To: KEN JENISON, DRP

FROM: SURRY R.I. OFFICE

April, '83

SRI Log

4/4-7 – AL, Burke

4/8 – FU on [illegible] items, U-1 [illegible] work, U-2 [illegible], etc.
9 AM – RII/[illegible], discuss [illegible]
[illegible] letter finalized.

84 JUL 24 P2:37

4/12 – HP [illegible] – [illegible]
[illegible] high [illegible] 2-4 [illegible] in cubicl
[illegible] >1,000,000 [illegible]
[illegible] – [illegible].
[illegible] few inches (12' for 1 Mev β)
[illegible]: Cs^{134}, Cs^{137} β ~ .1 to .2 Mev
[illegible], TLD [illegible] β [illegible] decreases
[illegible] window [illegible] energy req'd to penet. TLD ribbon

M-1 'C' Cubicle Air Activities

	E_R MPC	RWP
4/19 - 0416, 11'	24.3%	1

4/20 - No samples - 0045 Press'zg for Type A

4/21 - No Samples

— 0356 - Type A test sat; 0600 - depress'zg 3 psi/hr

4/22 - 1816 - 47' C.V ~ 4%, no cubes

4/23 - 0900 - (1.3) 8.4%

etc.

U-1 'C' Cubicle Air Samples (~10 min. sample,

(-3'6" level, unless noted)

	Date/time	(E_x)% MPC	RWP
Sat.	4/23, 0900	8.4%	1
	0933 (18')	96.8%	1
	1125	18.61 X MPC — Cs^{134} ~ 6^{-8}, Cs^{137} ~ 1.2^{-7}, Co^{58} 3.5^{-10}, " 60 1.5^{-9}	446
	1246 (post decon)	11%	446
	(Pre-work survey for snubber work; 1241 - 18' level)	153%	1
	1610	23.7%	102.3
	1940 (no work at sample time)	15.9%	1
	2050	7.3%	102.3
Sunday	4/24, 0100	11.3%	102.3
	0345	12 %	"
	0440 (18')	11 %	" ?
	0507	7 %	"
	0950	13.4%	1
	1127	10%	361
	1130 (18')	7%	1
9NS accid. discovered CS standpipe in 'C' 1245 (1300 - stdpipe isolated)	1440	90%	working snubbers
	1617	14%	above platform
	1700	11%	gen'l area
	2258	8%	

Con't

Date/time	(Σ_α) % MPC	RWP	
4/25, 0125 -	9%		
0745	10%		
0925 (18')	5%		
0930	27.6%		
1620	265%	Gen'l Area	$Cs^{137} \sim 1.7^{-8}$ $Cs^{134} \sim 9.1^{-9}$ $Co^{58} \sim 1.4^{-10}$
1635 (18')	18%	RWP 1	
2045	61.4%	Before work?	1023
4/26, 0930 —	68.5%	1023	
1550	17.8%	"	
4/27, 0135 -	94.8%	1023	
2215 -	27.8%	"	
4/28, 0013 -	37.6%	1023	

MEMORANDUM

TO File

FROM Supervisor-Health Physics

Surry Power Station

May 3, 1983

On March 11, 1983, Mr. M.L. Wells, HP Technician, found a PuBe neutron source (Source No. MRC-H-SS-W-PU8 Bc 141) in the Calibration Source Room still in its transfer shield and not in the proper storage shield. Mr. Wells conducted and documented a survey of the source room to determine neutron dose rates which existed (copy attached). Upon investigation, it was determined that the source had been returned to the source room on February 26, 1983 after use by station instrument technicians in Unit No. 1 containment. Apparently, the person returning the source had not replaced it in its storage shield and, thus, it was left in a partially exposed position for the period 2-26-83 until 3-11-83 (13 days).

