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RELATED CORRESPONDENCE

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OFFICE OF SECRETARY DOCKETING & SERVICE BRANCH

September 19, 1985
ST-HL-AE-1364
File No. G9.17

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Minutes from September 9 & 10, 1985
Meeting Between NRC Power Systems
Branch (PSB), Bechtel and HL&P in
Bethesda to Resolve Open Items

Dear Mr. Knighton:

On September 9 & 10, 1985, a meeting was conducted in your offices between the Power Systems Branch (PSB) - Mechanical Section of the NRC, Houston Lighting & Power Company (HL&P) and Bechtel. This meeting was requested by both HL&P and the NRC to resolve open items and discuss responses to Requests for Additional Information (RAI's) previously submitted to your staff by HL&P.

Attachment 1 to this letter provides a list of the open items from the PSB-Mechanical Section. Attachment 2 provides responses to these open items and RAI's which were discussed during the meeting. Also included in Attachment 2 are the marked-up FSAR pages and/or question responses which reflect the discussions during the meeting.

It is our understanding that all but three of our responses to your questions/open items (which are detailed in Attachment 1) were satisfactory with appropriate revisions incorporated as discussed during the meeting and as identified in Attachment 2. For the three items that were not resolved during the meeting (items 41, 42, and 43 from Attachment 1), information to support closure/resolution of these items is also included in Attachments 2 and 5. In addition, note that item 14 has been changed to "confirmatory" and that as stated in the revised response to NRC Question 430.25N (see attachment #2), HL&P will provide the NRC with written confirmation from the vendor.

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Houston Lighting & Power Company

Attachment 3 provides a copy of the P&ID for the Bulk Gas Storage Subsystem, attachment #4 provides a copy of the HL&P consultants letter on testing of sulfur content and attachment #5 provides a copy of the diesel generator performance methodology under meteorological or accident conditions.

If you should have any questions concerning this matter, please contact Mr. Michael E. Powell at (713) 993-1328.

Very truly yours,

Mark R. Wisenburg
Manager, Nuclear Licensing

MRW/MEP/bl

Attachments:
(1) List of NRC Open Items (PSB-Mechanical)
(2) HL&P Responses and Resolutions to the NRC Open Items (PSB-Mechanical)
(3) Bechtel Drawing - P&ID for the Bulk Gas Storage Subsystem - 6T180F00015
(4) Copy of consultant's letter on testing of sulfur content
(5) Summary of the Diesel Generator Performance Methodology

cc:

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* Attachments 1 through 5. All others, attachments 1 & 2

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Attachment 1

SOUTH TEXAS UNITS 1 AND 2
OPEN ITEM LIST
(MECHANICAL)

1. List of Open Items

1. The communication system capabilities - listing of safety-related areas, design characteristics and capabilities of the systems, location of systems, performance tests, etc., has not been addressed. (Section 9.5.2.3.1) (Open: Category 3a)

2. The discussion on the provisions for adequate communications following a design-basis event, including seismic has not been addressed. (Section 9.5.2.3.2) (Open: Category 3a)

3. The frequency of the inservice inspection, tests, preventive maintenance, and operability checks is not specified. (Section 9.5.2.3.3) (Open: Category 3a)

4. The description of lighting systems in safety-related areas is incomplete. (Section 9.5.3.3.1) (Open: Category 3a)

5. The description of minimum illumination levels in safety-related areas and access and egress routes; is incomplete. (Section 9.5.3.3.2) (Category 3a)

6. The discussion on the lighting system failure analysis effects resulting from accidents, components failure, etc.; has not been addressed. (Section 9.5.3.3.3) (Open: Category 3a)

7. A discussion on the provisions for adequate lighting following a design-basis event, including seismic; has not been addressed (Section 9.5.3.3.4) (Category 3a)

8. Dust control - Protection of electrical equipment has not been fully addressed (Section 9.5.4.1.3.2) (Open: Category 3a)

9. A discussion on the training program for initial and requalification training of personnel, as well as replacement personnel responsible for the operation and maintenance of the D/Gs has not been provided. (Section 9.5.4.1.3.3) (Open: Category 3a)

10. Procedures for loading the diesel generator during testing and troubleshooting have not been provided. (Section 9.5.4.1.3.4) (Open: Category 3a)

11. A discussion on the capability of the D/G to operate under all loading conditions (no load, light load and rated load) during extreme service conditions and weather disturbances has not been fully addressed. (Section 9.5.4.1.3.5) (Open: Category 3a)

12. The procedures for returning the D/G to an operable status following maintenance and/or repairs should incorporate a final equipment check. (Section 9.5.4.1.3.6) (Confirmatory: Category 7)

13. A description of the preventive maintenance and identification of root causes of failures programs have not been provided. (Section 9.5.4.1.3.7) (Category 3a)

14. D/G control and monitoring instrumentation panels capability of instruments to operate in the as installed conditions. (Section 9.5.4.1.3.8) (Confirmatory: Category 7)

15. The quality group classification of D/G engine mounted auxiliary system piping has not been specified. (Section 9.5.4.2.3.1.1) (Open: Category 3a)

16. The fuel oil drainage tank system has not been adequately described. (Section 9.5.4.2.3.1.2) (Open: Category 3a)

17. Internal corrosion protection for the fuel oil storage tanks has not been provided. (Section 9.5.4.2.3.2.1) (Open: Category 3a)

