No. 1928

APPENDIX I COST/BENEFIT ANALYSIS

SURRY UNITS 1 & 2

Prepared For

VIRGINIA ELECTRIC AND POWER COMPANY

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1.0 Introduction and Summary

Surry Power Station Units Nos. 1 and 2 have been evaluated with respect to their ability to meet the requirements set forth in Section II.D of Appendix I to 10 CFR 50, which states:

> "D. In addition to the provisions of paragraphs A, B, and C above, the applicant shall include in the radwaste system all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. As an interim measure and until establishment and adoption of better values (or other appropriate criteria), the values $1000 per total body man-rem and $1000 per man-thyroid-rem (or such lesser values as may be demonstrated to be suitable in a particular case) shall be used in this cost-benefit analysis."

The valuation shows that radiological effluent control equipment beyond that now installed cannot be justified on the basis of the Appendix I specified cost/benefit analysis.

Source terms used in the analysis are those presented in Reference 1. Details of the dose analyses are discussed in Sections 2.0 and 3.0. Results of the population dose calculations on a per unit basis are:

	Present Liquid System	Modified Liquid System
Liquid Effluents		
Total Body	44.5 man rem	39.9 man-rem
Thyroid	64.5 man-thyroid-rem	42.2 man-thyroid-rem
Gaseous Effluents		
Total Body	4.50 man-rem	
Thyroid	11.1 man-thyroid-rem	

For the purpose of the source term analysis presented in Reference 1, 100 percent discharge of the liquid streams was assumed. Considering the population doses resulting from the liquid effluent population, no additional treatment systems can be justified using the value of $1000 per man-rem and man-thyroid-rem assigned by the NRC.

No additional HEPA or charcoal filtration of gaseous effluents can be justified to reduce the already low total body and thyroid population exposure due to these releases using the value of $1000 per man-rem and man-thyroid-rem assigned by the NRC.

2.0 Population Doses from Liquid Effluents

Calculations of population doses resulting from radioactive liquid effluents from Surry Units 1 & 2 have been made using the NRC LADTAP code using models, parameter values, and assumptions as outlined in Regulatory Guide 1.109 (March 1976). Table 1 provides LADTAP input data utilized.

Liquid effluents from Surry Units 1 & 2 are discharged to the James River after dilution with the circulating water flow of 840,000 gpm per unit. A dilution factor of 10 was assumed for dilution in the James River. Pathways of exposure for significant population groups within 50 miles include internal exposure from invertebrate and fish ingestion, and external exposure while swimming, boating, or engaging in shoreline activities. Appropriate site specific use data for each of these exposure pathways was developed as input into the LADTAP program for dose analysis. Site specific LADTAP input data and resultant doses are discussed below for each pathway.

Population exposure via fish and invertebrate ingestion was calculated separately for both sport harvest and commercial harvest. Table 1 provides an estimate of sport and commercial catches caught annually in the James River. These estimates were based upon a survey of the commercial catch on the James River.[2] In this analysis, it was assumed that 100% of the commercial and sport catch were edible. For the sport catch, Regulatory Guide 1.109 makes the assumption that the total edible catch will be eaten by the population within 50 miles of the Surry Station. In Regulatory Guide 1.109 the commercial catch is considered as part of the U.S. harvest. As a result the concentration in the commercial catch is distributed throughout the U.S. in order to calculate the market dilution and hence the average concentration for population dose purposes.

Published estimates of activity days per year for various water-related recreational activities for regions of the State of Virginia were analyzed to estimate the number of man-hours per year spent in shoreline activities, swimming, and boating by people within 50 miles of the Surry Station.[3] Shoreline use was estimated at 2.81×10^8 man-hours per year, swimming at 1.10×10^8 man-hours per year, and boating at 6.06×10^7 man-hours per year.