Mr. F. Weimer had worked in the source room decontaminating dosimeters during this time period and thus, assignment of a proper dose for this exposure is necessary. As indicated by the survey, the dose rates in Mr. Weimer's work area were approximately 1.0 to 2.5 mrem/hr at 5 inches from the floor and 1.0 to 1.5 mrem/hr at 3 feet from the floor. Mr. Weimer's estimated total occupancy time was 48 hours. Therefore, his maximum extremity exposure (ankle) was estimated to be 120 mrem and maximum whole body exposure was estimated to be 72 mrem.

The exposure estimated for this incident was added to Mr. Weimer's first quarter 1983 exposure records for an accumulated total of 1368 mrem extremity and 1920 mrem whole body. This total exposure remains below the permissible dose levels specified in 10CFR20.101(b).

S.P. Sarver
Supervisor-Health Physics

Pu-Be ~ .064 $\frac{n/sec \times 10^{-6}}{curie}$ / gm
(α-n source)
Avg ~ 4.5 Mev neutrons
(Max ~ 10.7 Mev)

12 May 1983

TO File

FROM Ass't H.P. Supervisor for Rad Control

SUBJECT Exposure of Neutron Dose

On 2-22-83 and 2-24-83 four instrument technicians worked on neutron source in the calibration of instrumentation. The source used was a 3 Ci PuBe source with an exposure level of 35.6 mREM at 18 inches.

Name	Dist from source	Exposure Period	Dose assigned
Chandler, H.J.	18"	12 min	0.007 REM
Croom, A.W.	18"	12 min	0.007 REM
McGinnis, T.A.	18"	4 min	0.002 REM
Stallings, T.E.	18"	4 min	0.002 REM

(SIGNED) [illegible]

all stages of fuel-element treatment. It is necessary to make absolutely
hat a critical mass of fissile material is not assembled either in the solid
in solution [24]. Second, because of the intense radioactivity of the
l, even after cooling, special techniques and plant designs are required
ing out the operations and for maintaining the equipment [25].

COOLING IRRADIATED FUEL ELEMENTS

The purpose of the so-called "cooling" phase is to permit the decay
radioactive nuclides present in the spent fuel. These nuclides include
ducts and isotopes of elements of high mass number, e.g., 92 (uranium)
nd (§ 8.113). The more significant consequences of cooling are the
(1) the beta and gamma activity is decreased to a level at which radi-
composition of the processing reagents is not significant, (2) fission
of short half-life decay almost completely and the reprocessing opera-
plified by the decrease in the number of impurity elements which must
d from the spent fuel, and (3) certain heavy isotopes, which cannot be
chemically from the final products, decay to the point where their
ity is no longer a problem.

d the extraction (or separation) phase of the reprocessing operation
be use of solutions, the first two of these objectives are important and,
ral rule, so also is the third. In these circumstances an extended
riod, on the order of 100 days, is required. For certain separation
in which solutions are not employed and in which remote handling is
uite short cooling periods may be possible. From the economic stand-
decrease in cooling time is highly desirable. Cooling costs, which
arges for storage facilities, for use (or lease) of the fuel, and for the
ested in the fuel inventory (§ 14.21 *et seq.*), can add appreciably to the
st of nuclear power.

According to equations (2.53) and (2.54), the gross beta and gamma
of the fission products are roughly proportional to $t^{-1.2}$, where t is the
removal from the reactor. Consequently, the gross activity after
of cooling is about 10^{-1} of the activity at 1 hr. Most of the decay
the early stages, but the 100-day cooling period is often required for
oses.

