B. Singh

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

NOV 28 1984

Docket No. 50-412

MEMORANDUM FOR: Thomas M. Novak, Assistant Director for Licensing, DL

FROM: Daniel R. Muller, Assistant Director for Radiation Protection, DSI

SUBJECT: METEOROLOGY AND EFFLUENT TREATMENT BRANCH INPUT FOR THE SAFETY EVALUATION REPORT PERTAINING TO THE BEAVER VALLEY STATION, UNIT NO. 2, FINAL SAFETY ANALYSIS REPORT

PLANT NAME: Beaver Valley, Unit No. 2
LICENSING STAGE: OL DOCKET NUMBER: 50-412
RESPONSIBLE BRANCH: LB#3; B. K. Singh, PM
REVIEW STATUS: SER input complete with some open items

Enclosed is the marked-up input to the Safety Evaluation Report (SER) regarding the meteorological and radiological effluent treatment sections of the Beaver Valley, Unit No. 2, Final Safety Analysis Report. At this time, some additional information and analysis is required to close out several open items. These items are listed below

1. Section 11.3, Gaseous Waste Processing Systems, unresolved issues pertaining to the containment vacuum system exhaust filtration (i.e., unsatisfactory iodine removal filtration system).

2. Section 11.5, the applicant must specify the ranges for the effluent release monitors.

3. The applicant, in FSAR Sections 1.10 and 13.5.2.1 has not adequately described their program to minimize reactor coolant leakage outside the containment (NUREG-0737, Item III.D.1.1). A description of this program covering the systems and the surveillance methods and maintenance procedures should be submitted for NRC approval.

4. The applicant must submit and obtain NRC approval of their Solid Waste Process Control Program prior to processing for disposal of any solid waste.

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This review was performed by Earl Markee (x27635), Meteorology Section, and Robert Fell (x27642), Effluent Treatment Systems Section, METB. Please contact the respective reviewers for any questions.

Original signed by,

Daniel R. Muller, Assistant Director
for Radiation Protection
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Enclosure:
As stated

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BEAVER VALLEY POWER STATION, UNIT NO. 2
INPUT TO ~~DRAFT~~ SER

2.3 Meteorology

Evaluation of regional and local climatological information, including extremes of climate and severe weather occurrences which may affect the design and siting of a nuclear plant, is required to assure that the plant can be designed and operated within the requirements of Commission regulations. Information concerning atmospheric diffusion characteristics of a nuclear power plant site is required for a determination that radioactive effluents from postulated accidental releases, as well as routine operational releases, are within Commission guidelines.

Sections 2.3.1 through 2.3.5 have been prepared in accordance with the review procedures described in the Standard Review Plan (NUREG-0800), utilizing information presented in Section 2.3 of the FSAR, responses to requests for additional information, and generally available reference materials as described in the appropriate sections of the Standard Review Plan.

2.3.1 Regional Climatology

The plant is located in southwest Pennsylvania in a mountain valley near the western edge of the Appalachian Mountains and in a humid continental type of climate.

Continental air masses, predominantly of polar origin, dominate the region in winter, and alternate with maritime tropical air masses in summer. The mean annual temperature in the area is about 10^{o}C (50^{o}F) ranging from about -2.2^{o}C (28^{o}F) in January to about 22.2^{o}C (72^{o}F) in July. Annual precipitation in the area is about 915 mm (36 inches).

The site lies near a principal track of storms moving northeast along the Atlantic coast and of low pressure systems moving across the U.S., resulting in a variety of severe weather phenomena which affect the site area. About 53 thunderstorms can be expected on about 36 days each year. About 70% of these thunderstorms occur from May through August. Considering the frequency of thunderstorms, the applicant has estimated the number of lightning strikes to the containment structure per year to be 0.8. Hail often accompanies severe thunderstorms. During the period 1955-1967, eight occurrences of hail with diameters 19 mm (3/4 inch) or greater were reported in one-degree latitude-longitude square containing the site.

Tornadoes are not uncommon in the region. For a one degree latitude-longitude "square" (3,597 square

miles) containing the site, an average of about 1.04 tornadoes per year were reported for the period 1954-1981. Using a calculated expected mean tornado path area of 0.55 square miles, the computed probability of occurrence for a tornado at the plant site is about 1.6×10^{-4} per year. The applicant has computed a lower probability of occurrence (about 1.4×10^{-4} per year) based on a smaller tornado path area (0.4 square miles) and a higher annual frequency (1.22 tornadoes per year) using the period of record from 1950 through 1981. The pressure drop rate characteristics of the design basis tornado considered by the applicant for the Beaver Valley plant are different than the recommendations of Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," for this region of the country. The applicant's design basis tornado has a 290 mph rotational velocity with a translational velocity of 70 mph, a total pressure drop of 3 psi and an average rate of pressure drop of 3 psi in 3 seconds. The tornado winds and total pressure drop are consistent with Regulatory Guide 1.76. However, the rate of pressure drop is not consistent with Regulatory

Guide 1.76, in which a rate of pressure drop of 2 psi/sec is specified. ~~This will be an open issue only if the design of the Category I structures cannot accommodate a pressure drop of 2 psi/sec.~~ The acceptability of the design of Category I structures with respect to NRC design basis tornado characteristics and load combinations is discussed in Section 3.3.2.

High wind speed occurrences in the area are usually associated with severe thunderstorms and extratropical cyclones. The highest "fastest mile" wind speed reported at Greater Pittsburgh Airport was 58 mph in Feburary 1967. The applicant has selected an operating basis wind speed (defined as the "fastest mile" wind speed at a height of 30 feet with a return period of 100 years) to be 80 mph for consideration in plant design.

Since the ultimate heat sink for the plant is the Ohio River, meteorological conditions related to evaporation and heating are not relevant to determination of the adequacy of the river to perform its function for a 30 day period.

Heavy snowfall is not uncommon in the region, and roof loads may accumulate due to a wintertime precipitation mixture of snow, ice, and rain. Maximum monthly snowfall observed at Greater Pittsburgh Airport was 1021 mm (40.2 inches) in January 1978, and the maximum snowfall in a 24-hour period at Pittsburgh was 373 mm (14.7 inches) in March 1962. Ice storms, which can plug drains and scuppers as well as disrupt offsite power, are relatively frequent. The applicant estimates that ice pellets or freezing rain may occur about 8 times per year in the Beaver Valley region, with a glaze accumulation of 0.5 inches or greater expected about once per year.

The applicant has estimated the weight on the ground of the 100-year return period snowpack to be 19.5 psf ~~To determine the probable maximum snowload for consideration in the design of safety-related structures, the~~ applic~~ant has added~~ and the weight of the 48-hour probable maximum winter precipitation to be equivalent to 71.2 psf. ~~to the weight of the 100 year return snowpack for a total weight of 90.7 psf.~~ The plant design basis is a snow or ice loading of 71 psf.

The staff's estimate of the 100-year return period snowpack based on ANSI 58.1-1982, extrapolated from the 50-year return period in the standard to a 100-year return period, produces a weight of near 30 psf. This snowpack weight, when added to the weight produced by the 48-hour probable maximum winter precipitation (about 70 psf) produces a total ~~design~~ snowload of 100 psf, which should have been used in the loading factors for plant design. ~~This will be an open issue only if the design of the Category I structures cannot accommodate a snowload of 100 psf.~~ The acceptability of the applicant's design of safety related structures, with respect to the staff's estimate of design snowload and load combinations, is discussed in Section 3.8.1.

Large-scale episodes of atmospheric stagnation occur in the region. About 41 atmospheric stagnation cases totaling at least 164 days were reported in the area in the period 1936-1975.

As discussed above, the staff has reviewed available information relative to the regional meteorological conditions of importance to the safe design and siting of this plant in accordance

with the criteria contained in Section 2.3.1 of the Standard Review Plan. Based on this review, the staff concludes that, with the exception of the design basis tornado rate of pressure drop and snowpack, the applicant has identified appropriate regional meteorological conditions for consideration in the design and siting of this plant. With the exception of ~~the NRC criteria for the design basis tornado rate of pressure drop (Section 3.3.2) and design basis~~ an acceptable snowpack design (Section 3.8.1), the applicant has met the requirements of 10 CFR Part 100.10 and 10 CFR Part 50, Appendix A, General Design Criteria 2 and 4.

Although the design basis tornado characteristics selected by the applicant are different than the position set forth in Regulatory Guide 1.76, the differences are not considered significant for the determination of an acceptable design basis tornado for missile generation. Therefore, the applicant has met the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 4 for the consideration of tornado missiles.

2.3.2 Local Meteorology

Climatological data from Pittsburgh, PA, and available onsite data have been used to assess local meteorological characteristics of the plant site.

