - highest penetrating exposure for current year
  - highest annual tritium contribution
- Average dose/year of employment
- Dose distribution, i.e., 0-1 rem, 1-2 rems, etc.

Data may be formatted to meet special needs such as information to the Energy Research and Development Administration and to the National Transuranium Registry. Fig. 14 illustrates flow of data to provide information and assist in minimizing exposure to ionizing radiation.

Summary

Documentation and management of individual radiation exposure records are vital to any nuclear facility. Utilization of a computer is effective in accumulating histories and reporting data in forms that are useful in maintaining individual exposures as low as reasonably attainable.

RADIATION EXPOSURE HISTORY

NAME: _____
(Please Print)

The Savannah River Plant Health Physics Section maintains radiation exposure records on all personnel. This includes radiation received at this site, and, in addition, that received at other locations.

Were you ever engaged in activities (work, training, military service or other) wherein you were exposed to radiation or radioactive materials for any reason other than medical treatment? YES____ NO____

If the answer above is "Yes," please provide the following information concerning your location when the exposure occurred.

Period Covered: From _____ To _____

Please sign the attached form authorizing the release of your radiation history data.

_____
Employee's Signature

Fig 1. Radiation Exposure History

Name PR #

- BIOASSAY KARDEX RECORD
- CHEST COUNT CALCULATION
- SPECIAL BIOASSAY REQUEST, OSR 4-28
- MISSING EXPOSURE INVESTIGATIONS, OSR 4-51
- CONFIRMED ASSIMILATION REPORT, OSR 4-16B
- FILM BADGE INTERPRETATIONS
- SPECIAL SUMMARIES -

Fig 2. Individual Dosimetry File

OSR 5-2 (Rev. 7-61)

SAVANNAH RIVER PLANT

E. I. du Pont de Nemours & Co.

INTRODUCTORY SLIP

REPORTING TO	INTRODUCING
REPORTING DATE	PAYROLL NUMBER
EMPLOYED AS	SOCIAL SECURITY NUMBER
RATE PER $	BIRTH DATE
DEPARTMENT	HAIR EYES
REQUISITION NO. / TYPE BADGE REQUESTED	WEIGHT HEIGHT
	ADDRESS (STREET, CITY & STATE)

APPROVALS

EMPLOYMENT

Fig 3. Introductory Slip

OSR 24-F-75

SAVANNAH RIVER PLANT

COMPUTER STORAGE LAYOUT

APPLICATION: HEALTH PHYSICS' PERSONNEL MONITORING | BY: J. H. CARROLL | DATE | PAGE OF

1 - 50	DAY; ROLL; PREFIX; EMPLOYEE NUMBER; EMPLOYEE NAME; SEX; SOCIAL SECURITY NUMBER; DATE OF BIRTH; ADJUSTED SERVICE DATE; PLANT SERVICE DATE; H.P. DEPT. NUMBER; HP
51 - 100	AREA; MOR Q; SUPERVISOR LOCATION; PAY ROLL PREFIX; DATE FIRST BADGED MO YR; AOR T; TERMINATION DATE; FILLER; BIOASSAY START DATE MO YR; BACAT; TYPE; BIOASSAY SAMPLE TYPE; FREQUENCY; AND DUE DATE; FREQUENCY; DATE DUE MO YR
101 - 150	OCCURS 6 TIMES; CHEST COUNT; TYPE; FREQUENCY; DUE DATE MO YR; START DATE MO YR; FILLER; FLAG; TRITIUM 1 2 3 4 5 6 7 8 9 1
151 - 200	BIOASSAY RESULTS 0 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31; PRIOR MREM; FILLER
201 - 250	FILLER; CYCLE NUMBER; FLAG; TLD BADGE RESULTS FOR YEAR (12 CYCLES); CYCLE 1 OW S; CYCLE 2 OW S; CYCLE 3 OW S; CYCLE 4 OW S; CYCLE 5 OW S; CYCLE 6 OW S; CYCLE 7 OW S; CYC- OW
251 - 300	LE 8 S; CYCLE 9 OW S; CYCLE 10 OW S; CYCLE 11 OW S; CYCLE 12 OW S; QUARTER EXPOSURE OW S; YEAR EXPOSURE OW S; PLANT EXPOSURE OW S; NUMBER OF BADGES; M
301 - 350	TRITIUM EXPOSURE: ON 1; MON 2; MON 3; PREVIOUS QUARTER; YEAR; PLANT; NEUTRON BADGE EXPOSURE: MON 1; MON 2; MON 3; PREVIOUS QUARTER; YEAR; PLANT; FILLER
351 - 400	FILLER

