NUREG-75/087

U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 6.4 HABITABILITY SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Accident Analysis Branch (AAB)

Secondary - Site Analysis Branch (SAB)
Auxiliary and Power Conversion Systems Branch (APCSB)
Effluent Treatment Systems Branch (ETSB)
Radiological Assessment Branch (RAB)

I. AREAS OF REVIEW

The control room ventilation system and control building layout and structures as described in the applicant's safety analysis report (SAR), are reviewed with the objective of assuring that plant operators are adequately protected against the effects of accidental releases of toxic or radioactive gases. A further objective is to assure that the control room can be maintained as the center from which emergency teams can safely operate in the case of a design basis radiological release. To assure that these objectives are accomplished the following items are reviewed:

1. The zone serviced by the control room emergency ventilation system is examined to ascertain that all critical areas requiring access in the event of an accident are included within the zone (control room, kitchen, sanitary facilities, etc.) and to assure that those areas not requiring access are generally excluded from the zone.

2. The capacity of the control room in terms of the number of people it can accommodate for an extended period of time is reviewed to confirm the adequacy of emergency food and medical supplies and self-contained breathing apparatus and to determine the length of time the control room can be isolated before $CO_2$ levels become excessive.

3. The control room ventilation system layout and functional design is reviewed and flow rates and filter efficiencies are determined for input into the AAB analyses of the buildup of radioactive or toxic gases inside the control room, assuming a design basis release. Basic deficiencies that might impair the effectiveness of the system are examined. In addition, the system operation and procedures are reviewed. The APCSB has primary responsibility in the system review area under Standard Review Plan (SRP) 9.4.1. The APCSB is consulted when reviewing hardware and operating procedures.



11/24/75

4. The flow rates and iodine removal efficiencies used in the [redacted] analysis are obtained from the ETSB (see SRP 6-5.1)

5. The physical location of the control room with respect to potential release points of hazardous airborne materials (SAR chapter 2 and other pertinent chapters) is reviewed to determine the location and source strength of radioactive, toxic, or noxious materials. The layout of the control building is reviewed to assure that airborne materials will not enter the control room from corridors or ventilation ducts, etc. Estimates of dispersion of airborne contamination are made.

6. Radiation shielding provided by structural concrete is analyzed to determine the effectiveness of shielding and structure surrounding the control room. The control building layouts are checked to see if radiation streaming through doors (or other apertures) or from equipment might be a problem.

7. Independent analyses are performed to determine whether dose values or toxic gas concentrations remain below recommended levels. The SAB checks and concurs with the meteorological analysis used to obtain the X/Q values for the control room location.

II. ACCEPTANCE CRITERIA

1. Control Room Emergency Zone
   See Section III.1 of this plan.

2. Control Room Personnel Capacity
   Food, water, and medical supplies should be sufficient to maintain the emergency team (at least 5 men) for 5 days. Also see Section III.2 of this plan.

3. Ventilation System Criteria (See III.3 of this plan)
   Self-contained breathing apparatus for the emergency team (at least 5 men) should be on hand. A six-hour onsite bottled air supply should be available with unlimited offsite replenishment capability from nearby location(s). Refer to References 3 thru 6, and see Section III.3 of this plan.

4. Emergency Standby Filters
   [redacted]
   See SRP 6-5.1 for acceptance criteria for control room ESF systems.

5. Relative Location of Source and Control Room
   In general, the control room inlets must be so placed in relation to the location of potential release points as to minimize control room contamination in the event of a release. Specific criteria as to radiation and toxic gas sources are as follows:

   a. Radiation Sources
      As a general rule the control room ventilation inlet should be separated from the major potential release points by at least 100 ft laterally and by 50 ft vertically. However, the actual minimum distances must be based on the dose analyses. Refer to Section III of this plan and Reference 7 for further information.

b. Toxic gases

The minimum separation distance is dependent upon the gas in question, the container size, and the available control room protection provisions. Refer to Regulatory Guide 1.78 (Ref. 3) for general guidance and to Regulatory Guide 1.95 (Ref. 4) for specific acceptable design provisions related to chlorine.

