UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

DOCKETED
USNRC
AUG 14 1981
Office of the Secretary
Docketing & Service
Branch

In the Matter of	)	
PENNSYLVANIA POWER & LIGHT COMPANY	)	
and	)	Docket Nos. 50-387
	)	50-388
ALLEGHENY ELECTRIC COOPERATIVE INC.	)	
(Susquehanna Steam Electric Station, Units 1 and 2)	)	

AFFIDAVIT OF JOHN C. DODDS IN SUPPORT OF PARTIAL SUMMARY DISPOSITION OF CONTENTION 2

RECEIVED
AUG 18 1981
U.S. NUCLEAR REGULATORY COMMISSION

County of San Francisco)
: ss.
State of California)

John C. Dodds, being duly sworn according to law, deposes and says as follows:

1. I am Nuclear Engineering Group Leader, Dose Assessment Group, Bechtel Power Corporation ("Bechtel"). My business address is 50 Beale Street, San Francisco, California. I am responsible for the radiological work for all the nuclear power plant construction projects handled by Bechtel's San Francisco power division, including the Susquehanna Steam Electric Station ("Susquehanna"). Among other things, my duties include supervising the analysis of activity releases

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and doses from normal plant operation, the development of radiological monitoring systems design criteria, the evaluation of safety system performance as related to biological concerns, and the preparation of Final Safety Analysis Report and Environmental Report sections on those matters. I give this affidavit in support of Applicants' Motion for Partial Summary Disposition of Contention 2 in this proceeding. I have personal knowledge of the matters set forth herein and believe them to be true and correct. A summary of my professional qualifications and experience was attached as Exhibit "A" to my affidavit dated June 11, 1981 in support of Applicants' motion for summary disposition of Contention 5(b).

2. Contention 2 alleges, in relevant part, that the residual risks of low-level radiation that will result from the release from the Susquehanna facility of radionuclides, and particularly from the release of cesium-137 and cobalt-60, into the Susquehanna River, have not been adequately assessed. My affidavit will describe how the radioactive releases from the Susquehanna plant to the Susquehanna River and to the atmosphere were obtained for inclusion in Applicants' Environmental Report ("ER") for Susquehanna and set forth the levels of those releases.

3. The anticipated releases of radionuclides from Susquehanna to the river and the atmosphere were computed by

Bechtel personnel under my supervision. The releases were estimated utilizing the "GALE" computer code, as described in NUREG-0016 Rev. 0, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors" (1976). The GALE code, which was developed for the NRC Staff by Battelle Pacific Northwest Laboratories, consists of a series of calculations and data which model the various pathways by which radioactive matter can be released from a nuclear power plant, such as Susquehanna, that features one or more boiling water reactors.

4. The mathematical models in the GALE code have been developed over a period of many years based on typical plant systems common to most boiling water reactors, operating reactor data, field tests, and laboratory data for specific systems. The models in the code are adjusted to account for plant-specific data, which are entered as inputs to the code. This was done in the case of Susquehanna; Exhibit "A" to this affidavit, which is Table 3.5-1a of the Susquehanna ER, lists the plant-specific parameters used to compute the releases from the plant.

5. The radioactive releases computed by the GALE code have been compared to recent plant release data, such as those contained in the semi-annual reports by utilities of plant releases [Reference 1] and Electric Power Research Institute publication EPRI-NP-495, "Sources of Radioiodine at Boiling Water Reactors" [Reference 2]. The GALE code has been

found to provide conservatively high estimates of plant releases.

6. The GALE code is under continuous revision to incorporate the most recent data from operating plants, and/or to update the release models, as necessary. For example, NUREG-0016 (Rev. 1) was issued in 1979 to account for the better performance of the newer General Electric fuel cladding (such as will be used in the fuel for Susquehanna), and to provide a more exact estimate of radioiodine releases based on the above mentioned EPRI-NP-495 report as well as more up-to-date estimates of releases of other radionuclides. The net result of the changes in the GALE code, as applicable to Susquehanna, would be a 17% reduction in the offgas system noble gas releases, a minor reduction in gaseous iodine releases, a 33% reduction in the liquid releases adjustment factor (which is a conservative margin to account for uncertainties in the calculations), and a 20% increase in the tritium (H-3) releases due to more current plant data on actual tritium releases.