Liquid doses were calculated for three sets of source terms. These source terms were calculated for variations in the treatment of the dirty wastes and steam generator blowdown (SGB). One set of source terms was based upon the present plant treatment methods of liquid radwaste, the second set was based upon the proposed modifications to the existing system which involves the treatment of steam generator blowdown by two mixed-bed demineralizers in series, and the third set was based upon installation of a new 15 gpm evaporator to replace the existing inoperable 6.0 gpm evaporator. These

three methods of treatment are given in Table 2 along with their associated population doses. It can be seen from Table 2 that the population thyroid dose for the present system (dirty wastes - two temporary mixed bed demineralizers; SGB - no treatment) was calculated to be 64.5 man-thyroid-rem. The population thyroid dose resulting from the proposed modified system (dirty wastes - two mixed bed demineralizers; SGB - treated by two mixed bed demineralizers) was calculated to be 42.2 man-thyroid-rem, while the system with the 15 gpm evaporator replacing the two temporary mixed bed demineralizers results in a population thyroid dose of 1.67 man-thyroid-rem.

Population whole body doses were calculated for the present system and the two augments indicated in Table 2. It can be seen from Table 2 that the reduction in whole body population dose from the present system to the proposed system is minimal. The biggest reduction in the population whole body dose occurs when the mixed bed demineralizers are replaced by a 15 gpm evaporator and a mixed bed demineralizer. However, the incremental reduction in whole body dose cannot be justified when weighed against the total annualized cost of the evaporator alone. (See Table 3.) Therefore, the population doses were analyzed only for the thyroid.

Table 3 present the total annualized costs for each of the two liquid radwaste system augments. From this table it can be seen that no augment can be added to the existing system which is cost effective from a radiological dose aspect. However, two mixed bed demineralizers are going to be installed to treat the steam generator blowdown for the purpose of reducing the amount of secondary makeup treatment requirements.

3.0 Population Doses from Gaseous Effluents

Population doses due to gaseous effluents from Surry Units 1 & 2 have been evaluated using the NRC GASPAR computer code and models, parameter values,

and assumptions as specified in Regulatory Guide 1.109 (March 1976). All standard GASPAR data were utilized, including dose conversion factors, food intake and production rates, stable element transfer coefficients, time delays, etc. All calculations were based on the projected year 1990 population distributions as given in Table 4.

The 0-50 mile vegetable and meat production estimates were based upon Virginia estimates.[4] The 0-50 mile milk production estimate was obtained from the Virginia Crop Reporting Service[5] and the North Carolina Agricultural Statistics.[6]

Source term release rates were based upon ground level and mixed mode releases. The process vent qualifies as a mixed mode release. All other release points were considered ground level. The input meteorological data, including X/Q and D/Q values for ground level and mixed mode releases are provided in Tables 5 and 6 respectively. All GASPAR input meteorological data include appropriate open site terrain correction factors in accordance with Regulatory Guide 1.111 (March 1976). Table 7 provides the remainder of the site specific GASPAR input data utilized, and a summary of the pertinent dose results.

It can be seen from Table 7 that 7.70 man-thyroid-rem resulting from operation of Surry Unit 1 or 2 comes from particulates and radioiodines. The output from the GASPAR calculations indicate that 72% of this dose results from releases of I-131 and about 14% results from releases of I-133. Table 2.1-5 of the Surry Units 1 & 2 Appendix I Analysis showed that approximately 84% of the predicted I-131 releases and 81% of the predicted I-133 releases result from the steam generator blowdown flash tank. The steam generator blowdown cooling systems became operational in April 1977. This will eliminate this source of release and reduce the population doses approximately 75%. However, from Table 3 it can be seen that the venting of the steam generator flash tank to the main condenser would not be cost effective if considered only from a radiological dose aspect.