Fig 4. Computer Master File

TO PERSONNEL MONITORING, BLDG 735-A

FROM (NAME & BLDG NO.) PHONE NO.

OSR 4-26 (Rev 11-71)

SRP PERSONNEL MONITORING BADGE CHANGE OF STATUS

DATE

Prepare in duplicate and forward to Personnel Monitoring, 735-A. Check (✓) the appropriate block and complete statement as necessary.

☐ Change badge from _____ to _____. *NOTE: On this form list only personnel transferring from same area to the same area; e.g., all personnel from M Area transferring to C Area.*

☐ Change badge cycle from _____ to _____.

☐ Remake badge because _____.

☐ Issue new badge (new employee or badge not previously issued but required).

☐ Pull badge (no longer required in assigned work area).

☐ Terminate badge (employee terminated).

NAME	PAYROLL NO.	NAME	PAYROLL NO.
1.		6.	
2.		7.	
3.		8.	
4.		9.	
		10.	

Fig 5. Badge Change of Status

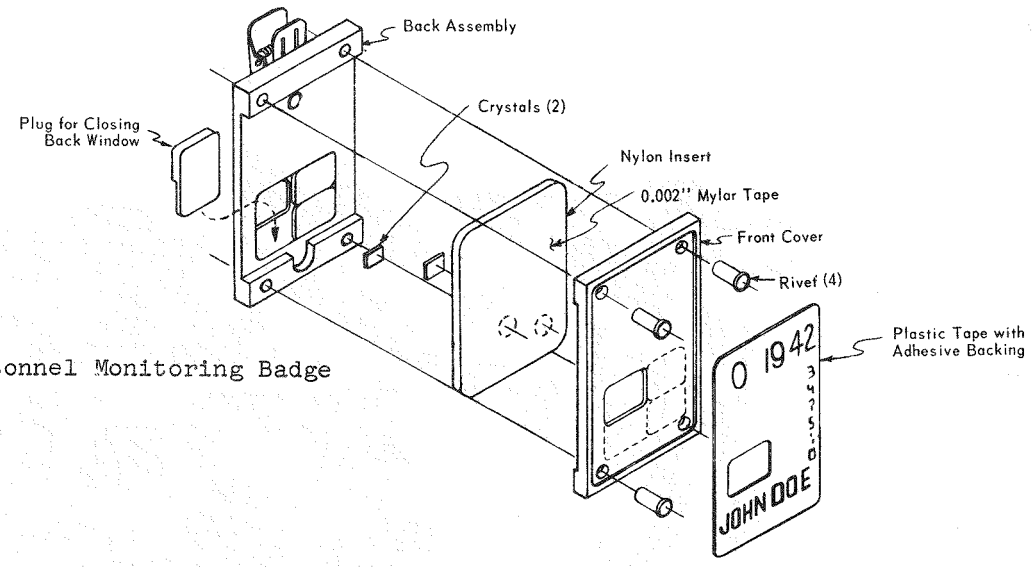


Fig 6. Personnel Monitoring Badge

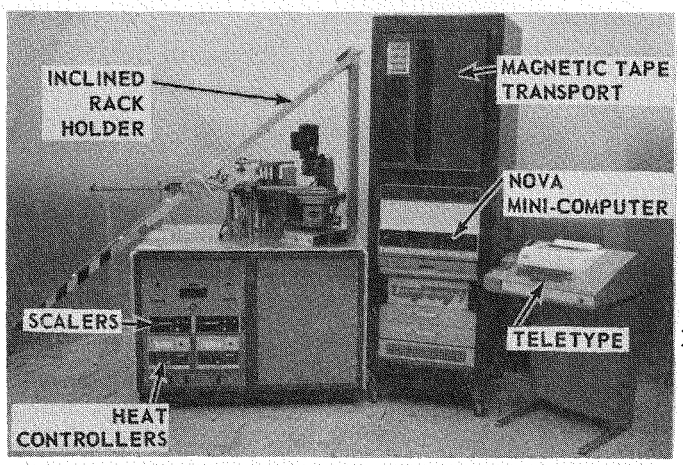
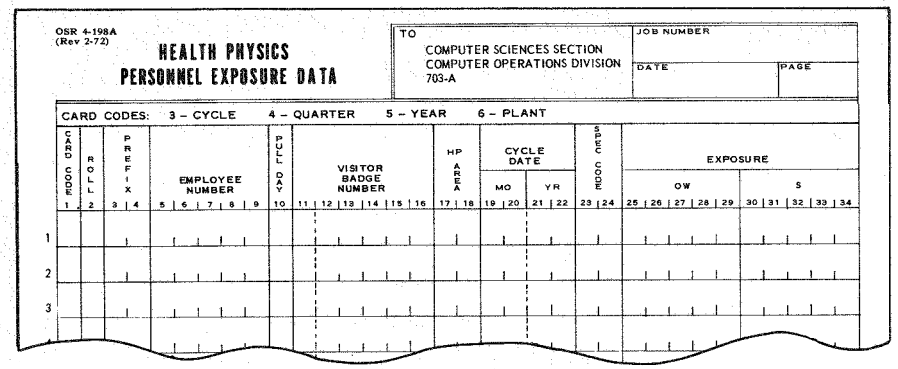


Fig 7. Automatic TLD Reader


OSR 4-198A
(Rev 2-72)

HEALTH PHYSICS
PERSONNEL EXPOSURE DATA

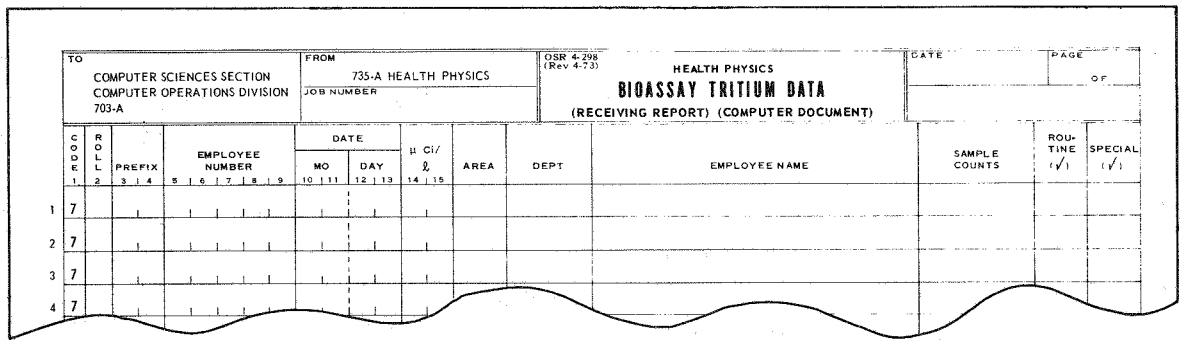
TO
COMPUTER SCIENCES SECTION
COMPUTER OPERATIONS DIVISION
703-A

JOB NUMBER
DATE
PAGE

CARD CODES: 3 - CYCLE 4 - QUARTER 5 - YEAR 6 - PLANT

	CARD CODE	ROLL	PREFIX	EMPLOYEE NUMBER	PULL DAY	VISITOR BADGE NUMBER	HP AREA	CYCLE DATE MO	CYCLE DATE YR	SEC CODE	EXPOSURE OW	EXPOSURE S
	1	2	3 | 4	5 | 6 | 7 | 8 | 9	10	11 | 12 | 13 | 14 | 15 | 16	17 | 18	19 | 20	21 | 22	23 | 24	25 | 26 | 27 | 28 | 29	30 | 31 | 32 | 33 | 34
1												
2												
3												