6. Radiation Shielding

See discussion of General Design Criterion 19 below.

7. Radioactive and Toxic Gas Hazards

a. Radiation Hazards

The dose guidelines (see General Design Criterion 19, Appendix A of 10 CFR Part 50) used in approving emergency zone radiation protection provisions are as follows:

(1) Whole body gamma: 5 rem

(2) Thyroid: 30 rem

(3) Beta skin dose: 30 rem*

The whole body gamma dose consists of contributions from airborne radioactivity inside and outside the control room, as well as direct shine from fission products inside the reactor containment building.

b. Toxic Gases

For acceptance purposes, three exposure categories are defined: protective action exposure (2 minutes or less), short-term exposure (between 2 minutes and 1 hour), and long-term exposure (1 hour or greater). Because the physiological effects can vary widely from one toxic gas to another, the following general restrictions should be used as guidance: there should be no chronic effects from exposure, and acute effects, if any, should be reversible within a short period of time (several minutes) without benefit of medication other than the use of self-contained breathing apparatus.

*Credit for the beta radiation shielding afforded by special protective clothing and eye protection is allowed if the applicant commits to their use during severe radiation releases. However, even though protective clothing is used, the calculated unprotected skin dose is not to exceed 75 rem. The skin and thyroid dose levels are to be used only for judging the acceptability of the design provisions for protecting control room operators under postulated design basis accident conditions. They are not to be interpreted as acceptable emergency doses. The dose levels quoted here are derived for use in the controlled plant environment and should not be confused with the conservative dose computation assumptions used in evaluating exposures to the general public for the purposes of comparison with the guideline values of 10 CFR Part 100.

The allowable limits should be established on the basis that the operators should be capable of carrying out their duties with a minimum of interference caused by the gas and subsequent protective measures. The limits for the three categories normally are set as follows:

(1) Long-term limit (1 hour or greater): use a limit assigned for occupational exposure (40-hour week).

(2) Short-term limit (2 min. to 1 hour): use a limit that will assure that the operator will not suffer incapacitating effects after a one-hour exposure.

(3) Protective action limit (2 min. or less): use a limit that will assure that the operator will quickly recover after breathing apparatus is in place. In determining this limit, it should be assumed that the concentration increases linearly with time from zero to two minutes and that the limit is attained at two minutes.

The protective action limit is used to determine the acceptability of emergency zone protection provisions during the time personnel are in the process of fitting themselves with self-contained breathing apparatus. The other limits are used to determine whether the concentrations with breathing apparatus in place are applicable. (They are also used in those cases where the toxic levels are such that emergency zone isolation without use of protective gear is sufficient.) As an example of appropriate limits, the following are the three levels for chlorine gas:

| | |
|---|---|
| Long-term: | 1 ppm by volume |
| Short-term: | 4 |
| Protective action: | 15 |

(See Reference 3 for protective action levels for other toxic gases)

III. REVIEW PROCEDURES

The reviewer selects and emphasizes aspects of the areas covered by this review plan as may be appropriate for a particular case. The judgment on areas to be given attention and emphasis in the review is based on an inspection of the material presented to see whether it is similar to that recently reviewed for other plants and whether items of special safety significance are involved.

1. Control Room Emergency Zone

The reviewer checks to see that the zone includes the following:

a. Instrumentation and controls necessary for a safe shutdown of the plant, i.e., the control room, including the critical document reference file.

b. The computer room, if it is used as an integral part of the emergency response plan.

c. The shift supervisor's office.

d. The operators' wash room and the kitchen.

The emergency zone should be limited to those spaces requiring operator occupancy. Spaces such as battery rooms, cable-spreading rooms, or any other spaces not requiring continuous or frequent occupancy after a design basis accident (DBA) generally should be excluded from the emergency zone. Inclusion of these spaces may increase the probability of smoke or hazardous gases entering the emergency zone. They may also increase the possibility of infiltration into the emergency zone, thus decreasing the effectiveness of the ventilation system in excluding contamination. It is advantageous to have the emergency zone located on one floor, with the areas included in the zone being contiguous.