TABLE 1

LADTAP INPUT DATA

Exposure Pathway	Dilution Factor (1)	Delay Time, hrs.	Use Rate
Sport Invertebrate Ingestion	10	168	1.05(6) (kg/yr)*
Commercial Invertebrate Ingestion	10	240	2.10(6) (kg/yr)
Sport Fish Ingestion**	10	168	6.86(5) (kg/yr)
Commercial Fish Ingestion**	10	240	1.37(6) (kg/yr)
Shoreline Activities	10	0	2.81(8) (hrs/yr)
Swimming	10	0	1.10(8) (hrs/yr)
Boating	10	0	6.06(7) (hrs/yr)

Other Data:

Plant discharge flow	=	840,000 gpm/unit
Shorewidth factor	=	0.2
50 mile population	=	2.05(6)

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* $1.05(6) = 1.05 \times 10^6$

** Note that the population dose resulting from sportfish ingestion assumes that all the sportfish caught within 50 miles of the plant are eaten by the 0-50 mile population. The dose resulting from commercial fish ingestion is based upon distribution of all commercial fish caught within 50 miles of the plant throughout the total U.S. harvest. The same holds for sport and commercially caught invertebrates.

(1) A dilution factor of 10 was used to determine concentration of exposures for the 0-50 mile population doses. This factor was increased from 5 which had been used for the maximum individual in the Appendix I Analysis for Surry Units 1 and 2.

TABLE 2

Liquid Population Doses Resulting From Treatment of Liquid Radwaste By Various Augments

System	Treatment					
Dirty Waste System	2 Mixed Bed Demineralizers In Series		2 Mixed Bed Demineralizers In Series		Evaporator and Mixed Bed Demineralizer In Series	
Steam Generator Blowdown Treatment	None		2 Mixed Bed Demineralizers In Series		2 Mixed Bed Demineralizers In Series	
	Population Dose man-rem per unit		Population Dose man-rem per unit		Population Dose man-rem per unit	
Exposure Pathway	T.Body	Thyroid	T.Body	Thyroid	T.Body	Thyroid
Sport Invertebrate Ingestion	3.73	2.27(1)*	2.10	5.36	1.49(-1)	8.24(-1)
Commercial Invertebrate Ingestion	2.56(-2)	1.43(-1)	1.59(-2)	3.39(-2)	1.08(-3)	5.32(-3)
Sport Fish Ingestion**	1.71	2.65	1.57	6.14(-1)	3.49(-2)	9.40(-2)
Commercial Fish Ingestion**	6.02(-2)	7.28(-2)	5.55(-2)	1.69(-2)	1.23(-3)	2.60(-3)
Shoreline Activities	3.84(+1)	3.84(+1)	3.59(+1)	3.59(+1)	7.38(-1)	7.38(-1)
Swimming	4.28(-1)	4.28(-1)	2.54(-1)	2.54(-1)	6.88(-3)	6.88(-3)
Boating	1.18(-1)	1.18(-1)	7.01(-2)	7.01(-2)	1.90(-3)	1.90(-3)
Total	4.45(1)	6.45(1)	3.99(1)	4.22(1)	9.33(-1)	1.67

* $2.27(1) = 2.27 \times 10^{1}$

** Note that the population dose resulting from sportfish ingestion assumes that all the sportfish caught within 50 miles of the plant are eaten by the 0-50 mile population. The dose resulting from commercial fish ingestion is based upon distribution of all commercial fish caught within 50 miles of the plant throughout the total U.S. harvest. The same holds for sport and commercially caught invertebrates.

TABLE 3

TOTAL ANNUALIZED COST AND INCREMENTAL REDUCTION IN THYROID DOSE
FOR AUGMENTS TO SURRY UNITS 1 & 2 GASEOUS AND LIQUID RADWASTE SYSTEM

Augment	System	Incremental Reduction In Dose (man-thyroid rem)	Total Annualized Cost (10^3)
SGB-two 50-gpm Mixed Bed Demineralizers	Liquid	44.6	137
Dirty Waste - One 15-gpm Evaporator	Liquid	126	239
Steam Generator Flash Tank Vent to Main Condenser	Gaseous	11.1	16.3

* Capital Recovery Factor based the cost of money being 10% per year.