Fig 8. Computer Input Document


TO
COMPUTER SCIENCES SECTION
COMPUTER OPERATIONS DIVISION
703-A

FROM
735-A HEALTH PHYSICS
JOB NUMBER

OSR 4-298
(Rev 4-73)

HEALTH PHYSICS
BIOASSAY TRITIUM DATA
(RECEIVING REPORT) (COMPUTER DOCUMENT)

DATE
PAGE
OF

	CODE	ROLL	PREFIX	EMPLOYEE NUMBER	DATE MO	DATE DAY	μ Ci/ℓ	AREA	DEPT	EMPLOYEE NAME	SAMPLE COUNTS	ROUTINE (√)	SPECIAL (√)
	1	2	3 | 4	5 | 6 | 7 | 8 | 9	10 | 11	12 | 13	14 | 15						
1	7												
2	7												
3	7												
4	7												

Fig 9. Tritium Data Sheet

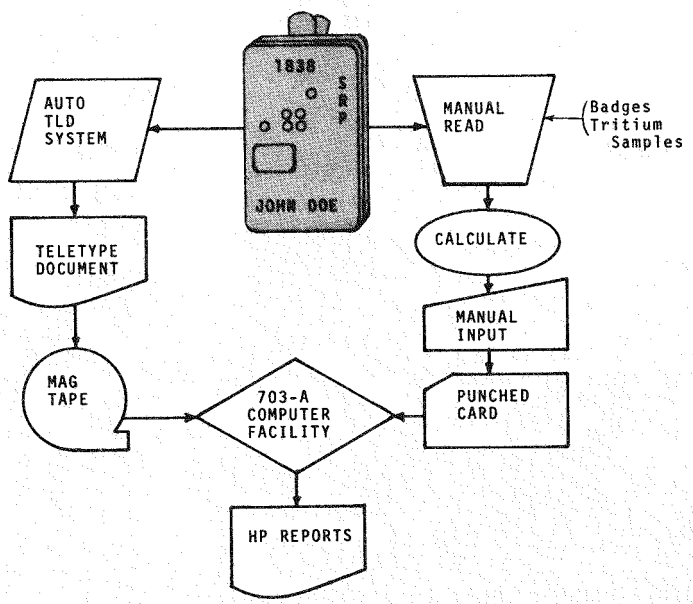
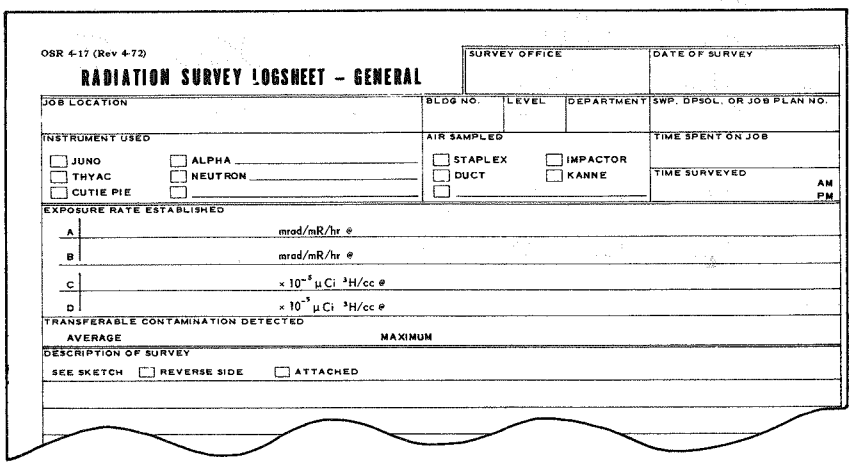


Fig 10. Exposure Data Handling



OSR 4-17 (Rev 4-72)

RADIATION SURVEY LOGSHEET – GENERAL

SURVEY OFFICE | DATE OF SURVEY

JOB LOCATION | BLDG NO. | LEVEL | DEPARTMENT | SWP, OPSOL, OR JOB PLAN NO.