2. Control Room Personnel Capacity

The reviewer checks to see that emergency food and water are provided. Normally a five-day supply for five men would be sufficient for land-based plants. A medical kit is also helpful. Specific requirements for these items have not been formulated. The air inside a 100,000 cubic-foot control room would support five persons for at least six days. Thus, $CO_2$ buildup in an isolated emergency zone is not normally considered a limiting problem.

3. Ventilation System Layout and Functional Design

This area is a major portion of the review. The procedures are as follows:

a. The type of system proposed is determined. The following types of protection provisions are currently being employed for boiling water reactor (BWR) or pressurized water reactor (PWR) plants:

(1) Zone isolation, with the incoming air filtered and a positive pressure maintained by the ventilation system fans. This arrangement is often provided for BWR's having high stacks. Air flow rates are between 400 and 4000 cfm.

(2) Zone isolation, with filtered recirculated air. This arrangement is often provided for BWR's and PWR's with roof vents. Recirculation rates range from 2,000 to 30,000 cfm.

(3) Zone isolation, with filtered recirculated air, and with a positive pressure maintained in the zone. This arrangement is essentially the same as that in (2), with the addition of the positive pressure provision.

(4) Dual air inlets for the emergency zone. In this arrangement, two widely spaced inlets are located outboard (on opposite sides) of potential toxic and radioactive gas sources. The arrangement guarantees at least one inlet being free of contamination (except under extreme no-wind conditions). It can be used in all types of plants. Makeup air supplied from the contamination-free inlet provides a positive pressure in the emergency zone and thus minimizes infiltration.

(5) Bottled air supply for a limited time. In this arrangement, a flow rate of 400 to 600 cfm is provided from compressed air containers for about one hour, to prevent inleakage. It is used in systems having containments whose internal atmospheric pressure becomes negative within an hour after a DBA (subatmospheric containments).

b. The input parameters to the radiological dose model are determined (see Item 5). The parameters are emergency zone volume, filter efficiency, filtered makeup air flow rate, unfiltered inleakage (infiltration), and filtered recirculated air flow rate.

c. The ventilation system components and the system layout diagrams are examined. The responsible reviewer in the APCSB should be consulted if there are questions pertaining to the system design. He will determine if the system meets the single failure criterion as well as other safety requirements (see SRP 9.4.1). Damper failure and fan failure are especially important. The review should confirm that the failure of isolation dampers on the upstream side of fans will not result in too much unfiltered air entering the control room. The AAB dose analysis results are used to determine how much unfiltered air can be tolerated.

d. The following information may be used in evaluating the specific system types (see Reference 7 for further discussion):

(1) Zone isolation, with filtered incoming air and positive pressure. These systems may not be sufficiently effective in protecting against iodine. The staff allows an iodine protection factor (IPF), which is defined as the time-integrated concentration of iodine outside over the time-integrated concentration within the emergency zone of 20 to 100 for filters built, maintained, and operated according to Regulatory Guide 1.52 (an IPF of 100 requires deep bed filters). Such systems are likely to provide a sufficient reduction in iodine concentration only if the source is at some distance from the inlets. Thus, in most cases only plants with high stacks ($\sim$ 100 m) would meet Criterion 19 with this system. Normally the staff suggests that these systems be modified to allow isolation and operation with recirculated air since only minor ducting changes are necessary.

(2) Zone isolation, with filtered recirculated air. These systems have a greater potential for controlling iodine than those having once-through filters. IPF's ranging from 20 to over 150 can be achieved. These are the usual designs for plants having vents located at containment roof level. A system having a recirculation rate of 5000 cfm and a filter efficiency of 95% would be rated as follows:

| Infiltration (cfm) | IPF* |
|---|---|
| 200 | 25 |
| 100 | 49 |
| 50 | 96 |
| 25 | 191 |

*Within the range of interest, the iodine protection factor is directly proportional to recirculation flow rate times efficiency.