TABLE 4

POPULATION DISTRIBUTION WITHIN 50 MILES OF THE SURRY PLANT

SITE POPULATION DATA

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	-0.	-0.	-0.	-0.	-0.	1.611E+04	8.007E+03	2.666E+03	2.766E+03	4.493E+03	3.404E+04
NNE	-0.	7.000E+00	-0.	-0.	6.000E+00	7.338E+03	5.385E+03	5.884E+03	6.961E+03	3.827E+03	2.941E+04
NE	-0.	-0.	-0.	-0.	6.000E+00	6.788E+03	6.740E+03	5.924E+03	6.370E+02	-0.	2.010E+04
ENE	-0.	-0.	-0.	-0.	-0.	2.479E+04	6.239E+03	1.376E+03	3.000E+02	5.024E+03	3.773E+04
E	-0.	-0.	-0.	-0.	1.400E+01	3.884E+04	3.135E+04	-0.	3.019E+03	2.074E+03	7.530E+04
ESE	-0.	-0.	-0.	-0.	-0.	3.800E+04	1.477E+05	7.565E+04	2.325E+04	3.430E+04	3.189E+05
SE	-0.	-0.	-0.	-0.	-0.	9.499E+03	5.184E+04	1.839E+05	2.983E+05	1.796E+05	7.231E+05
SSE	-0.	-0.	-0.	-0.	3.400E+01	1.170E+02	6.591E+03	2.295E+04	4.495E+04	3.915E+04	1.138E+05
S	-0.	-0.	2.100E+01	4.800E+01	8.500E+01	6.180E+02	3.275E+03	1.058E+04	2.280E+04	5.037E+03	4.246E+04
SSW	-0.	-0.	4.800E+01	-0.	6.500E+01	4.580E+02	2.453E+03	3.998E+03	1.579E+04	5.513E+03	2.833E+04
SW	-0.	-0.	-0.	-0.	7.200E+01	3.580E+02	1.139E+03	2.495E+03	3.820E+03	5.034E+03	1.292E+04
WSW	-0.	-0.	9.600E+02	1.700E+01	4.800E+01	5.520E+02	1.268E+03	3.317E+03	1.834E+03	4.832E+03	1.283E+04
W	-0.	-0.	-0.	4.100E+01	1.160E+02	5.300E+02	2.000E+01	3.089E+03	8.433E+04	3.757E+04	1.257E+05
WNW	-0.	-0.	-0.	-0.	2.800E+02	3.330E+02	1.072E+03	4.305E+03	7.658E+04	1.873E+05	2.699E+05
NW	-0.	-0.	-0.	-0.	-0.	7.564E+03	3.605E+03	4.204E+03	2.265E+04	1.142E+05	1.522E+05
NNW	-0.	-0.	-0.	2.800E+01	2.100E+01	2.298E+04	9.118E+03	5.569E+03	2.163E+03	3.364E+03	4.324E+04
TOTAL	0.	7.000E+00	1.029E+03	1.340E+02	7.470E+02	1.749E+05	2.858E+05	3.359E+05	6.102E+05	6.313E+05	2.040E+06