Extreme temperatures of -27.8°C (-18°F) and 37.2°C (99°F) have been reported at Pittsburgh. The applicant has considered a maximum outdoor temperature of 32.2°C (90°F) and a minimum temperature of -20.6°C (-5°F) in the design of all heating, ventilating and air conditioning (HVAC) systems. Regional analyses in NUREG/CR-1390, "Probability Estimates of Temperature Extremes for the Contiguous United States" show that an ambient temperature of 35°C (95°F) will be exceeded for at least one hour every two years, on the average, and that an ambient temperature of about 41.1°C (106°F) will be exceeded at least one hour every 100 years, on the average. Also, an ambient temperature of less than -22.2°C (-8°F) is expected to occur for at least one hour every two years, on the average, and an ambient temperature of less than -36.7°C (-34°F) is expected to occur for at least one hour every 100 years, on the average. ~~Further justification of the adequacy of the ambient extreme temperatures considered by the applicant for the design of HVAC systems protecting safety related~~

~~auxiliary systems and components is required. This will be an open issue only if~~ The applicant has demonstrated that exceedence of extreme design temperatur - ~~for the~~ will not ~~HVAC system~~ result~~s~~ in sudden failure ~~or malfunc~~ ~~n~~ of Category I auxiliary systems and compone s (SER Sections 9.4.1 through 9.4.5). ~~which is being evaluated by the Auxiliary Systems Branch.~~

Precipitation is well-distributed throughout the year, ranging from about 61 mm (2.4 inches) in February to about 97 mm (3.8 inches) in July. Maximum and minimum monthly amounts of precipitation observed at Pittsburgh have been 208 mm (8.2 inches) in October 1954 and 4 mm (0.16 inches) in October 1963, respectively. The maximum amount of precipitation in a 24 hour period at Pittsburgh was 90 mm (3.56 inches) in October 1954.

Annual precipitation at Pittsburgh is about 919 mm (36.2 inches) and onsite precipitation measurements for the 5-year period 1976-1980 presented by the applicant indicate annual precipitation of about 572 mm (22.5 inches). These differences can be attributed to the different periods of record and terrain differences.

Wind data taken from the 10.7 m level of the onsite meteorological tower for a 5-year period (January 1976-December 1980), as summarized by the applicant,

indicate prevailing winds from the southwest (10.5%) and west-southwest (10.2%) with a secondary peak frequency from the southeast (9.2%). Winds from the north-northeast and north-northwest for this period occurred least frequently, each occurred less than 4% of the time. The mean annual wind speed observed at the 10.7 m level of the onsite meteorological tower for the period 1976-1980 was about 1.9 m/sec (4 mph), with calm conditions (defined as wind speeds less than the starting threshold of the anemometer) occurring almost 0.8% of the time.

Wind data taken from the 152 m level of the onsite tower for the 5-year period (1976-1980) indicate prevailing winds from the southwest, west-southwest and west (totaling 37.7%). Winds from the north-northeast direction occurred least frequently at 2.7% of the time. The mean annual wind speed observed at the 152 m level of the tower for the 1976-1980 period of record was about 4.5 m/sec (10 mph), with calm conditions occurring about 0.2% of the time.

Atmospheric stability assessments, based on vertical temperature difference measurements for the 5-year period (1976-1980), have been summarized by the

applicant for a shallow (45.7 m to 10.7 m) layer and a deep (152 m to 10.7 m) layer. Unstable conditions (indicating rapid diffusion rates) occur 21.6% and 5.0% of the time in the shallow and deep layers, respectively. Neutral and slightly stable conditions predominate and occur 53.2% and 80.1% of the time, respectively, in the shallow and deep layers. Moderately stable and extremely stable conditions (indicating slow diffusion rates) occur 25.3% of the time in the shallow layer and 14.9% of the time in the deep layer.

As discussed above, the staff has reviewed available information relative to local meteorological conditions of importance to the safe design and siting of this plant in accordance with the criteria contained in Section 2.3.2 of the Standard Review Plan. The staff concludes that ~~, with the exception of the design basis temperatures for HVAC systems,~~ the plant will adequately withstand extreme ~~applicant has identified and considered appropriate~~ local meteorological conditions ~~in the design and siting of this plant,~~ and, therefore, meets the requirements of 10 CFR Part 100.10 and 10 CFR Part 50, Appendix A, General Design Criterion 2.

2.3.3 Onsite Meteorological Measurements Program

The present onsite meteorological measurements program was initiated at the Beaver Valley site in January 1976. Measurements are made on a tower extending 152 m (500-feet) above a grade of 223 m (730 feet) msl, located about 1100 m northeast of the Beaver Valley Power Station, Unit No. 1, reactor structure location and about 800 m northeast of the natural draft cooling tower locations for both units. The following meteorological measurements are made on the tower: wind speed and direction at the 10.7 m, 45.7 m, and 152 m levels; vertical temperature gradient between the 45.7 m and 10.7 m levels and between the 152 m and 10.7 m levels; and temperature and dewpoint at the 10.7 m level. Precipitation is measured at an elevation of about 1 m above grade near the tower.

A digital data acquisition system, backed up by analog strip charts, has been and is currently being used to record meteorological data. The measurements system was inspected daily, and the entire system was calibrated quarterly. The joint data recovery for wind speed, and wind direction at the 10.7 m level, and atmospheric stability (defined by the vertical

temperature difference between the 45.7 and 10.7 m levels) for the 5-year period January 1976-December 1980 presented in the FSAR was 90% with yearly data recovery ranging from 85 to 93%. The joint data recovery for wind speed and wind direction at the 152 m level and atmospheric stability (defined by vertical temperature difference between the 152 and 10.7 m levels) for the 5-year period was 88% with yearly data recovery ranging from 79 to 93%.

The meteorological measurements systems complies with the siting and accuracy specifications in Regulatory Guide 1.23, "Onsite Meteorological Programs." ~~However, in the ER-OL, the applicant makes the statement that changes in the meteorological tower location in January 1976 produced a shift in the prevailing wind directions and that this shift was due to the channeling effect of the valley. Therefore, the applicant was asked by the staff (RAI E451.4) to provide additional information on the representativeness of the new tower location for the determination of atmospheric dispersion. Until this question is resolved, the assessments in SER Sections 2.3.4 and 2.3 5 cannot be finalized.~~

The representativeness of the 5-year period of onsite data of long term conditions was determined by comparisons of data from the concurrent 5-year period for Pittsburgh with data from a 28-year period for Pittsburgh. These comparisons indicate that reasonable estimates of atmospheric dispersion for accidental and routine releases of radioactive effluents can be made from the onsite data record.

The meteorological program described above appears to meet the criteria for upgraded meteorological measurements during plant operation as part of the emergency response capability. These upgrades must be completed in accordance with the schedule of NUREG-0737, III.A.2, "Clarification of TMI Action Plan Requirements," and its supplement, and a post implementation staff review will be conducted. The incorporation of current meteorological information into a real-time atmospheric dispersion model for dose assessments will also be considered as part of the upgraded capability.

The staff has reviewed the onsite meteorological measurements system in accordance with the criteria

contained in Section 2.3.3 of the Standard Review Plan. ~~Although the applicant maintains that~~ the current instrumentation and data reduction procedures conform to the recommendations of Regulatory Guide 1.23, "Onsite Meteorological Programs." ~~the staff is concerned about the representativeness of the data collected at the new tower location.~~ The current meteorological measurements program has provided adequate data to represent onsite meteorological conditons as required in 10 CFR Part 100.10; however, the staff is continuing its evaluation of the adequacy of the proposed upgrades to the program. Nevertheless, the staff concludes that the historical site data provide a reasonable basis for making preliminary estimates of atmospheric dispersion conditions for estimating consequences of design basis accident and routine releases from the plant.

2.3.4 Short-Term (Accident) Diffusion Estimates

To audit the applicant's estimates, the staff has performed an independent, ~~preliminary~~ assessment of short-term (less than 30 days) accidental releases from buildings and vents using the direction-dependent atmospheric dispersion model described in Regulatory

Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," with consideration of increased lateral dispersion during stable conditions accompanied by low wind speeds. Five years (January 1977-December 1981) of onsite data available to the staff on magnetic tape, which had 92% data recovery, were used for this evaluation. Wind speed and wind direction data were based on measurements at the 10.7 m level and atmospheric stability was defined by the vertical temperature gradient measured between the 45.7 m and 10.7 m levels. A ground-level release with a building wake factor, cA, of 800 m^2 was assumed. The relative concentration (X/Q) for the 0-2 hour time period was determined to be 1.9 x 10^{-3} sec/m^3 at an exclusion area boundary distance of 527 m in the northwest sector. The X/Q values for appropriate time periods at the outer boundary of the low population zone (5800 m) are:

Time Period	X/Q (sec/m^3)
0-8 hours	9.8 x 10^{-5}
8-24 hours	6.4 x 10^{-5}
1-4 days	3.2 x 10^{-5}
4-30 days	1.2 x 10^{-5}

The applicant has calculated a lower (about 30 ~~40%~~) X/Q value for the 0-2 hour time period at the exclusion area boundary than that calculated by the staff. The X/Q values calculated by the applicant for the various time periods at the LPZ distance are within 20 ~~15%~~ of those calculated by the staff. ~~These small differences may be attributed primarily to different periods of meteorological data record used by the staff and the applicant.~~

Based on the above ~~preliminary~~ evaluation performed in accordance with the criteria contained in SRP Section 2.3.4 ~~of the Standard Review Plan~~, the staff concludes that the applicant has slightly underestimated atmospheric dispersion conditions at the exclusion area boundary for assessments of the consequences of radioactive releases for design basis accidents in accordance with the requirements of 10 CFR Part 100.11. The atmospheric dispersion estimates provided above, which were independently calculated by the staff, have been used by the staff in its ~~an independent preliminary~~ assessment of the consequences of radioactive releases for design basis accidents.