7. Attached as Exhibits "B" and "C" hereto are Tables 3.5-7 and 3.5-13 from the Susquehanna ER, as prepared by Bechtel utilizing the NUREG-0016 (Rev. 0) version of the GALE code. Table 3.5-7 shows the liquid pathway releases and Table 3.5-13 shows the gaseous pathway releases. As can be seen from the tables, the expected amounts of radionuclides released from Susquehanna are minute and constitute small fractions of the

maximum permissible concentrations under 10 CFR Part 20. While some of the release figures in Tables 3.5-7 and 3.5-13 would become somewhat larger or smaller if computed using the more recent version of the GALE code, the estimated releases would remain within the same order of magnitude and therefore would remain minute.

8. In particular, it can be seen that the concentration of cesium-137 is .025 Ci/yr, and that for cobalt-60 is .0096 Ci/yr. The corresponding concentrations in the river water at the Danville intake would be 3.9×10^{-3} pCi/l of cesium-137 and 1.5×10^{-3} pCi/l of cobalt-60. See Table 5.2-3, Susquehanna ER, attached as Exhibit "D" hereto.

9. The cesium-137 release figure would be modified slightly to .029 Ci/yr if recomputed utilizing the NUREG-0016 (Rev. 1) version of the GALE code. The cobalt-60 release figure would remain unchanged. The release figures for these radionuclides remain quite small.

10. In my opinion, the radionuclide release estimates in the Susquehanna ER, including those for cesium-137 and cobalt-60, represent conservatively high estimates of the

actual releases that will take place when Susquehanna goes into operation.

John C Dodds
John C. Dodds

Sworn to and subscribed before me this 24th day of August, 1981.

Mavis M. Lynde
Notary Public

MAVIS M. LYNDE
NOTARY PUBLIC – CALIFORNIA
CITY & COUNTY OF SAN FRANCISCO
My Commission Expires April 26, 1985

MAVIS M. LYNDE
NOTARY PUBLIC – CALIFORNIA
CITY & COUNTY OF SAN FRANCISCO
My Commission Expires April 26, 1985

REFERENCES

1. "Report on Releases of Radioactivity in Effluents and Solid Wastes from Nuclear Power Plants for 1972", Directorate of Regulatory Operations, August 1973. "Summary of Radioactivity Releases in Effluents from Nuclear Power Plants During 1973", NUREG-75/001, January 1975. "Radioactive Materials Released from Nuclear Power Plants 1974", NUREG-0077, June 1976. "Radioactive Materials Released from Nuclear Power Plants 1975", NUREG-0218, March 1977. "Radioactive Materials Released from Nuclear Power Plants, 1976", NUREG-0367, March 1978. "Radioactive Materials Released from Nuclear Power Plants, 1977", NUREG-0521, January 1979.

2. Pelletier, C. A. et al., "Sources of Radioiodine at Boiling Water Reactors", Electric Power Research Institute Report EPRI-NP-495 (February 1978).