Infiltration should be determined conservatively. The calculated or measured gross leakage is used to determine the infiltration rate that will be applied in the evaluation of the radiological consequences of postulated accidents. This rate is determined as follows:

(i) The leakage from the control room when pressurized to 1/8-inch water gauge is calculated on the basis of the gross leakage data. One-half of this value is used to represent the base infiltration rate. Component leak rates may be used to calculate gross leakage (see, for example, References 8 and 9).

(ii) The base infiltration rate is augmented by adding to it the estimated contribution of opening and closing of doors associated with such activities as the required emergency procedures external to the control room. Normally 10 cfm is used for this additional contribution.

(iii) An additional factor that is used to modify the base infiltration rate is the enhancement of the infiltration occurring at the dampers or valves upstream of recirculation fans. When closed, these dampers typically are exposed to a several-inch water gauge pressure differential. This is accounted for by an additional infiltration contribution over the base infiltration at 1/8-inch water gauge.

The use of an infiltration rate that is based on calculation is acceptable except in the case where the applicant has assumed exceptionally low rates of infiltration. In these cases, more substantial verification or proof may be required. For instance, if an applicant submits an analysis that shows a gross leakage rate of less than 0.06 volume changes per hour the reviewer would require that the gross leakage be verified by periodic tests as described in Regulatory Position C.5 of Regulatory Guide 1.95.

(3) Zone isolation, with filtered recirculated air, and with a positive pressure. This system is essentially the same as the preceding one. However, an additional operational mode is possible. Makeup air for pressurization is admitted. It is filtered before entering the emergency zone. Pressurization reduces the unfiltered inleakage that is assumed to occur when the emergency zone is not pressurized. Assuming a filter fan capacity of 5000 cfm and a filter efficiency of 95%, the following protection factors result (flows in cfm):

| Makeup Air | Recirculated Air | IPF (Assuming No Infiltration) | IPF (Assuming Infiltration*) |
|---|---|---|---|
| 400 | 4600 | 238 | 159 |
| 750 | 4250 | 128 | 101 |
| 1000 | 4000 | 96 | 80 |

*Normally 10 cfm infiltration is assumed for conservatism. This flow could be reduced or eliminated if the applicant provides assurance that backflow (primarily as a result of ingress and egress) will not occur. This may mean installing two-door vestibules or equivalent.

The makeup flow rate should have adequate margin to assure that the control room will be maintained at a pressure of at least 1/8-inch water gauge. The applicant should indicate that an acceptance test will be performed to verify adequate pressurization. If the makeup rate is less than 0.5 volume changes per hour, supporting calculations are required to verify adequate air flow. If the makeup rate is less than 0.25 volume changes per hour, periodic verification testing is required in addition to the calculations and the acceptance test.

A question that often arises is whether "pressurization" or "isolation and recirculation" of the control room is to be preferred. Which design gives the lowest doses depends on the assumptions as to unfiltered inleakage. Isolation is generally preferred in that it will limit the entrance of noble gases (not filterable) and, in addition, it is a better approach when the accident involves a short term "puff release." If infiltration is 25 cfm or less, "isolation" would be best in any event.

A second question related to the first involves the method of operation. The following possibilities have been considered:

(i) Automatic isolation with subsequent manual control of pressurization.

(ii) Automatic isolation with immediate automatic pressurization.

The first is advantageous in the case of external puff releases. Simple isolation would minimize the buildup of the unfilterable noble gases. It would also protect the filters from excessive concentrations in the case of a chlorine release. However, the second method does guarantee that infiltration (unfiltered) is reduced to near zero immediately upon accident detection. This would be beneficial in the case where the contamination transport path to the emergency zone is mainly inside the building. Method (i) should be used in the case of a toxic gas release and either method (i) or (ii) should be used in the case of a radiological release, provided Criterion 19 guidelines can be satisfied. (A substantial time delay should be assumed where manual isolation is assumed, e.g., 20 minutes for the purposes of dose calculations.)