2.3.5 Long-Term (Routine) Diffusion Estimates

To audit the applicant's estimates, the staff ~~will~~ performed an independent calculation of annual average relative concentration (X/Q) and relative deposition (D/Q) values.

Annual average relative concentration (X/Q) and relative deposition (D/Q) values at specific receptor points and in arrays to 80 Km (50 mi) for use in population dose assessment will be based on the straight-line gaussian atmospheric dispersion model, described in Regulatory Guide 1.111, modified to reflect spatial and temporal variations in airflow using the applicant's correction factors calculated from a variable trajectory plume model. Releases through the turbine enclosure and the reactor enclosure vents will be considered to be partially elevated, based on the criteria contained in Regulatory Guide 1.111.

However, the staff diffusion estimates cannot be performed until the issues in FSAR Section 11.3 are resolved and the response to a request for additional information on the ER-OL (RAI E451.5) is received and evaluated.

~~BEAVER VALLEY POWER STATION, UNIT 2~~
~~METEOROLOGICAL INPUT TO APPENDIX D~~
~~OF DRAFT ENVIRONMENTAL STATEMENT~~

Annual average relative concentration (X/Q) and relative deposition (D/Q) values were calculated for specific receptor points and in arrays to 80km (50mi) using the straight-line Gaussian atmospheric dispersion model described in Regulatory Guide 1.111, modified to reflect potential spatial and temporal variations in airflow using site-specific correction factors developed by the applicant. Releases through the process vent (at the top of the cooling tower) were assumed to be elevated, and releases from the turbine building were assumed to be at ground level with mixing in the turbulent wake of plant structures. Releases through the containment vent were assumed to be partially elevated, except for the transport directions (affected sectors) of north-northeast, northeast, east-southeast, and southeast. Dispersion in these transport directions is affected by the large natural draft cooling towers, and, for these transport directions, releases from the containment vent were assumed to be at ground level with mixing in the turbulent wake of plant structures. Intermittent releases through the containment vent were evaluated using the methodology contained in NUREG/CR-2919.

A 5-year period of record (January 1977-December 1981) of onsite meteorological data was used for this evaluation. For releases from the containment and turbine building vents, wind speed and direction data were based on measurements made at the 10.7m (35-ft) level, and atmospheric stability was defined by the vertical temperature difference between the 45.7m (150-ft) and 10.7m levels. For releases through the process vent at

the top of the cooling tower, wind speed and direction data were based on measurements made at the 152m (499-ft) level, and atmospheric stability was defined by the vertical temperature difference between the 152m and 10.7m levels.

The applicant has calculated similar X/Q and D/Q values to those calculated by the NRC staff.

Based on the above evaluation performed in accordance with SRP Section 2.3.5, the NRC staff concludes that the applicant has considered representative atmospheric dispersion estimates for demonstrating compliance with the numerical guides for doses in 10 CFR 50, Appendix I. The atmospheric dispersion estimates developed by the NRC staff have been used in its assessment of compliance with Appendix I, which appears in Section 11.3 of this report. They have also been used in the preparation of the NRC staff's Draft Environmental Statement and are included in the assessment of the radiological impact to humans from routine releases to the atmosphere that appears in the Beaver Valley, Unit No. 2, Environmental Statement.

6.5 Engineered Safety Feature (ESF) Filter Systems

6.5.1 Introduction

Section 6.5 of the Final Safety Analysis Report (FSAR) contains information pertaining to engineered safety feature (ESF) filter systems, their design bases, and applicable acceptance criteria.

6.5.2 Acceptance Criteria

The staff has reviewed the applicant's design, design criteria, and design bases for the ESF filter systems for the Beaver Valley Nuclear Generating Station, Unit 2. The acceptance criteria used as the basis for our evaluation are set forth in the Standard Review Plan (SRP) NUREG-0800, in Section II of SRP 6.5.1. These acceptance criteria include the applicable General Design Criteria (Appendix A to 10 CFR Part 50), ANSI Standard N509-1980, "Nuclear Power Plant Air Cleaning Units and Components", and ANSI Standard N510-1980, "Testing of Nuclear Air Cleaning Systems". Guidelines for implementation of the requirements of the acceptance criteria are provided in the ANSI Standards, Regulatory Guide 1.52, and other documents identified in Section II of the SRP. Conformance to the

acceptance criteria provides the bases for concluding that the ESF filter systems meet the requirements of 10 CFR Part 50.

6.5.3 Method of Review

The Beaver Valley Station, Unit 2, has two ESF filter systems, the Control Room Pressurization Fresh Air Filter System, and the Supplementary Leak Collection and Release System (SLCRS). Each of these these systems was reviewed in accordance with the SRP. The results of these reviews are discussed below.

6.5.4 Review Discussion

The ESF filter systems for the Beaver Valley Station, Unit 2, include the main control room area pressurization filtration system and the supplementary leak collection and release system (SLCRS). These systems operate after an accident to control the release of radioactive materials in gaseous effluents (radioiodine and particulates.

6.5.4.1 Main Control Room Pressurization Filtration System

Part of the function of the control building ventilation system is to isolate the control room and provide a fresh supply of air in the event of an accident.

For this purpose, the main control room pressurization filter system is activated during an accident when the control room bottled air pressurizing system is depleted. This 100% redundant filter system takes suction from the control room outside air intake at 1,000 cfm. The air is dehumidified by a demister and electric heater, passed through a HEPA filter, a charcoal filter and another HEPA filter and then through a 1,000 cfm fan before the air enters and pressurizes the control room. The system and components are designed to seismic Category I, are powered by Class 1E buses, and located in a seismic Category 1 structure. A complete description of the system is provided in Section 9.4.1 of the Beaver Valley Station FSAR.

For the evaluation of the ESF filter systems in Section 6, the staff has assigned removal efficiencies of 95% for all radioiodines and 99% for particulates, as specified for 2-inch deep charcoal beds and HEPA filters, respectively. From the system description in the FSAR, we determined that the control room pressurization filter system is designed consistent with GDCs 19 and 61 and as referenced in the SRP.

Except for some minor deviations from Regulatory Guide 1.52 Revision 2 requirements noted in Section 6.5.5, we find the design of the ESF control room pressurization filter system adequate to maintain a positive control room pressure and significantly remove concentrations of radioactive materials from the control room makeup supply air.

6.5.4.2 Supplementary Leak Collection and Release System

The function of the supplementary leak collection and release system (SLCRS) is to operate during an accident to collect, process and filter containment air leakage prior to atmospheric release. In addition, the SLCRS will also process exhaust air from the fuel building, some exhaust air from potentially contaminated areas of the Auxiliary building, and exhaust air from the Waste Handling building. This system is a seismic Category 1 design with redundant ESF filter trains each powered by normal and emergency Class 1E buses. During a loss of coolant accident, the SLCRS collects, filters and releases at the top of the containment any leakage into the contiguous areas which house

containment penetration and ESF equipment cubicles that circulate radioactive water. Also, for a fuel handling accident, the SLCRS processes leakage from the fuel building.

There are two redundant filter trains. Each train consists of a dehumidifier and electric heater for humidity control, followed by two parallel HEPA, charcoal and HEPA filters. Following are two 100% redundant filter exhaust fans that discharge to the elevated release point. A manual water spray system is provided to prevent ignition of the charcoal in the event of decay heat buildup.

From the system description in the FSAR, we determined that the SLCRS is designed consistent with GDC's 41, 42, 43, 61, and 64, as referenced in the SRP. In our evaluation of the system design efficiencies for removal of elemental iodine and organic iodines, we assigned the system radioiodine decontamination efficiencies of 90% for normal and 95% for accident conditions for the SLCRS carbon adsorbers (one 2-inch deep bed with humidity control), in accordance with Regulatory Guides 1.140 and 1.52 and 99% for particulates for the SLCRS HEPA filters. Except for some minor deviations from Regulatory Guide 1.52,

~~Revision 2, requirements noted in Section 6.5.5,~~ we find that the design of the ESF supplementary leakage control system adequate to collect and filter radioactive particulate and iodine from containment and fuel building leakage.