DENSITY(/M**2) = 1.02E-04

SITE VEGETATION PRODUCTION, KGR

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	-0.	-0.	-0.	-0.	-0.	6.610E+04	2.100E+05	4.000E+05	5.500E+05	6.400E+05	1.866E+06
NNE	-0.	-0.	-0.	-0.	7.100E+03	6.610E+04	2.000E+05	4.410E+05	3.100E+05	6.000E+05	1.624E+06
NE	-0.	-0.	-0.	-0.	6.400E+03	6.610E+04	2.300E+05	3.700E+05	6.160E+04	7.940E+03	7.420E+05
ENE	-0.	-0.	-0.	-0.	-0.	6.610E+04	1.100E+05	8.800E+04	6.160E+04	4.800E+05	8.057E+05
E	-0.	-0.	-0.	-0.	-0.	6.610E+04	1.330E+05	8.800E+04	1.200E+05	3.200E+05	7.271E+05
ESE	-0.	-0.	-0.	-0.	-0.	6.610E+04	2.650E+05	8.800E+04	1.800E+05	2.400E+05	8.391E+05
SE	-0.	-0.	-0.	-0.	-0.	3.300E+04	5.300E+04	2.600E+05	6.160E+05	7.940E+05	1.756E+06
SSE	-0.	-0.	-0.	-0.	-0.	6.610E+03	2.500E+05	4.410E+05	6.160E+05	7.940E+05	2.108E+06
S	-0.	-0.	-0.	-0.	-0.	5.900E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.175E+06
SSW	-0.	-0.	4.410E+03	6.160E+03	7.940E+03	6.610E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.201E+06
SW	-0.	-0.	3.100E+03	-0.	7.940E+03	6.610E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.193E+06
WSW	-0.	-0.	-0.	4.300E+03	7.940E+03	6.610E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.194E+06
W	-0.	-0.	-0.	1.850E+03	6.400E+03	6.610E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.190E+06
WNW	-0.	-0.	-0.	-0.	-0.	3.300E+04	1.300E+05	3.700E+05	5.900E+05	7.940E+05	1.917E+06
NW	-0.	-0.	-0.	-0.	-0.	5.900E+04	2.650E+05	4.410E+05	6.160E+05	7.940E+05	2.175E+06
NNW	-0.	-0.	-0.	-0.	-0.	6.610E+04	2.650E+05	4.200E+05	6.160E+05	7.940E+05	2.161E+06
TOTAL	0.	0.	7.510E+03	1.231E+04	4.372E+04	9.177E+05	3.436E+06	5.612E+06	7.417E+06	1.023E+07	2.767E+07

DENSITY(/M**2) = 1.38E-03

TABLE 5

ANNUAL X/Q AND D/Q FOR GROUND LEVEL RELEASES FROM THE SURRY PLANT

SITE ANNUAL X/Q DATA, SEC/M3

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	4.400E-05	4.700E-06	1.700E-06	9.400E-07	6.200E-07	2.600E-07	1.100E-07	5.500E-08	3.600E-08	2.700E-08
NNE	4.400E-05	4.700E-06	1.700E-06	9.200E-07	6.100E-07	2.600E-07	1.000E-07	5.400E-08	3.600E-08	2.600E-08
NE	4.500E-05	4.800E-06	1.700E-06	9.500E-07	6.200E-07	2.600E-07	1.100E-07	5.600E-08	3.700E-08	2.700E-08
ENE	2.000E-05	2.100E-06	7.500E-07	4.100E-07	2.700E-07	1.100E-07	4.600E-08	2.400E-08	1.600E-08	1.100E-08
E	1.800E-05	1.900E-06	6.600E-07	3.600E-07	2.400E-07	9.900E-08	4.000E-08	2.100E-08	1.400E-08	1.000E-08
ESE	1.500E-05	1.500E-06	5.300E-07	2.900E-07	1.900E-07	7.800E-08	3.100E-08	1.600E-08	1.100E-08	7.800E-09
SE	1.500E-05	1.600E-06	5.500E-07	3.000E-07	1.900E-07	8.100E-08	3.300E-08	1.700E-08	1.100E-08	8.100E-09
SSE	1.600E-05	1.600E-06	5.600E-07	3.000E-07	1.900E-07	8.000E-08	3.200E-08	1.600E-08	1.100E-08	7.800E-09
S	1.500E-05	1.600E-06	5.300E-07	2.900E-07	1.800E-07	7.600E-08	3.000E-08	1.500E-08	1.000E-08	7.300E-09
SSW	8.100E-06	8.200E-07	2.800E-07	1.500E-07	9.400E-08	3.800E-08	1.500E-08	7.600E-09	4.900E-09	3.600E-09
SW	9.400E-06	9.500E-07	3.300E-07	1.800E-07	1.200E-07	4.800E-08	1.900E-08	9.700E-09	6.400E-09	4.600E-09
WSW	8.200E-06	8.200E-07	2.800E-07	1.500E-07	9.500E-08	3.900E-08	1.500E-08	7.800E-09	5.000E-09	3.700E-09
W	1.300E-05	1.300E-06	4.400E-07	2.400E-07	1.500E-07	6.300E-08	2.500E-08	1.300E-08	8.200E-09	6.000E-09
WNW	1.800E-05	1.900E-06	6.400E-07	3.500E-07	2.300E-07	9.400E-08	3.800E-08	2.000E-08	1.300E-08	9.300E-09
NW	2.100E-05	2.200E-06	7.800E-07	4.200E-07	2.800E-07	1.200E-07	4.600E-08	2.400E-08	1.600E-08	1.200E-08
NNW	3.300E-05	3.600E-06	1.300E-06	7.000E-07	4.600E-07	2.000E-07	7.900E-08	4.100E-08	2.700E-08	2.000E-08

