PENNSYLVANIA POWER & LIGHT COMPANY
SUSQUEHANNA STEAM ELECTRIC STATION
OFFSITE DOSE CALCULATION MANUAL

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PORC Review Required Yes ( ) No (✓) Date

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Manager-Nuclear Support

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where:

K_i = the whole body dose factor due to gamma emissions for each identified noble gas radionuclide (i) (mrem/yr per $\mu Ci/m^3$) from Table 2.

Q'_{iv} = the release rate of radionuclide (i) from vent (v) which results in an annual dose rate of 500 mrem to the whole body or 3000 mrem to the skin of the critical receptor ($\mu Ci/sec$).

$(\chi/Q)_v$ = the highest calculated annual average relative concentration for estimating the dose to the critical offsite receptor in an unrestricted area from vent release point (v) (sec/m^3).

500 = the 10 CFR 20 annual whole body dose limit (mrem/yr) to an individual in an unrestricted area.

L_i = the skin dose factor due to beta emissions for each identified noble gas radionuclide (i) (mrem/yr per $\mu Ci/m^3$) from Table 2.

M_i = the air dose factor due to gamma emissions for each identified noble gas radionuclide (i) (mrad/yr per $\mu Ci/m^3$) from Table 2 (conversion constant of 1.1 converts air dose-mrad to skin dose-mrem).

3000 = the 10 CFR 20 annual skin dose limit (mrem/yr) to an individual in an unrestricted area.

Xenon-135 should be the principal noble gas radionuclide released from the reactor building vents and the standby gas treatment system vent while Xenon-133 should be the principal noble gas radionuclide released from the turbine building vent due to the offgas holdup system. It is appropriate that these noble gas radionucldes be used as the reference isotopes for establishing the particular monitor setpoints. The whole body dose will be the most limiting and the release rate limit is calculated by substituting the appropriate values in Equation 4. After the release rate limit is determined for each vent, the corresponding vent concentration limits can be calculated based on high limit vent flow rates:

$$\text{Setpoint } \frac{\mu Ci}{cc} = \frac{Q'_{iv}\ (\mu Ci/sec)}{\text{Flow rate (cc/sec)}} \qquad (6)$$

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Sample calculations for determining release limits for the whole body dose and the skin dose are given in Section A.1.2 of Appendix A. Also, typical values for flow rates and calibration factor are given for determining the setpoint of the Unit 1 turbine building vent gaseous effluent monitor.

Vent flow rates and sample flow rates are monitored and recorded for each of the five SSES release points. The measured flow rates are used to calculate vent concentrations and release rates. Flow channel setpoints are set at 10% and 90% of the calibrated sensor ranges to provide indication of possibly abnormal flow rates.

SPECIFICATION 3.11.2.6 - THE CONCENTRATION OF HYDROGEN OR OXYGEN IN THE MAIN CONDENSER OFFGAS TREATMENT SYSTEM SHALL BE LIMITED TO LESS THAN OR EQUAL TO 4% BY VOLUME.

Hydrogen recombiners are used at SSES to maintain the relative concentration of components of potentially explosive gas mixtures outside the explosive envelope. The main condenser offgas treatment system explosive gas monitoring system (offgas hydrogen analyzers) have setpoints of 1% hydrogen to alarm and 2% hydrogen to isolate.

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The SSES solid radwaste system was designed to solidify all wet wastes for ultimate offsite disposal. There are two Backwash Receiving Tanks, one per unit, which collect two filter-demineralizer backwashes per tank (2450 gal capacity). Air spargers for resin mixing are driven by instrument air. Regeneration Waste Surge Tanks (4) and Phase Separators (3) have internal mixing eductors for sludge mixing driven by recirculation flow. The Spent Resin Tank has a reversible progressing cavity pump and internal mixing eductors. Two solidification trains have waste mixing tank progressing cavity feed and mixing pumps, and screw conveyors for feeding of dry Portland cement. Mixing is facilitated by the addition of sodium silicate.

Common solidification equipment includes waste container fill-port, transfer cart, capper washdown station, and swipe tool; cement silo with rotary feed valve, aeration blower, baghouse, and exhaust fan; sodium silicate tank and pump. Dry contaminated solids are compacted into 55 gallon drums. The trash compactor was hydraulic pump and hydraulic press piston with exhaust fan and HEPA filter.

A flow diagram of the SSES solid radwaste treatment system is shown in Figure 5.