6.5.5 Deviations from the Standard Review Plan

Our review of the above systems has found agreement with the guidelines of the Standard Review Plan (SRP), NUREG-0800, except for the items noted below. These items are deviations from Regulatory Gudie 1.52, Revision 2, ~~and are considered~~ as "open items" ~~requiring further evaluation~~ by the applicant:

- Several paragraphs of IEEE-STD 279-1971 relating to testing of manual initiation and system status of protective systems have been deleted. The staff does not agree with the applicant that these design requirements can be deleted for ESF filter systems.
- The applicant has taken exception to the requirement that dampers used in contaminated air streams be designed to ANSI B31.1 (construction Class A dampers). Instead, these dampers will be designed only to meet the strength and leak tightness necessary for use in contaminated air streams. The staff considers this position acceptable except that

dampers used for isolation and shutoff of contaminated air streams (either toxic chemical or airborne radioactive materials) should be construction Class A. The applicant should verify to the staff that all isolation and shutoff dampers in potentially contaminated airstreams are in fact construction Class A.

- The applicant has taken exception to the 10 hour per month filter purge, with heaters operational, to maintain the charcoal in an "accident ready" condition. Instead, the applicant considers 15 minutes all that is necessary to demonstrate operability and keep the charcoal free of moisture. The staff disagrees with the applicant. With regard to the control room pressurization system, the charcoal filters will normally be idle, thus, during periods of high humidity and with dampers that do not seal 100%, water vapor by diffusion will enter the charcoal and possibly degrade its performance. Therefore, it is essential to periodically purge the charcoal filters with low humidity air for a duration (considered to be 10 hours) to maintain the charcoal dry and in an "accident ready" condition.

6.5.6 Evaluation Findings

The staff concludes that the design of the ESF atmosphere cleanup systems, including the equipment and instrumentation to control the release of radioactive materials in gaseous effluents following a postulated DBA, are acceptable. This conclusion is based on the applicant having met the requirements of GDCs 19, 41 and 61 by providing ESF atmosphere cleanup systems on the control room habitability, containment and associated systems. The applicant has met the requirements of GDCs 42, 43, and 64 by providing for inspecting and testing the ESF atmosphere cleanup systems and monitoring for radioactive materials in effluents from these systems. In meeting these regulations, the applicant has demonstrated that the design of the ESF atmosphere cleanup systems ~~with exceptions noted in~~ 6.5.5 meet the guidelines of Regulatory Guide 1.52 and the ANSI N509 and N510 industry standards, as referenced in the SRP. We have reviewed the applicant's system descriptions and design criteria for the ESF atmosphere cleanup systems. Based on our evaluation with respect to the SRP criteria, we find the proposed ESF atmosphere cleanup

systems are acceptable ~~pending resolution of the "open items" noted in 6.5.5~~. The filter efficiencies given in Table 2 of Regulatory Guide 1.52 are appropriate for use in accident analyses.

10.4.2 Main Condenser Evacuation System

10.4.2.1 Introduction

Section 10.4.2 of the Final Safety Analysis Report (FSAR) contains information pertaining to the main condenser evacuation (air removal) system, the system design bases, and the applicable acceptance criteria.

10.4.2.2 Acceptance Criteria

The staff has reviewed the applicant's design, design criteria, and design bases for the main condenser evacuation system (MCES) for Beaver Valley, Unit 2. The acceptance criteria used in our evaluation are those in the Standard Review Plan (SRP), NUREG-0800, in Section II of SRP 10.4.2. The SRP acceptance criteria include the applicable GDC (Appendix A to 10 CFR Part 50) and Heat Exchanger Institute Standard "Standards for Steam Surface Condensers." Guidelines for implementation of the requirements of the

acceptance criteria are provided in the Regulatory Guides referenced in Section II of the SRP. Conformance to the acceptance criteria of the SRP provides the bases for concluding that the MCES meets the requirements of 10 CFR Part 50.

10.4.2.3 <u>Method of Review</u>

The MCES was reviewed in accordance with the SRP. The results of the review are disccussed below.

10.4.2.4 <u>Review Discussion</u>

The MCES is designed to (1) establish a vacuum in the condenser and (2) remove non-condensable gases from the main condenser and discharge them to the atmosphere. For condenser evacuation, a priming steam driven air ejector is utilized to bring the condenser from atmospheric pressure to 15 inches mercury absolute pressure. Then, the primary ejector is isolated and one (or two) main air ejector is brought into service to complete the evacuation down to 1 inch of mercury absolute.

The effluent air from the air ejectors is normally discharged directly to the atmosphere atop the Beaver Valley Unit 1 cooling tower. If radioactivity is

detected in this effluent by the air ejector discharge activity monitor, this effluent air will be redirected to the Beaver Valley Unit 2 air ejector charcoal delay system (discussed further in Section 11.3).

There are three activity monitors associated with this effluent stream; one at the air ejector discharge, one at the discharge point atop the Beaver Valley Unit 1 cooling tower, and one downstream of the air ejector charcoal delay system.

10.4.2.5 Evaluation Findings

The main condenser evacuation system includes equipment and instruments to establish and maintain condenser vacuum and to prevent an uncontrolled release of gaseous radioactive material to the environment. The scope of our review included the system capability to transfer radioactive gases to the gaseous waste processing system or ventilation exhaust systems, and the design provisions incorporated to monitor and control releases of radioactive materials in effluents. The staff has reviewed the applicant's system descriptions, piping and instrumentation

diagrams, and design criteria for the components of the main condenser evacuation system in accordance with the SRP.

The staff concludes that the Beaver Valley Unit 2 design is acceptable in that the applicant has met the requirements of GDCs 60 and 64 with respect to the control and monitoring of releases of radioactive materials to the environment. The applicant has met the criteria for applying appropriate industrial standard on the design of heat exchangers and air ejectors.

10.4.3 Turbine Gland Sealing System

10.4.3.1 Introduction

Section 10.4.3 of the Final Safety Analysis Report contains information pertaining to the turbine gland sealing system, the design bases, and applicable acceptance criteria.

10.4.3.2 Acceptance Criteria

The staff has reviewed the applicant's design, design criteria, and design bases for the turbine gland sealing system for Beaver Valley, Unit No. 2. The

acceptance criteria used as the basis for our evaluation are set forth in section 10.4.3 of the Standard Review Plan (SRP) NUREG-0800. The acceptance criteria are the applicable GDC (Appendix A to 10 CFR Part 50) as referenced in the SRP. Guidelines for implementation of the requirements of the acceptance criteria are provided in the Regulatory Guides identified in Section II. of the SRP. Conformance to the acceptance criteria provides the bases for concluding that the turbine gland sealing system meets the requirements of 10 CFR Part 50.

10.4.3.3 <u>Method of Review</u>

The turbine gland sealing system for Beaver Valley, Unit 2, was reviewed in accordance with SRP 10.4.3. The results of the review are discussed below.

10.4.3.4 <u>Review of Turbine Gland Sealing System</u>

The turbine gland sealing system (TGSS) is designed to provide a continuous supply of "clean" steam to main turbine shaft seals. This sealing steam is used to prevent air leaking into the steam cycle and radioactive steam leaking out of the steam cycle into the Turbine building. Non-condensible gases are

evacuated from the gland seal steam condenser by one of two 100% capacity charcoal filtration units. Each unit draws air through a moisture separator/electric heater for humidity control, then through charcoal and HEPA filters followed by an exhaust fan which discharges out the Auxiliary building ventilation stack.

The TGSS includes the equipment and instruments to provide a source of clean sealing steam to the annulus space where the turbine shafts penetrate their casings. The scope of our review included the source of sealing steam and the provisions incorporated to monitor and control releases of radioactive material in gaseous effluents in accordance with GDC 60 and 64. We have reviewed the applicant's system descriptions and design criteria for the components of the TGSS and found them consistent with Regulatory Guide 1.26.

The basis for acceptance in our review has been conformance of the applicant's designs, design criteria, and design bases for the turbine gland sealing system to the acceptance criteria of SRP 10.4.3.

10.4.3.5 Evaluation Findings

The staff concludes that the turbine gland sealing system design is acceptable in tnat the applicant has met the requirements of GDCs 60 and 64 with respect to the control and monitoring of releases of radioactive materials to the environment.

11.0 RADIOACTIVE WASTE MANAGEMENT

11.1 Introduction

The radioactive waste management systems for Beaver Valley, Unit 2, is designed to provide for the controlled handling and treatment of liquid, gaseous and solid wastes. The liquid radioactive waste system processes wastes from equipment and floor drains, sample wastes, decontamination and laboratory wastes, and chemical wastes. The gaseous radioactive waste system provides holdup capacity to allow decay of short lived noble gases released from the primary coolant gas stripper and vents from tanks and other equipment containing primary coolant. The liquid and gaseous waste systems utilize decay tanks and charcoal adsorbers to obtain "as low as is reasonably achievable" levels in accordance with 10 CFR Part 20 and 10 CFR Part 50.34a. The solid radioactive waste

system has been designed to solidify all wet waste, provide short term interim storage and ship off-site for final burial. At this time, the radioactive waste management review area includes the process and effluent radiological monitoring and sampling systems provided for the detection and measurement of radioactive materials in plant process and effluent streams.