SITE ANNUAL DEPOSITION DATA, M-2

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	9.700E-08	7.300E-09	2.100E-09	9.900E-10	5.900E-10	2.000E-10	5.400E-11	2.000E-11	1.000E-11	6.200E-12
NNE	1.400E-07	1.000E-08	3.000E-09	1.400E-09	8.400E-10	2.800E-10	7.800E-11	2.900E-11	1.500E-11	8.900E-12
NE	1.400E-07	1.000E-08	3.000E-09	1.400E-09	8.300E-10	2.800E-10	7.600E-11	2.800E-11	1.400E-11	8.800E-12
ENE	6.400E-08	4.800E-09	1.400E-09	6.500E-10	3.900E-10	1.300E-10	3.600E-11	1.300E-11	6.700E-12	4.100E-12
E	6.000E-08	4.500E-09	1.300E-09	6.100E-10	3.600E-10	1.200E-10	3.300E-11	1.200E-11	6.200E-12	3.800E-12
ESE	6.000E-08	4.500E-09	1.300E-09	6.200E-10	3.700E-10	1.200E-10	3.400E-11	1.200E-11	6.300E-12	3.900E-12
SE	7.400E-08	5.500E-09	1.600E-09	7.600E-10	4.500E-10	1.500E-10	4.100E-11	1.500E-11	7.700E-12	4.700E-12
SSE	8.400E-08	6.300E-09	1.800E-09	8.600E-10	5.100E-10	1.700E-10	4.700E-11	1.700E-11	8.800E-12	5.400E-12
S	7.700E-08	5.700E-09	1.700E-09	7.900E-10	4.600E-10	1.500E-10	4.300E-11	1.600E-11	8.000E-12	4.900E-12
SSW	4.500E-08	3.300E-09	9.600E-10	4.600E-10	2.700E-10	9.000E-11	2.500E-11	9.100E-12	4.600E-12	2.900E-12
SW	4.000E-08	3.000E-09	8.800E-10	4.200E-10	2.500E-10	8.200E-11	2.300E-11	8.300E-12	4.200E-12	2.600E-12
WSW	4.100E-08	3.100E-09	8.800E-10	4.200E-10	2.500E-10	8.200E-11	2.300E-11	8.300E-12	4.300E-12	2.600E-12
W	6.400E-08	4.800E-09	1.400E-09	6.500E-10	3.900E-10	1.300E-10	3.600E-11	1.300E-11	6.700E-12	4.100E-12
WNW	7.000E-08	5.200E-09	1.500E-09	7.100E-10	4.200E-10	1.400E-10	3.900E-11	1.400E-11	7.300E-12	4.500E-12
NW	7.200E-08	5.400E-09	1.600E-09	7.300E-10	4.300E-10	1.400E-10	4.000E-11	1.500E-11	7.500E-12	4.600E-12
NNW	7.000E-08	5.300E-09	1.500E-09	7.200E-10	4.300E-10	1.400E-10	3.900E-11	1.400E-11	7.300E-12	4.500E-12