INSTRUMENT USED
- ☐ JUNO ☐ ALPHA
- ☐ THYAC ☐ NEUTRON
- ☐ CUTIE PIE ☐

AIR SAMPLED
- ☐ STAPLEX ☐ IMPACTOR
- ☐ DUCT ☐ KANNE
- ☐

TIME SPENT ON JOB

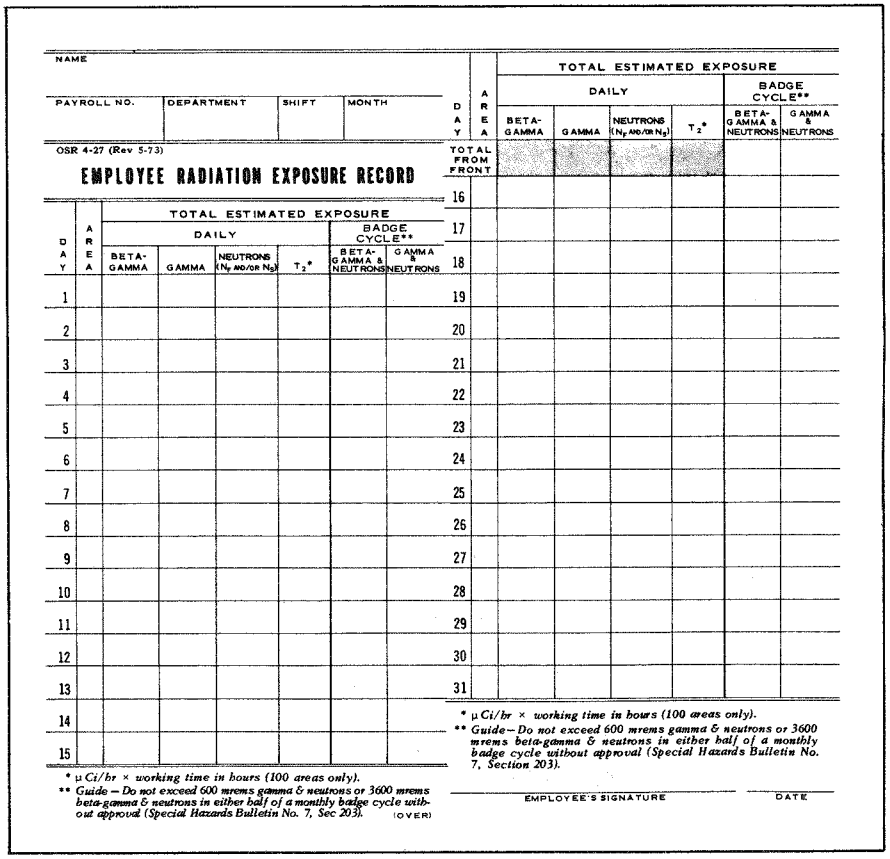
TIME SURVEYED AM PM

EXPOSURE RATE ESTABLISHED
- A: mrad/mR/hr @
- B: mrad/mR/hr @
- C: × 10^{-5} μCi ^{3}H/cc @
- D: × 10^{-5} μCi ^{3}H/cc @

TRANSFERABLE CONTAMINATION DETECTED
AVERAGE MAXIMUM

DESCRIPTION OF SURVEY
SEE SKETCH ☐ REVERSE SIDE ☐ ATTACHED

Fig 11. Radiation Survey Logsheet



NAME

PAYROLL NO. | DEPARTMENT | SHIFT | MONTH

OSR 4-27 (Rev 5-73)

EMPLOYEE RADIATION EXPOSURE RECORD

DAY	AREA	TOTAL ESTIMATED EXPOSURE: DAILY: BETA-GAMMA	GAMMA	NEUTRONS (N_γ AND/OR N_3)	T_2*	BADGE CYCLE**: BETA-GAMMA & NEUTRONS	GAMMA & NEUTRONS
TOTAL FROM FRONT							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

* μCi/hr × working time in hours (100 areas only).