11.1.1 Acceptance Criteria

The staff has reviewed the applicant's design, design criteria, and design bases for the radioactive waste management systems for the Beaver Valley Station, Unit 2. The acceptance criteria used as the basis for our evaluation are set forth in the SRP, NUREG-0800, in Section II of SRPs 11.1, 11.2, 11.3, 11.4, and 11.5. These acceptance criteria include the applicable GDC (Appendix A to 10 CFR Part 50), Section 20.106 of 10 CFR Part 20, Appendix I to 10 CFR Part 50, and ANSI Standard N13.1, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities". Guidelines for implementation of the requirements of the acceptance criteria are provided in the ANSI Standards, Regulatory Guides, and other documents identified in Section II of the SRP. Conformance to

the acceptance criteria provides the bases for concluding that the radioactive waste management systems meet the requirements of 10 CFR Part 20 and 10 CFR Part 50.

11.1.2 Liquid and Gaseous Effluent Source Terms

The estimated expected releases of radioactive materials in liquid and gaseous effluents were calculated by the applicant using the PWR GALE Code described in NUREG-0017. The staff has reviewed these source terms and found them consistent with the guidelines of SRP 11.1. The applicant's source terms were used in our evaluation. These source terms are given in Table 11.1-2 of the FSAR. The principal parameters used in our calculations are given in Table 11.1 of this SER.

11.1.3 Method of Review

The Beaver Valley Nuclear Generating Station, Unit 2, has three radioactive waste management systems; a Liquid Waste Management System that serves Unit 2, but can be cross connected to receive waste from Unit 1; a Gaseous Waste Management System; and a Solid Waste Management System. Additionally, the Beaver Valley

Unit 2 Station has several radiation monitoring subsystems used for radiological monitoring of processes and plant effluents. These systems are reviewed in accordance with the applicable portions of the Standard Review Plan Sections 11.1, 11.2, 11.3, 11.4, and 11.5. The results of these reviews are discussed below.

11.2 Liquid Waste Management System

11.2.1 System Description and Review

The liquid radioactive waste management system consists of process equipment and instrumentation necessary to collect, delay, process, monitor and dispose of radioactive liquid wastes. The liquid wastes from operation of Beaver Valley, Unit No. 2, originates from the containment sump, Auxiliary building sump, laboratory drains, reactor coolant samples, condensate demineralizer rinse water, and other miscellaneous sources. Turbine building liquid drains are monitored and if no activity is detected, released without processing to the environment. Otherwise, the turbine building drains are sent to the liquid waste processing system for delay and processing prior to release.

The liquid waste procesing system consists of two 7,500 gallon waste drain tanks for collection and initial holdup; two 20 gpm evaporators for initial radioactivity removed; followed by two mixed bed ion demineralizers and then two 18,000 gallon test tanks for sampling processed liquid prior to release. If additional storage is required, due to unusual leakage or out of service processing equipment, two 50,000 gallon steam generator blowdown hold tanks are made available to accommodate the additional storage.

The applicant states the expected daily waste flows to be processed is approximately 4,060 gallons per day. This input is consistent with SRP guidelines. At this rate, assuming only one waste drain tank and one steam generator blowdown holdup tank are available (57,500 gallons storage capacity), sufficient storage tank capacity (over 14 days) is provided to accommodate transient flows and unexpected maintenance activities requiring shutdown of the processing equipment. With a process flow of 20 gpm through the evaporator and demineralizer, the expected daily flows can be processed in sufficient time, less than 4 hours.

After the water has been processed by the evaporator, it can be sent directly to the test tanks or through mixed bed demineralizer prior to entering the test tanks. The water in the test tanks is sampled at the primary sample panel to determine its activity level. If additional cleanup is required, the test tank pumps can direct water through the mixed bed cleanup demineralizer at a rate of 100 gpm and return the filtered water to the test tanks. With the water in the test tanks determined to be acceptable for discharge, the test tank pumps discharge the tank contents through a flow control valve to either the Unit 1 or Unit 2 cooling tower blowdown. An activity monitor continuously surveys the discharge prior to release to the blowdown flow. The discharge flow will be terminated if high activity is detected.

The evaporator bottoms gradually buildup high concentrations of radioactive elements, suspended solids, and chemicals. The evaporator bottoms are periodically discharged via redundant evaporator bottoms pumps at 20 gpm through a cooler and into a heat traced evaporator bottom holdup tank (2,200 gallons). The

holdup tank pump then transports the contents to the solid waste processing system for solidification and offsite disposal.

In our evaluation of the liquid radioactive waste management system, we considered: (1) the capability of the system for keeping the levels of radioactivity in effluents "as low as is reasonably achievable" based on expected radwaste inputs over the life of the plant, (2) the capability of the system to maintain releases below the limits in 10 CFR Part 20 and also to limit radiological doses to less than allowed by Appendix I to 10 CFR 50, during periods of fission product leakage at design levels from the fuel, (3) the capability of the system to meet the processing demands of the station during anticipated operational occurrences, (4) the quality group and seismic design classification applied to the equipment and components and structures housing the system, and (5) the design features that are incorporated to control the releases of radioactive materials in accordance with General Design Criterion 60.

The estimated releases of radioactive materials in liquid effluents were calculated by the applicant using the PWR-GALE Code described in NUREG-0017.

The PWR-GALE Code is a computerized mathematical model for calculating the routine releases of radioactive material in effluents from pressurized water reactors (PWR). The code has been in use since 1976 for all PWR licensing reviews. The calculations in the code are based on (1) data generated from operating reactors, (2) field and laboratory tests, (3) standardized coolant activities derived from American Nuclear Society (ANS) 18.1 Working Group recommendations, (4) release and transport mechanisms that result in the appearance of radioactive material in liquid streams, and (5) the Beaver Valley Unit 2 radwaste system design features used to reduce the quantities of radioactive materials ultimately released to the environs. The principal parameters used by the staff in their calculations are given in Table 11.1 of this SER. The liquid source term is given in Table 11.1-2 of the applicant's Final Safety Analysis Report.

11.2.2 Evaluation Findings

The liquid radwaste systems include the equipment necessary to control the releases of radioactive materials in liquid effluents in accordance with GDCs 60 and 61 of Appendix A of 10 CFR Part 50 and 10 CFR Part 50.34a. Capacities of principal components considered in the liquid waste processing system evaluation are listed in Table 11.2-12 of the FSAR. The staff concludes that the design of the liquid waste management system is acceptable and meets the requirements of 10 CFR Part 20, Section 20.106, 10 CFR Part 50, Section 50.34a, GDC's 60 and 61 and 10 CFR Part 50, Appendix I, as referenced in the SRP. This conclusion is based on the following:

1. The applicant has met the requirements of Section II.A of Appendix I of 10 CFR Part 50 with respect to dose limiting objectives by proposing a liquid radwaste treatment system that is capable of maintaining releases of radioactive materials in liquid effluents such that the calculated individual doses for two unit operation in an unrestricted area from all liquid

pathways of exposure are less than 5 millirems/yr to the total body and less than 15 millirems/yr to any organ.

2. The staff has concluded that the applicant has met the requirements of the Commission's September 4, 1975 Annex to Appendix I of 10 CFR Part 50 with respect to meeting the "as low as reasonably achievable" criterion, and is, therefore exempt from the cost-benefit analysis required by Section II.D of Appendix I to 10 CFR Part 50.

3. The applicant has met the requirements of 10 CFR Part 20, Section 20.106 since we have considered the potential consequences resulting from reactor operation and have determined that the concentrations of radioactive materials in liquid effluents in unrestricted areas will be a small fraction of the limits in 10 CFR Part 20, Appendix B, Table II, Column 2.

4. The applicant has met the requirements of GDCs 60 and 61 with respect to controlling releases of radioactive material to the environment since we have considered the capabilities of the proposed liquid radwaste treatment system to meet

the demands of the plant due to anticipated operational occurrences and have concluded that the system capacity and design flexibility are adequate to meet the anticipated needs of the plant. We have reviewed the applicant's quality assurance provisions for the liquid radwaste systems, the quality group classifications used for system components, and the seismic design applied to structures housing these systems. The design of the systems and structures housing these systems meet the criteria as set forth in Regulatory Guide 1.143. We have reviewed the provisions incorporated in the applicant's design to control the release of radioactive materials in liquids due to inadvertent tank overflows and conclude that the measures proposed by the applicant are consistent with the criteria as set forth in Regulatory Guide 1.143.