NOTE: Vendor solidification services may be used in accordance with the SSES Process Control Program to supplement the plant solidification system or to take the place of the plant system when the plant system is out of service.

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9.2 MONITORING PROGRAM

SPECIFICATION 3.12.1 - THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SHALL BE CONDUCTED AS SPECIFIED IN TABLE 3.12.1-1.

Environmental samples shall be collected and analyzed according to Table 7 at locations shown in Figures 6 and 7. Analytical techniques used shall ensure that the detection capabilities in Table 8 are achieved.

A dust loading study (RMC-TR-81-01) was conducted to assure that the proper transmission factor was used in calculating gross beta activity of air particulate samples. This study concluded that the sample collection frequency of once per week was sufficient and that the use of 1 for the transmission connection factor for gross beta analysis of air particulate samples is valid.

The charcoal sampler cartridges used in the airborne radioiodine sampling program (Science Applications, Inc., Model CP-100) are designed and tested by the manufacturer to assure a high quality of radioiodine capture. A certificate from the manufacturer is supplied and retained with each batch of cartridges certifying the percent retention of radioiodine versus air flow rate through the cartridge.

The results of the radiological environmental monitoring program are intended to supplement the results of the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. Thus, the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from station operation. The initial radiological environmental monitoring program will be conducted for the first three years of commercial operation of Unit 1. Following this period, program changes may be proposed based on operational experience. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment, and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, an effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the annual report. Reporting requirements for the radiological environmental surveillance program are given in Appendix B.

9.3 CENSUS PROGRAM

SPECIFICATION 3.12.2 - A LAND-USE CENSUS SHALL BE CONDUCTED AND SHALL IDENTIFY WITHIN A DISTANCE OF 8 KM (5 MILES) THE LOCATION IN EACH OF THE 16 METEOROLOGICAL SECTORS OF THE NEAREST MILK ANIMAL, THE NEAREST RESIDENCE AND THE NEAREST GARDEN* OF GREATER THAN 50 M^2 (500 FT^2) PRODUCING BROAD LEAF VEGETATION.

A land use census will be conducted to identify the location of the nearest milk animal and the nearest residence in each of the 16 meteorological sectors within a distance of five miles. When a land use census identifies a location(s) which yields a calculated dose or dose commitment greater than the values calculated from current sample locations, appropriate changes in the sample locations will be made. If a land use census identifies a location(s) with a higher average annual deposition rate (D/Q) than a current indicator location, the following shall apply:

*Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two directional sectors with the highest predicted D/Q's in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 3.12.1-1, item 4C shall be followed, including analysis of control samples.

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Exposure Pathways and/or Sample	Number of Samples and Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
Sediment from Shoreline	7B Bell Bend - 1.2 mi SE	Semiannually	Gamma isotopic analysis semiannually.
Milk***	12B2 Shultz Farm - 1.69 mi. WSW 13E3 Dent Farm - 4.9 mi. W 5E1 Bloss Farm - 4.4 mi. E 10G1 Davis Farm - 14 mi. SSW[a]	Semi-monthly when animals are on pasture, monthly otherwise	Gamma isotopic and I-131 analysis of each sample.
Fish and Invertebrates	Outfall area 2H Falls, Pa. (Approximately 30 mi NNE)	Sample in season. One sample of each of the following species[c]: 1. Walleye 2. Catfish	Gamma isotopic on edible portions.
Food Products	11D1 Zehner Farm - 4.3 mi SW vegetable	At time of harvest	Gamma isotopic on edible portions.

*The location of samples and equipment were designed using the guidance in the Branch Technical Position to NRC Reg. Guide 4.8, Rev. 1 Nov. 1979, Reg. Guide 4.8 1975 and ORP/SID 72-2 Environmental Radioactivity Surveillance Guide. Therefore, the airborne sampler locations were based upon X/Q and/or D/Q.

**A dust loading study (RMS-TR-81-01) concluded that the assumption of 1 for the transmission correction factor for gross beta analysis of air particulate samples is valid. Air particulate samples need not be weighed to determine a transmission correction factor.

***If a milk sample is unavailable for more than two sampling periods from one or more of the locations, a vegetation sample shall be substituted until a suitable milk location is evaluated. Such an occurrence will be documented in the REMP annual report.

[a] Control sample location.

[b] Temporary locations until compositor is installed in intake and discharge lines; then frequency changes to composite sample collected over one-month period and location changes to 6S6 intake line, 6S7 discharge line. The upstream sample will be taken in the intake line and which is beyond significant influence of the discharges. The downstream sample will be taken in the discharge line.