TABLE 3.5-1a

GALE INPUT PARAMETERS

(1)	Thermal power level (MWT)	3440.
(2)	Plant capacity factor	0.80
(3)	Total steam flow (E+06 lbs/hr)	14.15
(4)	Mass of collant in reactor (M-lb)	0.38
(5)	Clean-up demin. flow (Mil-lbs/hr)	0.133
(6)	Cond. demin. regeneration time (D)	54.0
(7)	Fraction feedwater thru cond. demin.	1.0
(8)	Radwaste dilut. flow (thou gpm)	10.0
	Gaseous Waste Inputs	
(9)	Gland seal steam flow time (thou-lb/H)	0.0
(10)	Mass of steam in reactor (MI-lb)	0.021
(11)	Gland seal hold-up time (hrs)	0.0
(12)	Air-ejector off-gas hold-up (hr)	0.1555
(13)	Containment Bldg. iodine release fraction	0.01
(14)	Particulate realese fraction	0.01
(15)	Turbine Bldg. iodine release fraction	0.01
(16)	Particulate release fraction	0.01
(17)	Release fraction - special des. features	1.0
(18)	Gland seal vent iodine PF	1.0
(19)	Air-ejector off-gas iodine PF	0.0
(20)	Auxiliary Bldg. iodine release fraction	0.01
(21)	Particulate release fraction	0.01
(22)	Radwaste Bldg. iodine release fraction	0.30
(23)	Particulate release fraction	0.01
	Charcoal delay system	
(24)	Krypton holdup time (days)	1.03497
(25)	Xenon holdup time (days)	18.46167
(26)	Krypton dynamic adsorption coefficient (cm^5/gm)	18.5
(27)	Xenon dynamic adsorption coefficient (cm^5/gm)	330.0
(28)	Number of main condenser shells	3
(29)	Mass of charcoal (Thou. lbs)	152
	Liquid Waste Inputs	
(30)	High Purity Waste	
	(a) Flow Ratio (gal/day)	2.25 + 4
	(b) Fraction of PCA	0.189
	(c) Fraction Discharged	0.01
	(d) Collection time (days)	0.800
	(e) Decay time (days)	0.067
	(f) Decontamination Factors	
	(1) I	100
	(2) Cs	10
	(3) Others	100

EXHIBIT A

TABLE 3.5-1a (Continued)

(31) Low Purity Waste	
(a) Flow Ratio (gal/day)	0
(b) Fraction of PCA	0
(c) Fraction discharged	0
(d) Collection time (days)	0
(e) Decay time (days)	0
(f) Decontamination factors	
(1) I	0
(2) Cs	0
(3) Others	0
(32) Chemical Waste	
(a) Flow Ratio (gal/day)	600.
(b) Fraction of PCA	0.02
(c) Fraction discharged	0.10
(d) Collection time (days)	5.0
(e) Decay time (days)	0.104
(f) Decontamination factors	
(1) I	1,000
(2) Cs	10,000
(3) Others	10,000
(33) Regenerate Solids	
(a) Flow Ratio (gal/day)	3.4 + 3
(b) Fraction of PCA	---
(c) Fraction discharged	0.05
(d) Collection time (days)	3.53
(e) Decay time (days)	0.278
(f) Decontamination factors	
(1) I	1,000
(2) Cs	10,000
(3) Others	10,000

TABLE 3.5-7

EXPECTED YEARLY ACTIVITY RELEASED FROM LIQUID RADWASTE MANAGEMENT SYSTEMS (Ci/yr) USED FOR EVALUATION OF COMPLIANCE WITH APP. I OF 10CFR50