11.3 Gaseous Waste Management

11.3.1 System Description

The gaseous radioactive waste disposed and plant ventilation systems are designed to collect, store, process, monitor, and discharge potentially

radioactive gases which are generated during normal operation of the plant. The systems consist of equipment and instrumentation necessary to reduce releases of radioactive gases and particulates to the environment. The principal sources of gaseous waste are the effluents from primary coolant gas strippers, vents from tanks and other equipment processing reactor coolant, condenser evacuation system, and ventilation exhausts from the radwaste building, containment, auxiliary building, fuel building, and turbine building.

11.3.1.1 Degassifier Portion of Gaseous Waste Disposal System

A portion of the reactor coolant letdown containing dissolved hydrogen and fission gases is normally directed to a degasifier in the boron recovery system from the letdown line upstream of the VCT of the CVCS. Liquid collected by the nuclear equipment vent and drain system is directed to the other degasifier. Dissolved gases are separated from the liquid in the degasifier at a pressure of approximately 2 psig.

Effluent gases from the degasifier contain primarily hydrogen, water vapor, a small amount of nitrogen, and traces of xenon, krypton, and iodine. These gases are

dehumidified (dew point approximately 52^{o}F) in one of the two sets of coolers (degasifier vent chiller in the BRS and gaseous waste chiller). Condensation effluent from the water trap is returned to the primary drain transfer tank (PDTT) located outside containment, via a liquid seal. The cooled gas stream is passed through and filtered by ambient temperature charcoal bed adsorbers (cubicle temperature maintained at approximately 85^{o}F) and one of two redundant pre-filters. The heat due to radioactive decay is small and does not affect the adsorption of noble gases on the charcoal. The charcoal bed adsorbers are designed to delay xenon isotopes for a minimum of 30 days, and provide a 2 day delay for krypton isotopes for the normal letdown flow rates (60 gpm) when operated in series. In addition, decontamination of iodine to negligible levels is obtained during passage through the charcoal beds. The only radioisotopes present upon leaving the charcoal in the predominantly hydrogen stream is krypton-85.

After leaving the charcoal, one of the two overhead gas compressors compresses the radioactive gas stream in a gas surge tank to a pressure of about 65 psig.

Most of the gas flow is reduced in pressure and returned to the VCT in the CVCS. Periodically, for removal of krypton-85, the surge tank gas is bled to either the Beaver Valley Unit 1 charcoal delay tanks or the Beaver Valley Unit 2 gas waste storage tanks (GWST).

The compressors operate automatically in response to the suction pressure, thus maintaining the degasifier's overhead components at a pressure between established limits.

The degasifier effluent portion of the GWD system is designed to include hermetically-sealed valves and welded pipe. In addition, the gas flow is monitored for oxygen content. At an indication of a high oxygen content, the compressors are shut off. These precautions are used to preclude potentially explosive mixtures of oxygen/hydrogen.

In the event of unusually prolonged meteorological conditions of poor dispersion, or modes of fuel failure which might result in abnormal concentrations of fission products in the reactor coolant, storage space is also provided in Beaver Valley Unit 1 decay

tanks or Beaver Valley Unit 2 GWSTs. The tanks will be allowed to go to a higher holding pressure and will thus be able to accommodate a larger volume of gas. The higher pressure will not exceed the design pressure of the system.

11.3.1.2 Air Ejector Effluent Portion of Gaseous Waste Disposal System

The gaseous effluent stream from the main condenser air ejectors of Beaver Valley Unit Nos. 1 and 2 is directed, as necessary, to the air ejector vent charcoal delay beds which provide sufficient holdup for decay of short-lived radioactive components. Prior to entering these charcoal beds, the gas stream has a dew point of 55°F and the humidity is decreased by allowing the gas stream to heat up before entering the charcoal beds (cubicle maintained at approximately 77°F). Normally, the effluent from the air ejectors is not contaminated and the charcoal adsorber beds are by-passed.

11.3.1.3 Gaseous Waste Storage Tanks

The Unit 2 gaseous waste storage tankage is designed to handle all the gas generated by either Beaver

Valley Unit 1 or Unit 2 when going to a cold shutdown condition from the following sources:

1. Noncondensible gases in the pressurizer steam space, via the degasifier,
2. Hydrogen in the reactor coolant, and
3. Nitrogen used as an inert cover gas in the VCT via the degasifier.

During shutdwn activities, additional provisions are included to allow the unit which is operating to discharge to the Beaver Valley Unit 1 gaseous waste decay tanks while the Unit 2 GWSTs receive input from the above sources.

The system utilizes seven tanks with the ability for individual isolation. Pressure-relieving devices are provided on each tank. The total rated relieving capacity of each pressure-relief device is sufficient to prevent pressurization greater than 100 psi. These pressure-relieving devices discharge to the process vent release point on Beaver Valley Unit 1.

An off-line radiation monitor is provided to detect the contained activity in the tanks.

The discharge path from the Unit 2 GWSTs is routed to the Unit 1 gaseous waste decay tanks discharge path. This path is maintained by a flow control valve and is provided with automatic isolation upon receiving a high radiation signal from the process vent final release radiation monitor.

11.3.1.4 Ventilation Filter Systems

Beaver Valley Unit 2 utilizes a portion of the SLCRS to normally process potentially contaminated exhaust flows from the following items:

- Containment purge exhaust (30,000 and 7,500 cfm)
- Fuel building exhaust (3,000 cfm) normally filtered
- Portions of the auxiliary building where radioiodine gases may be present; these are the charging pump and component cooling pump rooms (13,000 cfm); and radwaste area of the auxiliary building and waste handling building (39,000 cfm) normally filtered
- Main steam value area (4,000 cfm) normally filtered
- Contiguous enclosed areas around the reactor containment (23,000 cfm) normally not filtered but will be filtered if high activity is detected in this flow stream.

The filtration system consists of two parallel trains. Each train consists of a moisture separator and an electric heater to remove water and control humidity followed by two parallel filter assemblies consisting of a HEPA/Charcoal/HEPA filter arrangement.

The SLCRS filtration system is employed during accident conditions, as well as during normal operation. This system for normal operation meets the requirements of Regulatory Guide 1.140. The filtration efficiencies for iodine and particulate removal assigned by the staff during normal operations are 90% and 99%, respectively.

11.3.1.5 Containment Vacuum System Exhaust

The containment vacuum system exhaust has not been adequately addressed in the FSAR as a source of radioactive gaseous release. As presently designed, redundant 45 cfm water seal vacuum pumps take suction on the containment and exhaust (at 100% RH) through the Unit 1 gaseous waste disposal charcoal filter. However, no provisions have been made on this Unit 1 filter to remove water, control relative humidity, provide particulate filter protection of the charcoal,

provide adequate surveillance DOP leakage testing, and methyl iodine laboratory charcoal performance testing. These conditions do not meet the requirements for non-ESF filter systems in Regulatory Guide 1.140. Consequently, no iodine removal credit can be allowed for this system. The applicant should provide an alternate discharge path for this flow sytream (such as upstream of the SLCRS filter units), and ~~provide~~ an analysis to include the dose contributions for this source with all the other sources.

11.3.2 Review Discussion

In our evaluation of the gaseous radwaste management system, we considered the following SRP criteria: (1) the capability of the system for keeping the levels of radioactivity in effluents "as low as is reasonably achievable" based on expected radwaste inputs over the life of the plant, (2) the capability of the system to maintain releases below the limits in 10 CFR Part 20 during periods of fission product leakage at design levels from the fuel, (3) the capability of the system to meet the processing demands of the station during anticipated operational

Insert A

~~[illegible]~~

The staff recognizes that the savings in annual population ~~dose~~ thyroid dose by properly filtering the ~~from contamination from the the~~ containment vacuum pump discharge is ~~a~~ small. ~~[illegible]~~ Nevertheless, this savings justifies ~~filtration~~ iodine filtration. By virtue of the fact →

That the applicant's present design directs the containment vacuum pump exhaust to the ~~Beaver~~ Beaver Valley Unit 1 gaseous waste disposal charcoal filter, the applicant's ~~[illegible]~~ intended to filter this ~~also~~ effluent stream for iodine prior to discharge. ~~This intent should be spelled out~~ Since this stream is to be filtered for iodine, it should be filtered properly by systems consistent with Regulatory Guide 1.140 or 1.52 Therefore, proper modifications should be made to the containment vacuum pump exhaust filter system. ~~If the applicant chooses not to make these recommended changes, then~~ the ~~applicant will be required to submit~~ a ~~cost benefit analysis for not performing~~ the ~~suggested changes in [illegible]~~ in accordance ~~with~~

occurrences, (4) the seismic design classification applied to the equipment and components and structures housing the system, (5) the design features that are incorporated to control the releases of radioactive materials in accordance with GDC 60, and (6) the potential for gaseous releases due to hydrogen explosion in the gaseous radwaste system.