TABLE 6

ANNUAL X/Q AND D/Q FOR MIXED MODE RELEASES FROM THE SURRY PLANT

SITE ANNUAL X/Q DATA, SEC/M3

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	5.600E-07	2.800E-07	1.400E-07	8.900E-08	6.800E-08	3.500E-08	1.200E-08	6.300E-09	4.100E-09	3.000E-09
NNE	8.300E-07	3.900E-07	1.800E-07	1.200E-07	8.900E-08	4.400E-08	1.400E-08	7.300E-09	4.800E-09	3.500E-09
NE	1.000E-06	3.900E-07	1.800E-07	1.100E-07	8.200E-08	4.100E-08	1.400E-08	6.900E-09	4.500E-09	3.300E-09
ENE	6.600E-07	2.300E-07	1.100E-07	6.600E-08	4.700E-08	2.400E-08	8.100E-09	4.100E-09	2.700E-09	2.000E-09
E	6.800E-07	2.300E-07	1.000E-07	6.400E-08	4.600E-08	2.300E-08	8.000E-09	4.100E-09	2.600E-09	1.900E-09
ESE	6.700E-07	1.900E-07	8.200E-08	5.300E-08	3.700E-08	1.800E-08	7.200E-09	3.700E-09	2.400E-09	1.700E-09
SE	7.500E-07	2.100E-07	9.100E-08	5.600E-08	4.000E-08	1.900E-08	7.100E-09	3.600E-09	2.300E-09	1.700E-09
SSE	7.300E-07	2.200E-07	9.500E-08	5.800E-08	4.000E-08	1.900E-08	6.700E-09	3.400E-09	2.200E-09	1.600E-09
S	8.700E-07	3.100E-07	1.400E-07	8.400E-08	5.900E-08	2.800E-08	8.600E-09	4.400E-09	2.800E-09	2.100E-09
SSW	6.200E-07	2.000E-07	8.900E-08	5.900E-08	4.300E-08	2.000E-08	6.600E-09	3.400E-09	2.200E-09	1.600E-09
SW	5.400E-07	1.600E-07	7.800E-08	4.800E-08	3.500E-08	1.700E-08	5.600E-09	2.900E-09	1.900E-09	1.400E-09
WSW	6.000E-07	1.700E-07	7.800E-08	5.300E-08	3.700E-08	1.900E-08	6.100E-09	3.100E-09	2.000E-09	1.500E-09
W	7.100E-07	2.300E-07	1.000E-07	6.700E-08	5.000E-08	2.300E-08	7.500E-09	3.800E-09	2.500E-09	1.800E-09
WNW	6.000E-07	2.300E-07	1.100E-07	6.600E-08	4.700E-08	2.300E-08	8.900E-09	4.500E-09	3.000E-09	2.200E-09
NW	7.500E-07	2.200E-07	1.000E-07	6.400E-08	4.600E-08	2.500E-08	9.200E-09	4.700E-09	3.100E-09	2.200E-09
NNW	4.400E-07	1.900E-07	9.600E-08	6.300E-08	4.700E-08	2.800E-08	9.800E-09	5.000E-09	3.300E-09	2.400E-09