	LRW Processing System	LRW Chemical Processing System	Total LRW	Adjusted Total	Detergent Wastes	Total
Corrosion and Activation Products						
Na-24	3.3-3	-	3.3-3	7.4-3	-	7.4-3
P-32	1.1-4	2.0-5	1.3-4	3.1-4	-	3.1-4
Cr-51	2.9-3	9.0-4	3.8-3	8.7-3	-	8.7-3
Mn-54	4.0-5	2.0-5	6.0-5	1.3-4	1.0-3	1.1-3
Mn-56	3.7-3	-	3.7-3	8.4-3	-	8.4-3
Fe-55	5.9-4	3.5-4	9.4-4	2.1-3	-	2.1-3
Fe-59	2.0-5	1.0-5	3.0-5	6.0-5	-	6.0-5
Co-58	1.2-4	5.0-5	1.7-4	3.9-4	4.0-3	4.4-3
Co-60	2.3-4	1.4-4	3.8-4	8.6-4	8.7-3	9.6-3
Cu-64	1.0-2	-	1.0-2	2.3-2	-	2.3-2
Ni-65	2.0-5	-	2.0-5	5.0-5	-	5.0-5
Zn-65	1.2-4	7.0-5	1.8-4	4.2-4	-	4.2-4
Zn-69m	7.0-4	-	7.0-4	1.6-3	-	1.6-3
Zn-69	7.3-4	-	7.3-4	1.7-3	-	1.7-3
W-187	1.3-4	-	1.3-4	2.9-4	-	2.9-4
Np-239	3.6-3	5.0-5	3.6-3	8.3-3	-	8.3-3
Fission Products						
Br-83	2.0-4	-	2.0-4	4.5-4	-	4.5-4
Br-84	1.0-5	-	1.0-5	3.0-5	-	3.0-5
Rb-89	1.0-5	-	1.0-5	2.0-5	-	2.0-5
Sr-89	6.0-5	2.0-5	8.0-5	1.9-4	-	1.9-4
Sr-91	1.1-3	-	1.1-3	2.6-3	-	2.6-3
Y-91m	7.2-4	-	7.2-4	1.6-3	-	1.6-3
Y-91	3.0-5	2.0-5	5.0-5	1.1-4	-	1.1-4
Sr-92	7.9-4	-	7.9-4	1.8-3	-	1.8-3
Y-92	1.7-3	-	1.7-3	3.9-3	-	3.9-3
Y-93	1.2-3	-	1.2-3	2.7-3	-	2.7-3
Zr-95	-	-	1.0-5	1.0-5	-	1.0-5
Nb-95	-	-	1.0-5	1.0-5	-	1.0-5
Nb-98	4.0-5	-	4.0-5	9.0-5	-	9.0-5
Mo-99	1.1-3	2.0-5	1.1-3	2.4-3	-	2.4-3
Tc-99m	4.6-3	2.0-5	4.6-3	1.0-2	-	1.0-2
Tc-101	1.0-5	-	1.0-5	2.0-5	-	2.0-5
Ru-103	1.0-5	-	1.0-5	4.0-5	1.4-4	1.8-4
Rh-103m	1.0-5	-	1.0-5	4.0-5	-	4.0-5
Tc-104	3.0-5	-	3.0-5	6.0-5	-	6.0-5
Ru-105	2.9-4	-	2.9-4	6.6-4	-	6.6-4
Rh-105m	2.9-4	-	2.9-4	6.6-4	-	6.6-4
Rh-105	9.0-5	-	9.0-5	2.1-4	-	2.1-4
Te-129m	2.0-5	1.0-5	3.0-5	7.0-5	-	7.0-5

TABLE 3.5-7 (Continued)

	LRW Processing System	LRW Chemical Processing System	Total LRW	Adjusted Total	Detergent Wastes	Total
Te-129	1.0-5	1.0-5	2.0-5	5.0-5	-	5.0-5
Te-131m	5.0-5	-	5.0-5	1.0-4	-	1.0-4
Te-131	1.0-5	-	1.0-5	2.0-5	-	2.0-5
I-131	2.0-3	5.6-2	5.8-2	1.3-1	6.0-5	1.3-1
Te-132	1.0-5	-	1.0-5	1.0-5	-	1.0-5
I-132	1.9-3	-	1.9-3	4.3-3	-	4.3-3
I-133	8.3-3	1.7-3	9.9-3	2.3-2	-	2.3-2
Cs-134	1.8-4	1.0-5	1.8-4	4.1-4	1.3-2	1.3-2
I-134	7.7-4	-	7.7-4	1.7-3	-	1.7-3
I-135	4.3-3	-	4.3-3	9.8-3	-	9.8-3
Cs-136	1.1-4	-	1.1-4	2.6-4	-	2.6-4
Cs-137	4.1-4	1.0-5	4.3-4	9.7-4	2.4-2	2.5-2
Ba-137m	3.8-4	1.0-5	4.0-4	9.0-4	-	9.0-4
Cs-138	3.0-4	-	3.0-4	6.8-4	-	6.8-4
Ba-139	2.7-4	-	2.7-4	6.2-4	-	6.2-4
Ba-140	2.3-4	4.0-5	2.7-4	6.1-4	-	6.1-4
La-140	4.0-5	4.0-5	8.0-5	1.9-4	-	1.9-4
La-141	1.0-4	-	1.0-4	2.4-4	-	2.4-4
Ce-141	2.0-5	1.0-5	3.0-5	6.0-5	-	6.0-5
La-142	1.9-4	-	1.9-4	4.3-4	-	4.3-4
Ce-143	1.0-5	-	1.0-5	3.0-5	-	3.0-5
Pr-143	2.0-5	-	3.0-5	6.0-5	-	6.0-5
All Others	2.0-5	1.0-5	3.0-5	6.0-5	-	6.0-5
Total (Except Tritium)	5.8-2	5.9-2	1.2-1	.27	.06	3.3-1
Tritium Release				6 curies per year		