The estimated releases of radioactive materials in gaseous effluents were calculated by the applicant using the PWR-GALE Code described in NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors." The PWR-GALE Code is a computerized mathematical model for calculating the routine releases of radioactive material in effluents from PWRs. The code has been in use since 1976 for all PWR licensing reviews. The calculations in the code are based on (1) data generated from operating reactors, (2) field and laboratory tests, (3) standardized coolant activities derived from American Nuclear Society (ANS) 18.1 Working Group recommendations, (4) release and transport mechanisms that result in the appearance of radioactive material in gaseous streams, and (5) the Beaver

Valley Unit 2 radwaste system design features used to reduce the quantities of radioactive materials ultimately released to the environs. The principal parameters used by the staff in their calculations are given in Table 11.2 of this SER.

We have reviewed the applicant's quality assurance provisions for the gaseous radwaste systems, the quality group classifications used for system components, the seismic design criteria applied to the design of the system, and of structures housing the radwaste systems. The design of the system and structures housing these systems meet the criteria as set forth in Regulatory Guide 1.143 for radwaste processing systems and referenced in the SRP.

We have reviewed the provisions incorporated in the applicant's design to control releases due to hydrogen explosions in the gaseous radwaste system and conclude that the measures proposed by the applicant are adequate to prevent the occurrence of an explosion or to withstand the effects of a hydrogen detonation.

We have reviewed the provisions incorporated in the applicant's design to collect airborne radioactive materials in the normal ventilation exhaust systems during normal plant operation, including anticipated operational occurrences. We find, with the exception noted in 11.3.1.5 pertaining to the containment evacuation system, the design of air filtration and adsorption units consistent with Regulatory Guide 1.140, as referenced in the SRP.

11.3.3 Evaluation Findings

The staff concludes that the design of the gaseous waste management systems, except as noted in 11.3.1.5 (Containment Evacuation Exhaust System) of ~~the Draft~~ SER, are acceptable and meet the requirements of 10 CFR Part 20, Section 20.106; 10 CFR Part 50, Section 50.34a; GDC 3, 60 and 61; and 10 CFR Part 50, Appendix I, Annex (RM-50-2), as referenced in the SRP. These conclusions are based on the following findings regarding all gaseous waste processing and filtration systems except for the containment evacuation exhaust system:

1. The applicant has met the requirements of GDC 60 and 64 with respect to controlling releases of

radioactive material to the environment by assuring that the design of the gaseous waste management system includes the equipment and instruments necessary to detect and to control the release of radioactive materials in gaseous effluents. Capacities of principal components considered in the gaseous waste processing system evaluation are listed in Table 11.2.

2. The applicant has met the requirements of Appendix I, Annex to 10 CFR Part 50 by meeting the "as low as is reasonably achievable" criterion as follows:

   a. Regarding Sections II.B and II.C of Appendix I, we have considered releases of radioactive material (noble gases, radioiodine and particulates) in gaseous effluents for normal operation including anticipated operational occurrences based on expected radwaste inputs over the life of the plant. We have determined that the proposed gaseous waste management system is capable of limiting releases of radioactive materials in gaseous effluents such

such that the calculated individual doses in an unrestricted area from all pathways of exposure are less than 5 mrems to the total body or 15 mrems to the skin and less than 15 mrems to any organ from releases of radioiodine and radioactive material in particulate form.

b. The applicant has met the requirements of the Commission's September 4, 1975, Annex to Appendix I to 10 CFR Part 50 with respect to meeting the "as low as reasonably achievable" criterion, and is therefore ~~exempt from~~ the cost-benefit analysis required by Section II.D of Appendix I to 10 CFR Part 50.

3. The applicant has met the requirements of 10 CFR Part 20 since we have considered the potential consequences resulting from reactor operation with primary coolant activities associated with 1% failed fuel and determined that under these conditions, the concentrations of radioactive materials in gaseous effluents in unrestricted

areas will be a small fraction of the limits specified in 10 CFR Part 20, Appendix B, Table II, column 1.

4. We have considered the capabilities of the proposed gaseous waste management system to meet the demands of the plant due to anticipated operational occurrences and have concluded that the system capacity and design flexibility are adequate to meet these demands.

5. We have reviewed the applicant's quality assurance provisions for the gaseous waste management system, the quality group classifications used for system components, the seismic design applied to the design of the system, and of structures housing the radwaste system. The design of the system and of structures housing the system meet the criteria as set forth in Regulatory Guide 1.143.

6. We have reviewed the provisions incorporated in the applicant's design to control releases due to hydrogen explosions in the gaseous waste management system and concluded that the measures

proposed by the applicant are adequate to prevent the occurrence of an explosion in accordance with GDC 3 of Appendix A to 10 CFR Part 50.

11.4 Solid Waste Processing System

The solid waste processing system is designed to collect, process and package radioactive wastes generated as a result of normal plant operation, including anticipated operational fluctuations and to store this packaged waste until it is shipped off-site to a licensed burial site. Spent demineralizer resins evaporator bottoms, decanted sludges, and spent filter media will be solidified and packaged in 55-gallon drums. Dry solid waste consisting of ventilation air filters, contaminated clothing, rags, and paper will be compacted in the Unit 1 compaction facility. A detailed description of the Beaver Valley Unit 2 solid waste processing system is found in Section 11.4 of the FSAR.

The review of the solid-waste-management system and components was performed under SRP Section 11.4. The review included an evaluation

of the system design, system design objectives (including expected and design volumes of waste), activity and expected radionuclide distribution, equipment design capacities and design parameters, flow diagrams and piping and instrumentation diagrams, and special design features. Also included in the review were expected chemical content, radionuclide concentrations, solidification methods, type and size of waste containers, packaging and storage, and quality group classification.

The applicant estimated that the expected annual solidified wet-waste volumes that will be shipped offsite or stored annually will be approximately 11,200 ft^3 containing 9,400 Ci; dry solidified waste (i.e., spent filters) is estimated to be approximately 2,600 ft^3/yr containing approximately 2,600 Ci; and dry compressible wastes shipped or stored annually will have a volume of 6,500 ft^3 and contain less than 5 Ci.

The applicant has employed components, system designs, and design criteria for the solid-radwaste systems that are consistent with components and systems used

in operating plants which have demonstrated their efficiency, capacity ratings, and availability factors in extensive operational use.

The applicant has not yet submitted a process control program for the purpose of providing assurance that waste solidification will meet the requirements for packaging, handling, shipping, and disposal. Although such a program is not addressed in this report, such a program will be required by the Technical Specifications as specified by BTP ETSB 11-3. Included with this Process Control Program, the applicant is required to address the additional requirements of 10 CFR Part 61.

The applicant will provide adequate storage space for onsite storage of solidified and dry wastes (28 weeks at the expected waste input rates) as specified by BTP ETSB 11-3. The capability of the proposed system to process the types and volumes of waste generated during normal operation, including anticipated operational occurrences, is in accord with GDC 60.

Provisions for handling of the wastes are in accordance with 10 CFR 20 and 70, and 49 CFR 171 to 179 (which are Department of Transportation regulations). The applicant's quality group classification and seismic design have been found to be acceptable. The system meets the requirements of Regulatory Guide 1.143.

The basis for the staff acceptance of the solid waste management systems has been conformance of the system design and design criteria to the regulations and guides referenced above. Based on the foregoing evaluation, the staff concludes that the proposed solid-radwaste system is acceptable.

11.5 Process and Effluent Radiological Monitoring and Sampling Systems

11.5.1 Radiological Monitor Description

The process and effluent radiological monitoring and sampling systems, monitor, record, and control the release of radioactive materials that may be generated during normal operation, anticipated operational variations and postulated accidents. These monitors supply information to operating personnel concerning radioactivity levels in plant process and effluent streams.

Monitors used in liquid streams are either "In line" or "off line" gamma detectors. Monitors in process gas or ventilation air streams are units that extract an isokinetic sample and perform the following functions on the sample; continuously filter for particulates (moving filters) and measure particulate activity as the filter media moves past a detector; collect radioiodine in charcoal fitler cartridges for subsequent laboratory counting; and continuously determine the noble gas activity as the gas sample passes through a gamma detector. Pipe mounted shielded gama detectors are utilized on steam lines. Table 11.3 lists the process and effluent monitors utilized in Beaver Valley Unit 2.

Our review included the locations and types of effluent and process monitoring provided for Beaver Valley, Unit No. 2. Based on the plant design and on continuous monitoring locations and intermittent sampling locations, we concluded that all normal and potential release pathways will be monitored. The applicant's description indicates that the process and effluent monitoring system design meets the guidelines in Regulatory Guide 4.15 for quality assurance.

We also determined that the sampling and monitoring provisions are adequate for detecting radioactive material leakage to normally uncontaminated systems and for monitoring plant processes which could affect radioactivity releases. On these bases, we consider that the monitoring and sampling provisions meet the requirements of General Design Criteria 60, 63, and 64 and the guidelines of Regulatory Guide 1.21, and, therefore, meet the acceptance criteria of the SRP.