[c] Other species in the same family could be sampled instead of the stated species if deemed desirable by the biological consultants.

[d] There is no river water intake at Berwick for drinking water. See Susquehanna SES-ER-OL Appendix G, page RAD-3.1. The calculated dose for Danville to the infant thyroid was 0.13 mrem per year. Therefore, there is no need to take a composite sample over two-week period and perform an I-131 analysis.

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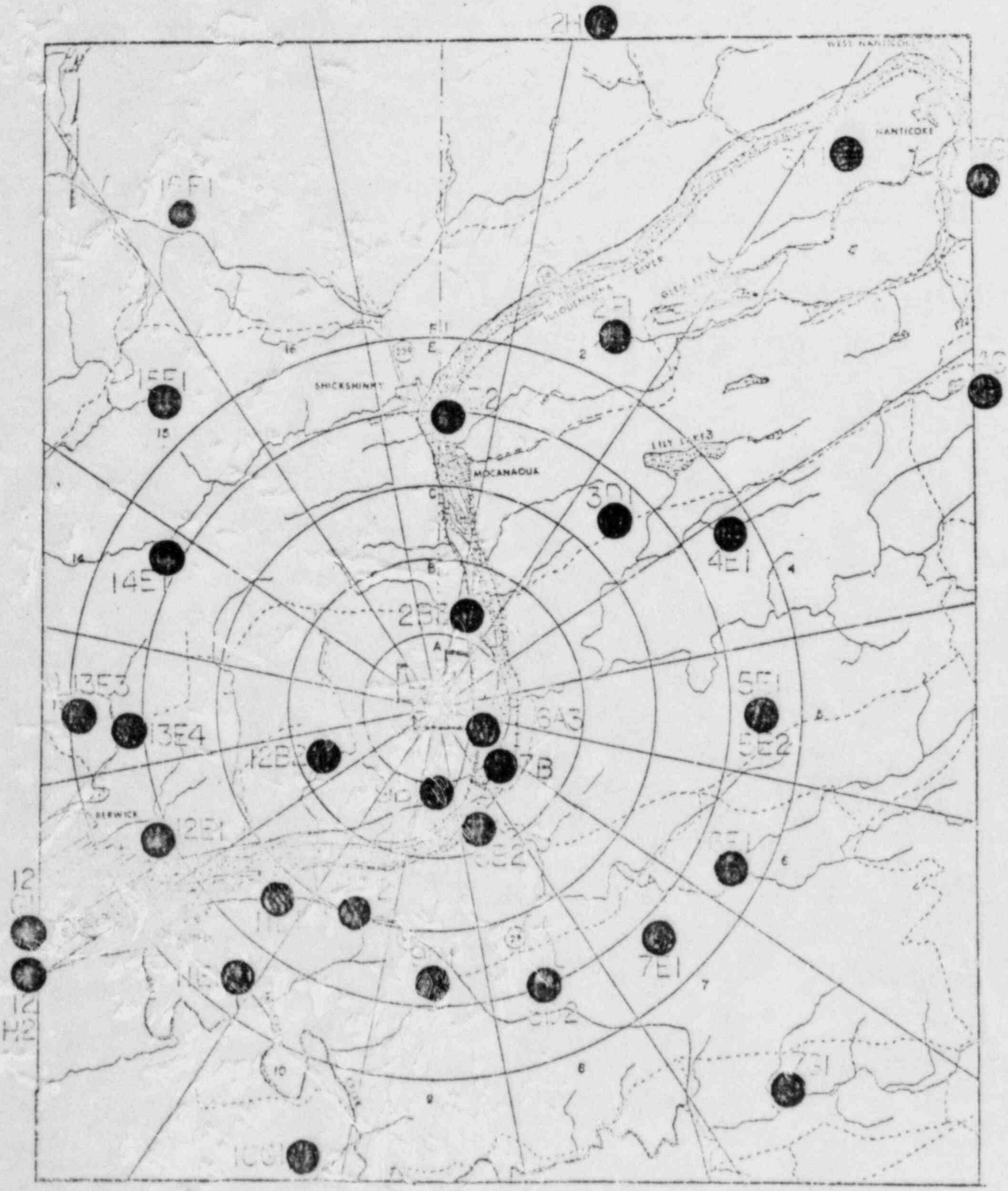

Figure [illegible] Offsite Environmental Sampling Locations - Susquehanna SES

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