TABLE 3.5-13

ANNUAL GASEOUS RELEASES PER UNIT

(Ci/Yr)

Nuclide	Reactor Bldg	Turbine Bldg	Radwaste Bldg	Air Ejector	Mech. Vac Pump	Total
Kr-83m	-	-	-	-	-	-
Kr-85m	6.0	1.4+1(1)	-	5.6+2	-	5.8+2
Kr-85	-	-	-	2.7+2	-	2.7+2
Kr-87	6.0	2.6+1	-	-	-	3.2+1
Kr-88	6.0	4.6+1	-	1.1+2	-	1.6+2
Kr-89	-	-	-	-	-	-
Xe-131m	-	-	-	5.3+1	-	5.3+1
Xe-133m	-	-	-	3.0+0	-	3.0+0
Xe-133	1.32+2	5.0+1	1.0+1	5.3+3	2.3+3	7.8+3
Xe-135m	9.2+1	1.3+2	-	-	-	2.2+2
Xe-135	6.8+1	1.3+2	4.5+1	-	3.5+2	5.9+2
Xe-137	-	-	-	-	-	-
Xe-138	1.4+1	2.9+2	-	-	-	3.0+2
Total Noble Gases						1.0+4
I-131	3.4-2	3.8-3	5.0-2	-	3.0-2	1.2-1
I-133	1.36-1	1.5-2	1.8-1	-	-	3.3-1
Cr-51	6.0-6	2.6-5	9.0-5	-	-	1.2-4
Mn-54	6.0-5	1.2-6	3.0-4	-	-	3.6-4
Fe-59	8.0-6	1.0-6	1.5-4	-	-	1.6-4
Co-58	1.2-5	1.2-6	4.5-5	-	-	5.8-5
Co-60	2.0-4	4.0-6	9.0-4	-	-	1.1-3
Zn-65	4.0-5	4.0-7	1.5-5	-	-	5.5-5
Sr-89	1.8-6	1.2-5	4.5-6	-	-	1.8-5
Sr-90	1.0-7	4.0-8	3.0-6	-	-	3.1-6
Zr-95	8.0-6	2.0-7	5.0-7	-	-	8.7-6
Sb-124	4.0-6	6.0-7	5.0-7	-	-	5.1-6
Cs-134	8.0-5	6.0-7	4.5-5	-	3.0-6	3.3-4
Cs-136	6.0-6	1.0-7	4.5-6	-	2.0-6	1.3-5
Cs-137	1.1-4	1.2-6	9.0-5	-	1.0-5	2.1-4
Ba-140	8.0-6	2.2-5	1.0-6	-	1.1-5	4.2-5
Ce-141	2.0-6	1.2-6	2.6-5	-	-	2.9-5
H-3						[illegible].0+1

(1) Typical: 1.4+1 means 1.4×10^1

EXHIBIT C

TABLE 5.2-3

EXPECTED CONCENTRATIONS OF RADIONUCLIDES IN UNTREATED DRINKING WATER AT THREE SUPPLIERS DOWNSTREAM OF SUSQUEHANNA SES (PER UNIT)