11.5.2 Evaluation Findings

The staff concludes that the process and effluent radiological monitoring instrumentation and sampling systems are acceptable and meet the relevant requirements of 10 CFR Part 20, Section 20.106, and GDC 60, 63, and 64, as referenced in the SRP. This conclusion is based on the following: The process and effluent radiological monitoring and sampling systems include the instrumentation for monitoring and sampling radioactivity, contaminated liquid and gaseous process and effluent streams. Our review included the provisions proposed to sample and monitor all station effluents in accordance with GDC 64, the provisions

proposed to provide automatic termination of effluent releases and assure control over discharges in accordance with GDC 60, the provisions proposed for sampling and monitoring plant waste liquid and gaseous process streams for process control in accordance with GDC 63, and the provisions for conducting sampling and analytical programs in accordance with the guidelines in Regulatory Guides 1.21 and 4.15.

The review included piping and instrument diagrams and process flow diagrams for the liquid and gaseous processing systems and also for ventilation systems, and the location of monitoring points relative to effluent release points as shown on the site plot diagrams.

We have determined that the applicant's designs, design criteria, and design bases for the process and effluent radiological monitoring instrumentation and sampling systems provided for normal operation meet the guidelines and industry standards referenced in SRP 11.5.

Open Items

The only open item remaining is for the applicant to specify the ranges for the post accident elevated release effluent monitors used in the Beaver Valley Unit 2 design.

15.7.3 Postulated Radioactive Releases Due to Liquid Tank Failures

15.7.3.1 Introduction

The applicant's analysis of the radioactive liquid waste tank failure accident appears in Section 15.7.3 of the FSAR. An evaluation of this accident was performed and the applicant's analysis was reviewed, in accordance with review specified in NUREG-0800, SRP Section 15.7.3.

15.7.3.2 Acceptance Criteria

The staff has conducted an independent evaluation of the consequences of component failures for radioactive-liquid-waste-components located outside the reactor containment which could result in releases of liquid containing radioactive materials to the environs.

The principal criteria governing acceptance in our review were (1) GDC 60, as it relates to the radioactive waste management systems being designed to control releases of radioactive materials to the environment; and (2) 10 CFR Part 20, as it relates to effluents to unrestricted areas. Tanks and associated components containing radioactive liquids

outside containment are considered acceptable, by the criteria of SRP 15.7.3, if failure does not result in radionuclide concentrations in excess of the limits in 10 CFR Part 20, Appendix B, Table II, Column 2, at the nearest potable water supply in an unrestricted area.

15.7.3.3 Method of Review

Beaver Valley Unit 2 has several radioactive liquid waste processing and storage tanks which are encompassed by the review conducted under SRP 15.7.3. The results of the reviews are discussed below.

15.7.3.4 Review Discussion

The applicant submitted one failure case that is considered limiting. This case is the failure of the refueling water storage tank. This tank is not enclosed and a rupture would release the water onto the ground surface and run into the river. The applicant states the dilution and decay time provided by the ri :r is sufficient to maintain at the nearest potable water supply intake (7.1 miles downstream) radionuclide concentrations below 10 CFR 20 limits.

The staff has ~~is presently~~ performed ~~performing~~ an independent analysis to verify the applicant's conclusions. ~~The result of this analysis will be available by June 1984 for incorporation in to the Final SER.~~

15.7.3.5 Evaluation Findings

(To be completed prior to Final SER).

Table 11.1 Parameters for Liquid Waste Processing Systems

Reactor Power	2766 MWt
Mass of Primary Coolant	420,000 lbs
Primary System Letdown Flow	60 gpm
Letdown Cation Demineralizer Flow	5.5 gpm
Number of Steam Generators	3
Total Steam Flow (million lbs/hr)	11.6
Mass of Steam in Each Steam Generator	6,700 lbs
Mass of Liquid in Each Steam Generator	99,300 lbs
Total Mass of Secondary Coolant	720,000 lbs
Steam Generator Blowdown Treated by Liquid Waste System	13,800 lbs/hr
Condensate Demineralizer Flow Fraction	1.0
Radwaste Dilution Flow	7,800 gpm
Shim Bleed Rate	1440 gal/day
Decontamination factors (I, Cs, Other)	10^2, 10^4, 10^4
Boron recovery holding tank collection time	27 days
Process time	3.6 days
Discharge fraction	0.1
Equipment Drains	75 gal/day
Fraction of primary coolant activity	1.0
Decontamination factors (I, Cs, Others)	10^3, 10^4, 10^4
Collection time	1.5 days
Process time	0.2 days
Discharge fraction	1.0
Dirty Waste	3985 gal/day
Fraction of primary coolant activity	0.007
Decontamination factors (I, Cs, Others)	10^3, 10^4, 10^4
Collection time	1.5 days
Process time	0.2 days
Fraction released	1.0
Steam Generator Blowdown Fraction Processed	1.0
Decontamination factors (I, Cs, Others)	10^3, 10^4, 10^4
Collection time	1.0 day
Process time	0.6 day
Release fraction	1.0

Table 11.2 Parameters for Evaluating Gaseous Waste System

- Continuous gas stripping of letdown flow: ~60 gpm
- Noble gas holdup time
  Krypton: 2.6 days
  Xenon: 4.6 days
- Ventilation exhaust through charcoal (90% iodine removal) and HEPA (99% particulate removal) filters for auxiliary building
- Containment volume: 1.8 million ft^3
- Containment atmosphere cleanup rate: 6,700 cfm
- Two containment volume purges per year
- Continuous 45 cfm containment low volume purge without iodine removal
- Total mass of charcoal delay beds: 4,000 lbs
- Dynamic adsorbtion coefficient (cm^3/gm)
  Krypton: 18.5
  Xenon: 330
- Charcoal delay bed flow rate: 0.31 cfm

Table 11.3

DETECTOR TECHNICAL REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor Designation	Detector Description	Maximum Background* (mRem/hr)	Reference Isotope	Minimum** Sensitivity (µCi/cc)	Detectable Range (µCi/cc)
Effluent					
Elevated release high range	Gas	2.5	Xe-133	1x10[illegible]	Later
Main steam discharge high range	Gas (Steam)	2.5	Cs-137	1x10[illegible]	Later
Ventilation vent	Particulate	2.5	I-131	1x10[illegible]	10[illegible] to 10[illegible]
	Gas 1		Xe-133	1x10[illegible]	10[illegible] to 10[illegible]
	Gas 2***		Kr-85	7x10[illegible]	7x10[illegible] to 10[illegible]
Elevated release	Particulate	2.5	I-131	1x10[illegible]	Later
	Gas 1		Xe-133	1x10[illegible]	
	Gas 2**		Kr-85	7x10[illegible]	
Liquid waste process effluent	Liquid	2.5	Cs-137	1x10[illegible]	
Waste gas storage vault	Gas	2.5	Xe-133	1x10[illegible]	10[illegible] to 10[illegible]
Condensate polishing vent stack	Particulate	2.5	I-131	1x10[illegible]	10[illegible] to 10[illegible]
	Gas		Xe-133	1x10[illegible]	10[illegible] to 10[illegible]
Turbine building drain	Liquid	1.0	Cs-137	1x10[illegible]	10[illegible] to 10[illegible]
Process					
Hydrogen purge vent high range	Gas	15	Xe-133	1x10[illegible]	10[illegible] to 10[illegible]
Recirculation spray heat exchanger service water	Liquid	5.0	Cs-137	1x10[illegible]	Later
Containment purge	Gas	2.5	Xe-133	1x10[illegible]	10[illegible] to 10[illegible]

Table 11.3

DETECTOR TECHNICAL REQUIREMENTS FOR PROCESS AND EFFLUENT RADIATION MONITORS

Monitor Designation	Detector Description	Maximum Background* (mRem/hr)	Reference Isotope	Minimum** Sensitivity (μCi/cc)	Detectable Range (μCi/cc)
Air ejector discharge	Gas	0.75	Xe-133	$1\times10^{-\text{[illegible]}}$	Later
Air ejector delay bed discharge	Gas	2.5	Xe-133	$1\times10^{-\text{[illegible]}}$	Later
Aerated vent transfer line	Gas	2.5	Xe-133	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Component cooling/ service water	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Component cooling heat exchanger service water	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Steam generator blowdown sample	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Reactor coolant letdown high range	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{\text{[illegible]}}$
Reactor coolant letdown low range	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{\text{[illegible]}}$
Gaseous waste surge tank transfer line	Gas	2.5	Kr-85	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{\text{[illegible]}}$
Component cooling	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Auxiliary steam condensate	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Evaporator reboiler condensate	Liquid	2.5	Cs-137	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$
Waste gas storage tanks	Gas	2.5	Xe-133	$1\times10^{-\text{[illegible]}}$	$10^{-\text{[illegible]}}$ to $10^{-\text{[illegible]}}$

*Background from gammas of 1 Mev energy

**Detector sensitivity will refer to the guidance described in ANSI 13.10.

***The ventilation vent and elevated release monitors include two gas detectors - one of which is gamma sensitive and the other beta sensitive for maximum Kr-85 sensitivity.