SITE ANNUAL DEPOSITION DATA, M-2

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	1.000E-08	1.100E-09	3.400E-10	1.800E-10	1.200E-10	5.800E-11	2.400E-11	1.000E-11	5.900E-12	4.100E-12
NNE	2.000E-08	2.200E-09	6.700E-10	3.400E-10	2.200E-10	9.800E-11	3.800E-11	1.600E-11	9.300E-12	6.400E-12
NE	2.900E-08	3.000E-09	9.000E-10	4.500E-10	2.900E-10	1.200E-10	4.300E-11	1.900E-11	1.100E-11	7.000E-12
ENE	1.600E-08	1.700E-09	5.200E-10	2.600E-10	1.600E-10	6.400E-11	2.300E-11	9.900E-12	5.600E-12	3.700E-12
E	1.700E-08	1.800E-09	5.300E-10	2.600E-10	1.600E-10	6.400E-11	2.300E-11	9.700E-12	5.500E-12	3.600E-12
ESE	2.100E-08	2.200E-09	6.500E-10	3.200E-10	1.900E-10	7.200E-11	2.400E-11	1.000E-11	5.700E-12	3.700E-12
SE	2.500E-08	2.600E-09	7.600E-10	3.700E-10	2.300E-10	8.500E-11	2.900E-11	1.200E-11	6.700E-12	4.400E-12
SSE	2.100E-08	2.300E-09	6.900E-10	3.400E-10	2.100E-10	7.800E-11	2.700E-11	1.200E-11	6.500E-12	4.300E-12
S	2.300E-08	2.600E-09	7.900E-10	3.900E-10	2.400E-10	9.100E-11	3.200E-11	1.400E-11	7.900E-12	5.200E-12
SSW	1.500E-08	1.800E-09	5.300E-10	2.600E-10	1.600E-10	6.100E-11	2.100E-11	9.200E-12	5.200E-12	3.400E-12
SW	1.300E-08	1.400E-09	4.200E-10	2.100E-10	1.300E-10	4.800E-11	1.600E-11	7.000E-12	3.900E-12	2.600E-12
WSW	1.500E-08	1.600E-09	4.900E-10	2.400E-10	1.500E-10	5.400E-11	1.900E-11	8.000E-12	4.500E-12	2.900E-12
W	1.700E-08	1.900E-09	5.700E-10	2.800E-10	1.700E-10	6.500E-11	2.300E-11	9.700E-12	5.500E-12	3.600E-12
WNW	1.200E-08	1.300E-09	4.000E-10	2.000E-10	1.300E-10	5.200E-11	1.900E-11	8.200E-12	4.700E-12	3.200E-12
NW	2.500E-08	2.400E-09	7.100E-10	3.500E-10	2.200E-10	8.200E-11	2.800E-11	1.200E-11	6.500E-12	4.300E-12
NNW	9.300E-08	9.600E-10	2.900E-10	1.500E-10	9.900E-11	4.500E-11	1.800E-11	7.500E-12	4.300E-12	3.000E-12

TABLE 7

GASPAR INPUT DATA AND
POPULATION DOSE RESULTS

GASPAR Input Parameter	Value Used
Fraction fresh leafy vegetables grown locally	1.0
Fraction of year cows, cattle, and goats on pasture	.5
Fraction of vegetable intake grown in garden	0.76
Fraction of feed from pasture while on pasture	1.0
Air water content, g/m^3	8.0
0-50 mile vegetation production, kg/yr	2.77(7)*
0-50 mile milk production, l/yr	6.05(7)
0-50 mile meat production, kg/yr	5.80(7)

Exposure Pathway	0-50 Mile Population Dose, man-rem/yr	
	Total Body	Thyroid
Noble gas plume immersion	3.35	3.35
Ground plane	2.02(-2)	2.02(-2)
Inhalation	7.14(-1)	5.30
Vegetation ingestion	1.01(-1)	4.76(-1)
Cow milk ingestion	1.20(-1)	1.58
Meat ingestion	1.63(-1)	3.20(-1)
Non-noble gas totals:	1.12	7.70

* $2.77(7) = 2.77 \times 10^7$

REFERENCES

(1) "Surry Units 1 & 2 Appendix I Analysis", Virginia Electric Power Company, Docket No. 50-280 and 50-281, October, 1976.

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(3) Commonwealth of Virginia, Commission of Outdoor Recreation, "The Virginia Outdoors Plan 1974".

(4) K. Eckerman, N. Dayem, R. Emch, "Code Input Data for Man-Rem Estimates:, U.S. Nuclear Regulatory Commission, October, 1975.

(5) Virginia Crop Reporting Service, "All Cattle and Milk Cow County Estimate, 1975".

(6) North Carolina Agricultural Statistics, "Milk Cows and Heifers That Have Calved: Number on Farm, By County, 1974".