(4) Dual air inlets for the emergency zone. Several plants have utilized this concept. The viability of the dual inlet concept depends upon whether or not the placement of the inlets assures that one inlet will always be free from contamination. The assurance of a contamination-free inlet depends in part upon building wake effects, terrain, and the possibility of wind stagnation or reversal. For example, in a situation where the inlets are located at the extreme edges of the plant structures (e.g., one on the north side and one on the south side), it is possible under certain low probability conditions for both inlets to be contaminated from the same point source. Reference 7 presents the interim position for dealing with the evaluation of X/Q's for dual inlet systems. These X/Q's are used only if the system incorporates automatic selection of the best inlet. If manual selection is used, the X/Q's are increased assuming that the worst inlet is operating as follows:

| Time after accident | Hours of improper operation |
|---|---|
| 0 - 8 hr | 2.4 hr out of 8 hr |
| 8 - 24 hr | 3.2 hr out of 16 hr |
| 1 - 4 days | 2.4 hr each day |
| 4 - 30 days | 1.2 hr each day |

Because damage to the ducting might seriously affect the system capability to protect the operators, the ducting should be seismic Category I and should be protected against tornado missiles. In addition, the number and placement of dampers must be such as to assure both flow and isolation in each inlet assuming one single active component failure. The location of the intakes with respect to the plant security fence should also be reviewed.

(5) Bottled air supply for a limited time. In some plant designs the containment pressure is reduced below atmospheric within one hour after a DBA. This generally assures that after one hour significant radioactive material will not be released from the containment. Such a design makes it feasible to maintain the control room above atmospheric pressure by use of bottled air.

Periodic pressurization tests are required to determine that the rated flow (normally about 300 to 600 cfm) is sufficient to pressurize the control room to at least 1/8-inch water gauge. The system is also required to be composed of several separate circuits (one of which is assumed to be inoperative to account for a possible single failure). At least one (non-redundant) once-through filter system for pressurization as a stand-by for accidents of long duration is also desirable.

Compressed air bottles should be protected from tornado missiles or internally generated missiles and should be placed so as not to cause damage to vital equipment or interference with operation if they fail.

4. Emergency Standby Filters

[redacted] Refer to SRP 6.5.1

5. Relative Location of Source and Control Room

This review area involves identification of all potential sources of toxic, radioactive, or otherwise potentially hazardous gases and analysis of their transport to the control room. There are three basic categories: DBA radioactive sources, toxic gases such as chlorine, and gases with the potential for being released inside confined areas adjacent to the control room.

a. DBA Radioactive Sources

The LOCA source terms determined in Appendix A to SRP 15.6.5 review are referred to and routinely used to evaluate radiation levels external to the control room. The dispersal from the containment or the standby gas-treatment vent is determined with a building wake diffusion model. This model is discussed in Reference 7. Other DBA's are reviewed to determine whether they might constitute a more severe hazard than the LOCA. If this is suspected, then an additional analysis is performed for the suspect DBA's. The SAB reviews the AAB meteorological analysis and compares it with site meteorological data as it becomes available.

b. Toxic Gases

The applicant is asked to identify those toxic substances stored (or transported) on or in the vicinity of the site which may pose a threat to the reactor operators by producing toxic gases upon accidental release. The method used to determine whether the quantity or location of the toxic material is such as to require closer study is described in Regulatory Guide 1.78 (Ref. 3). This guide also discusses the methods for analyzing the degree of risk and states, in general terms, the various protective measures that could be instituted if the hazard is found to be too great. In the case of chlorine, specific acceptable protective provisions have been determined; these are described in detail in Reference 4.

In summary, the following provisions or their equivalent are required (pertaining to the emergency zone ventilation system):

(1) Quick acting toxic gas detectors.

(2) Automatic emergency zone isolation.

(3) Emergency zone leak tightness.

(4) Limited fresh air makeup rates.

(5) Breathing apparatus and associated bottled air supply.

(Note that the best solution for a particular case will depend on the toxic gas in question and on the specific ventilation system design.)

c. Confined Area Releases

The reviewer studies the control building layout in relation to potential sources inside the control building or adjacent connected buildings. The following concerns are checked:

(1) Storage locations of $CO_2$ or other firefighting materials should be such as to eliminate the possibility of significant quantities of the gases entering the emergency zone. (The APCSB has the primary responsibility in this area.)