** Guide – Do not exceed 600 mrems gamma & neutrons or 3600 mrems beta-gamma & neutrons in either half of a monthly badge cycle without approval (Special Hazards Bulletin No. 7, Sec 203). (OVER)

* μCi/hr × working time in hours (100 areas only).

** Guide – Do not exceed 600 mrems gamma & neutrons or 3600 mrems beta-gamma & neutrons in either half of a monthly badge cycle without approval (Special Hazards Bulletin No. 7, Section 203).

EMPLOYEE'S SIGNATURE | DATE

Fig 12. Employee Radiation Exposure Record

HEALTH PHYSICS SECTION
PERSONNEL MONITORING
CYCLE EXPOSURE SUMMARY

ROLL	PRE FIX	EMPLOYEE NUMBER	HP AREA	DATE BADGED	CYCLE DATE	HP DEPT	EMPLOYEE NAME
2		7529	4H	1255	474	207	H P RECORD
2		7531	4H	1057	474	207	J Q DOE
2		7534	2F	1254	474	500	R TEST
2		7537	2F	955	474	703	
2		7552	2F	951	474	703	

EMPLOYEE IDENTIFICATION NUMBER

SPECIFIC WORK LOCATION

DATE BADGED

MONTH BADGE USED

SPECIFIC DEPARTMENT ASSIGNED

EMPLOYEE NAME

(CONT'D)

(CONT'D)

HEALTH PHYSICS SECTION
PERSONNEL MONITORING
CYCLE EXPOSURE SUMMARY

REPORT DATE 05/22/74
PAGE NO. 87

CYCLE		QUARTER		YEAR		PLANT	
OW	S	OW	S	OW	S	OW	S
15	15	15	15	30	30	11,090	4,595
30	30	30	30	80	80	12,670	5,865
135	30	135	30	845	295	42,645	14,405
200	25	200	25	645	110	4,575	2,085
				90	90	4,370	1,345

OW = SKIN DOSE

S = PENETRATING DOSE

CYCLE = BADGE PERIOD RESULT

EXPOSURE FOR CURRENT QUARTER

YEAR

TOTAL ACCUMULATED EXPOSURE FOR PLANT EMPLOYMENT

Fig 13. Cycle Exposure Summary

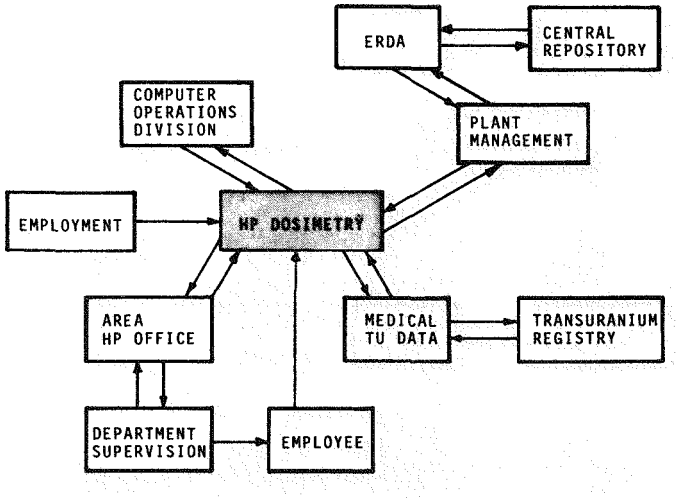

Fig 14. Flow of Exposure Data