	LOCATION (Concentrations* in pCi/l)		
NUCLIDES	DANVILLE	SUNBURY	SHAMOKIN DAM
DILUTION FACTOR	321	93.5**	361
TRANSIT TIME (Hours)	13.8	52.2**	21.6
Na-24	3.5E-04	2.1E-04	2.2E-04
P-32	4.6E-05	1.5E-04	4.0E-05
Cr-51	1.3E-03	4.4E-03	1.2E-03
Mn-54	1.7E-04	5.9E-04	1.5E-04
Mn-56	1.3E-06	1.4E-10	1.4E-07
Fe-55	3.3E-04	1.[illegible]E-03	2.9E-04
Fe-59	9.2E-06	[illegible].1E-05	8.2E-06
Co-58	6.8E-04	2.3E-03	6.0E-04
Co-60	1.5E-03	5.2E-03	1.3E-03
Ni-65	6.5E-09	5.8E-13	6.7E-10
Cu-64	8.8E-04	3.7E-04	5.1E-04
Zn-65	6.6E-05	2.2E-04	5.8E-05
Zn-69m	6.9E-05	3.5E-05	4.1E-05
Zn-69	1.7E-12	0.0E-01	0.0E-01
W-187	2.1E-05	2.4E-05	1.5E-05
Np-237	1.3E-03	4.5E-03	1.2E-03
Br-83	4.1E-08	2.1E-12	3.8E-09
Sr-89	2.9E-05	9.8E-05	2.6E-05
Sr-90	1.6E-06	5.4E-06	1.4E-06
Sr-91	6.2E-05	1.3E-05	3.1E-05
Y-91	1.7E-05	5.7E-05	1.5E-05
Sr-92	3.8E-07	7.1E-11	4.6E-08
Y-92	3.9E-06	7.3E-09	7.5E-07
Y-93	7.3E-05	1.8E-05	3.8E-05
Zr-95	1.5E-06	5.2E-06	1.4E-06
Nb-95	1.5E-06	5.1E-06	1.4E-06
Mo-99	2.9E-04	6.6E-04	2.3E-04
Tc-99m	8.1E-05	3.4E-06	2.9E-05
Ru-103	2.8E-05	9.2E-05	2.4E-05
Ru-105	1.9E-06	1.6E-08	4.9E-07
Rh-105	2.0E-05	[illegible]E-05	[illegible]E-05
Te-129m	1.1E-05	3.6E-05	9.[illegible]E-06
Te-129	1.7E-12	0.0E-01	1.5E-14
Te-131m	8.6E-06	1.2E-05	6.4E-06
I-131	1.9E-02	5.5E-02	1.6E-02
Te-132	1.2E-06	3.0E-06	1.0E-06
I-132	2.7E-07	8.2E-12	2.3E-08
I-133	1.5E-03	1.5E-03	1.0E-03
Cs-134	2.0E-03	7.0E-03	1.8E-03
I-135	1.0E-04	6.2E-06	4.0E-05
Cs-136	3.8E-05	1.2E-04	3.4E-05
Cs-137	3.9E-03	1.3E-02	3.5E-03
Ba-139	2.4E-10	0.0E-01	4.3E-12
Ba-140	9.0E-05	2.8E-04	7.9E-05
La-140	1.9E-05	3.4E-05	1.5E-05
La-141	3.7E-07	1.3E-09	8.2E-08
Ce-141	9.2E-06	3.0E-05	8.1E-06
La-142	6.1E-10	0.0E-01	1.6E-11
Ce-143	2.7E-06	4.2E-06	2.1E-06
Pr-143	8.9E-06	2.8E-05	7.8E-06
H-3	9.4E-01	3.2E 00	8.3E-01

* Drinking water includes 12 hour decay time in processing.

** Dilution and transit time are for August and September - the months facility is operational.

EXHIBIT D