(2) The ventilation zones adjacent to the emergency zone should be configured and balanced to preclude air flow toward the emergency zone.

(3) All pressurized equipment and piping (e.g., main steam lines and turbines) that could cause significant pressure gradients when failed inside buildings should be isolated from the emergency zone by multiple barriers such as multiple door vestibules or their equivalent.

6. Radiation Shielding

Control room operators as well as other plant personnel are protected from radiation sources associated with a normally operating plant by various combinations of shielding and distance. The adequacy of this type of protection for normal operating conditions is reviewed and evaluated by the RAB. To a large extent the same radiation shielding (and missile barriers) also provides protection from design basis accident radiation sources. This is especially true with respect to the control room walls which usually consist of at least 18 inches of concrete. In most cases, the radiation coming from external design basis accident radiation sources is attenuated to negligible levels. However, the following items should be considered qualitatively in assessing the adequacy of control room radiation shielding:

a. Control room structure boundary. Wall, ceiling, and floor materials and thickness should be reviewed. Eighteen inches to two feet of concrete or its equivalent will be adequate in most cases.

b. Radiation streaming. The control room structure boundary should be reviewed with respect to penetrations (e.g., doors, ducts, stairways, etc.). The potential for radiation streaming from accident sources should be identified, and if deemed necessary, quantitatively evaluated. Support from the RAB may be required for some radiation streaming dose calculations.

c. Radiation shielding from internal sources. If sources internal to the control room complex are identified, radiation shielding against them should be reviewed. Typical sources in this category include contaminated filter trains, or airborne radioactivity in enclosures adjacent to the control room.

Evaluations of radiation shielding effectiveness with respect to the above items should be performed using simplified analytical models for point, line, or volume sources such as those presented in References 10 and 11. If more extended analysis is required, analytical support from the RAB should be requested. The applicant's coverage of the above items should also be reviewed in terms of completeness, method of analysis, and assumptions.

7. Independent Analyses

a. Control Room Doses

Notwithstanding the fact that the applicant is required to calculate dose to control room operators, independent analyses are made by the AAB. Using the approach indicated in Reference 7, the source terms and doses due to a DBA are calculated. The source terms determined by the AAB's independent analysis of LPZ doses for a LOCA are used. The methods and assumptions for this calculation are presented in Appendix A to SRP 15.6.5. The control room doses are determined by estimating the X/Q from the source points to the emergency zone (see above), by determining the credit for the emergency zone's protection features, and by calculating the dose. Figure 6.4-1 shows a form which may be used to summarize the information that is needed for the control room dose calculation. The effective X/Q's are used for calculating the doses. The dose is then compared with the guidelines of General Design Criterion 19. If the guidelines are exceeded, the applicant is asked to improve the system. In the event that other DBA's are expected to result in doses comparable to or higher than the LOCA, additional analyses are performed. The limiting accidents are compared with Criterion 19.

b. Other Analyses

Special case analyses are performed when questions are raised about certain potential sources of toxic or radioactive gases. The methods used in these analyses

conform to current DBA methods concerning dispersion and dose calculations. Regulatory Guide 1.78 should be consulted by the site analyst to see if nearby facilities could present a potential hazard that requires detailed analysis.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that the review and calculations support conclusions of the following type, to be included in the staff's safety evaluation report:

a. If the plant meets Criterion 19, the following statement or its equivalent is made:

"The applicant proposes to meet General Design Criterion 19 of Appendix A to 10 CFR Part 50 by use of concrete shielding and by installing redundant _____ cfm recirculating charcoal filters in the control room ventilation system. These filters will be automatically activated upon an accident signal, high radiation signal, or high chlorine signal. Independent calculations of the potential radiation doses to control room personnel following a LOCA show the resultant doses to be within the guidelines of Criterion 19."

b. If the design is not adequate, the fact is stated. Alternatives such as an increase in the charcoal filter flow rate may be indicated as is given in the example below:

"The staff has calculated the potential radiation doses to control room personnel following a LOCA. The resultant whole body doses are within the guidelines of Criterion 19. The thyroid dose resulting from exposure to radioactive iodine exceeds the dose guidelines. The applicant will be required to commit to increasing the filtration system size from 2000 cfm to 4000 cfm. This increased filtration will be sufficient to keep the estimated thyroid doses within the guidelines."

c. If special protection provisions for toxic gases are not required, the following statement or its equivalent is made:

"The habitability of the control room was evaluated using the procedures described in Regulatory Guide 1.78. As indicated in Section 2.2, no offsite storage or transport of chemicals is close enough to the plant to be considered a hazard. There are no onsite chemicals that can be considered hazardous under Regulatory Guide 1.78. A sodium hypochlorite biocide system will be used, thus eliminating an onsite chlorine hazard. Therefore special provisions for protection against toxic gases will not be required. Self-contained breathing apparatus is provided for the emergency crew to provide assurance of control room habitability in the event of occurrences such as smoke hazards."

d. If special protection provisions are required, compliance or non-compliance with the guidelines of Regulatory Guides 1.78 and 1.95 should be stated.

V. REFERENCES


1. 10 CFR Part 50, Appendix A, General Design Criterion 19, "Control Room."

2. Regulatory Guide 1.53, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

3. Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release."

4. Draft Regulatory Guide 1.95, "Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release."

5. Draft Regulatory Guide 8.X, "Acceptable Programs for Respiratory Protection."

6. "Manual of Respiratory Protection Against Airborne Radioactive Material," WASH-1287, U.S. Atomic Energy Commission (1974).

7. K.G. Murphy and K.M. Campe, "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Design Criterion 19," 13th AEC Air Cleaning Conference, August 1974.

8. "Leakage Characteristics of Openings for Reactor Housing Components," NAA-SR-MEMO-5137, Atomics International, Div. of North American Aviation, Inc., June 20, 1960.

9. R.L. Koontz, et al., "Leakage Characteristics of Conventional Building Components for Reactor Housing Construction," Trans. Am. Nucl. Soc., November 1961.

10. R.G. Jaeger, et al., eds., "Engineering Compendium on Radiation Shielding," Vol. 1, "Shielding Fundamentals and Methods," Springer-Verlag (1968).

11. N.M. Schaeffer, "Reactor Shielding for Nuclear Engineers," TID-75951, U.S. Atomic Energy Commission.

FIGURE 6.4-1 Summary Sheet for Control Room Dose Analysis

MEMORANDUM TO: (Site Analyst)
(Meteorologist)

cc: E. Markee
B. Grimes (Habitability File)

CONCERNING CONTROL ROOM DOSE ANALYSIS FOR

The following summarizes the X/Q's used in determining the control room operator dose for the subject plant:

VENTILATION SYSTEM DESCRIPTION

SKETCH OF SYSTEM (and inlets/sources if applicable)

SUMMATION OF X/Q ANALYSIS

Source/Receptor Type and Distance

S/D Ratio K Factor

Number of 22 1/2° Wind Direction Sectors that Result in Exposure

Central Wind Sector (sector wind is blowing from)

5% Wind Speed (m/sec) 40% Wind Speed (m/sec)

Projected Area of Wake($m^2$) 5% X/Q ($sec/m^3$)

| Time | Wind Speed Factor | Wind Direction Factor | Occupancy Factor | Effective X/Q's |
|---|---|---|---|---|
| 0-8 hr | 1 | 1 | 1 | |
| 8-24 hr | | | 1 | |
| 1-4 day | | | 0.6 | |
| 4-30 day | | | 0.4 | |

ACTION REQUESTED

Site Analyst

- For your information only
- Please use the effective X/Q's in TACT run and provide control room doses. In addition, please summarize safety system assumptions and indicate their status (interim or final).

Meteorologist

- These are interim X/Q's. Please review to determine their reasonableness.
- These are final X/Q's. Please determine if they are accurate based on your analysis of site data.

Please Contact_____

SRP 6.5.1