The major contributions to the total activity made by individual
ducts during the cooling period are shown by the curves in Fig.
s are based on the supposition that the fuel elements have been in
an extended period so that the time of their removal from the
ition of equilibrium has been attained. It is seen that after 100 days
only about a dozen elements are responsible for nearly the whole of the
ty. These are the elements from which uranium and plutonium

8.113]

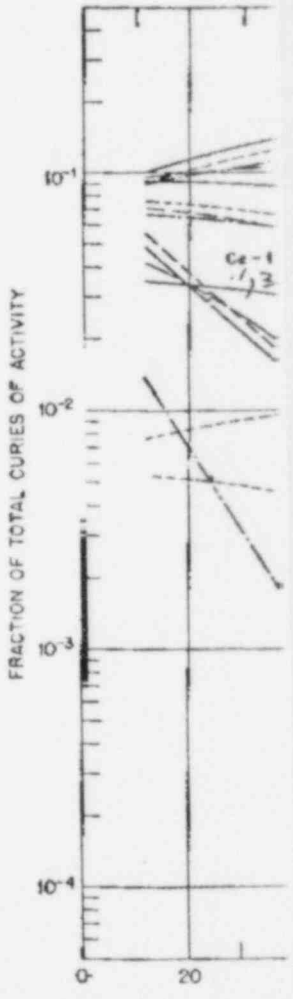

FIG 8.E. Activity of

few elements, such as the rare e
removed because they have large
not on account of their radioacti

8.113. The manner in which b
in a fuel consisting of uranium-2
arrows pointing to the right repr
left are for $(n, 2n)$ reactions wit
decay. Of immediate interest
formed by two (n, γ) stages start
with uranium-238.

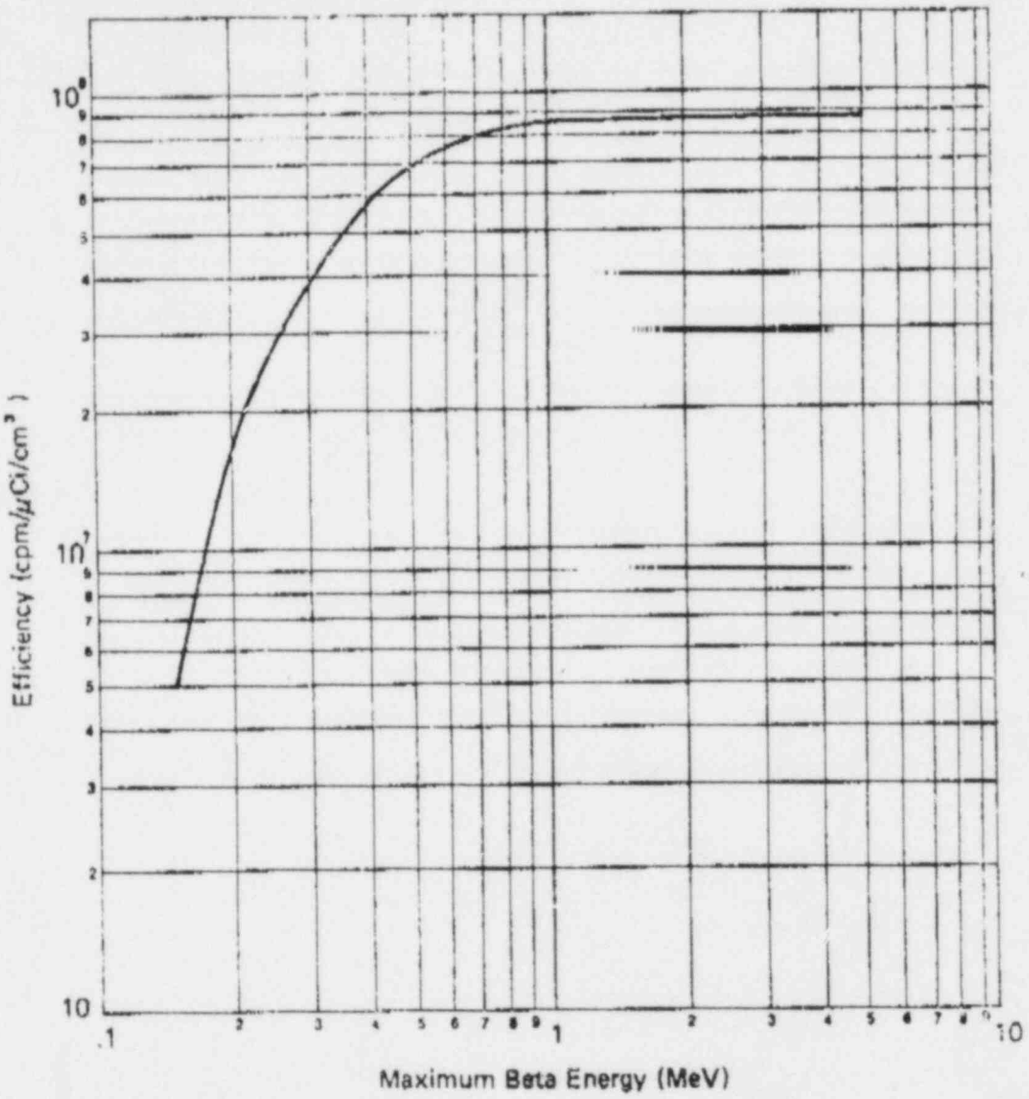

FIGURE 1

MODEL KDB BETA DETECTOR IN MODEL KSG GAS SAMPLER
EFFICIENCY TO RADIOACTIVE GAS VS. MAXIMUM BETA ENERGY
FROM POINT SOURCE ENERGY RESPONSE CORRECTED
TO Xe-133 & Kr-85 GAS EFFICIENCY

Alpha Particles

1. It requires an alpha particle of at least 7.5 MeV to penetrate the protective layer of the skin, 0.07 mm thick.

2. With 2π geometry, the surface of a thick source of tuballoy will give about 2,400 alpha cpm/cm^2; plutonium will give about 70,000 alpha cpm/μg; 16.2 g of ^{239}Pu has an activity of 1 Ci.

Beta Particles

1. When working with ^{198}Au, experience has shown that under certain conditions, the beta dose will be five times the gamma value. Therefore, only 1/6 of the total dose will be recorded by gamma dosimeters.

2. It requires a beta particle of at least 70 keV to penetrate the protective layer of the skin, 0.07 mm thick.

3. The range (R) of beta particles in g/cm^2 (thickness in cm multiplied by the density in g/cm^3) is approximately equal to the maximum energy (E) in MeV divided by 2 (i.e., R ≅ E/2).

4. The range of beta particles in air is about 12 ft per MeV; for example, a 3 MeV beta has a range of about 36 ft in air.

5. A chamber wall thickness of 30 mg/cm^2 will reduce a flux of 1 MeV (max.) betas by 30% and a flux of 0.4 MeV betas by a factor of 4 or 5.

6. The intensity of bremsstrahlung increases approximately with the energy of the beta particle and about the square of the atomic number of the absorbing material.

7. When betas of 1 to 2 MeV pass through light materials such as water, aluminum, or glass, less than 1% of their energy is dissipated as bremsstrahlung.

8. The bremsstrahlung from 1 Ci ^{32}P aqueous solution in a glass bottle is about 1 mR/hr at 1 meter.

9. When the beta particles from a 1 Ci source of ^{90}Sr-^{90}Y are absorbed, the bremsstrahlung hazard is approximately equal to that presented by the gamma from 12 mg of radium. The average energy of the bremsstrahlung is about 300 keV.

10. For a point source of beta radiation (neglecting self- and air-absorption) of strength C curies, the dose rate at 1 ft is approximately equal to 300 C rads/hr. The variation with energy is small over a wide range.

11. Beta-ray surface dose rates with 7 mg/cm^2 filter:

Source	mrads/hr
U slug	233
UO_2 (brown oxide)	207
UF_4 (green salt)	179
$UO_2(NO_3)_2 \cdot 6H_2O$ (yellow uranyl nitrate hexahydrate)	111
UO_3 (orange oxide)	204
U_3O_8 (black oxide)	203
UO_2F_2 (cliptite or uranyl fluoride)	176
$Na_2U_2O_7$ (soda salt or sodium diuranate)	167