18. A description of control, instrumentation, sensor and alarm testing/calibration and operator action upon alarm actuation has not been provided. (Section 9.5.4.2.3.2.2) (Open: Category 3a)

19. The fuel oil quality procedures and standards used are not in conformance with ANSI N-195, R.G. 1.137 or Standard Technical Specifications (Section 9.5.4.2.3.3.1) (Open: Category 3a)

20. The periodicity of water removal from the fuel oil storage tanks has not been defined. (Section 9.5.4.2.3.3.2) (Open: Category 3a)

21. The surveillance requirements for cathodic protection system for the buried fuel oil piping has not been described. (Section 9.5.4.2.3.3.3) (Open: Category 3a)

22. The ability to deliver fuel oil and lube oil during unfavorable environmental conditions, particularly during floods, is inadequately addressed. (Sections 9.5.4.2.3.4) (Open: Category 3a)

23. The description of the D/G fuel oil storage tank emergency fill line with regards to protection from tornado missiles is inadequate. (Section 9.5.4.2.3.5.1) (Open: Category 3a)

24. The discussion on minimizing the entrance of deleterious materials into the fuel oil system during recharging is incomplete with regard to the emergency fill connection. (Section 9.5.4.2.3.5.2) (Open: Category 3a)

25. The description of the D/G fuel oil storage tank emergency fill connection with regards to refueling procedures to be used. (Section 9.5.4.2.3.5.3) (Confirmatory: Category 7)

26. Engine mounted piping and components quality group classification. (Section 9.5.5.3.1) (Open: Category 3a)

27. Instrumentation and controls - testing frequency and operator action. (Section 9.5.5.3.2) (Open: Category 3a)

28. A discussion on permissible leakage rates between D/G cooling system and other auxiliary systems has not been provided. (Section 9.5.5.3.3) (Open: Category 3a)

29. A discussion on the ability of the D/G cooling water and lube oil systems to maintain standby conditions under extreme service conditions and weather disturbances has not been provided. (Sections 9.5.5.3.4) (Open: Category 3a)

30. Engine mounted piping and components quality group classification. (Section 9.5.6.3.1) (Open: Category 3a)

31. Instrumentation and controls - testing and frequency and operator action. (Section 9.5.6.3.2) (Open: Category 3a)

32. A discussion on the measures taken to preclude oil carry-over in the air start system is not provided. (Section 9.5.6.3.3) (Open: Category 3a)

33. The inservice inspection preventive maintenance program for air starting system air dryers is unacceptable. (Section 9.5.6.3.4) (Open: Category 3a)

34. The design of the D/G control air system with regards to system leakage and effects of the loss of the system is unacceptable. (Section 9.5.6.3.5) (Open: Category 3a)

35. Engine mounted piping and components quality group classification. (Section 9.5.7.3.1) (Open: Category 3a)

36. Instrumentation and controls - testing frequency and operator actions. (Section 9.5.7.3.2) (Open: Category 3a)

37. The frequency of the lube oil sampling has not been specified. (Section 9.5.7.3.3) (Open: Category 3a)

38. Verification that D/G auxiliary system piping including L.O. fill points has been properly identified or marked. (Section 9.5.7.3.4) (Open: Category 3a)

39. Engine mounted piping and components quality group classification. (Section 9.5.8.3.1) (Open: Category 3a)

40. Instrumentation and controls - testing frequency and operator action. (Section 9.5.8.3.1) (Open: Category 3a)

41. D/G intake protection from fire, gases, etc. is incomplete. (Section 9.5.8.3.3) (Open: Category 3a)

42. The effects of an ESF transformer fire on D/G operation is incomplete. (Section 9.5.8.3.4) (Open: Category 3a)

43. Degradation of D/G operation due to potential fire in the D/G building with a failure of the fire protection system is inadequate. (Section 9.5.8.3.5)

44. D/G exhaust protection from inclement weather conditions has not been provided (Section 9.5.8.3.6) (Open: Category 3a)

45. Description of bulk hydrogen storage system is not provided. (Section 10.2.3.1) (Open: Category 3a)

46. A failure modes and effects analysis for turbine bypass system is incomplete with regards to spurious valve opening and automatic drainage system failure. (Section 10.4.4.3.1) (Open: Category 3a)

47. The description of inservice inspection program test frequency for the turbine bypass system. (Section 10.4.4.3.2) (Open: Category 3a)

Attachment 2

HL&P Responses and Resolution's to the NRC - Open Items (PSB-Mechanical)

The following responses and resolution's correspond item for item to the list of open items in Attachment 1 and the appropriate section of the Draft SER is referenced:

1. STP has already provided a response to this concern with the exception of part 5. Refer to STP response to Q040.10 including Table Q040.10-1.

   The STP communication system provides an integrated design that will provide effective communication between plant personnel in all vital areas during normal plant operation and during the full spectrum of accident or incident conditions (including fire) under maximum potential noise levels. This conforms with the requirements of Standard Review Plant 9.5.2 (NUREG 0800). The areas (working stations) described by STP's response to Q040.10 are the only areas in the plant that communication is necessary to support safe shutdown of the plant or mitigation of the consequences of an accident. No other areas are considered to be "vital" with respect to the need for communications, or are necessary to support safe shutdown or accident mitigation activities. STP's response, including the list of subject areas, is similar to those of other previously reviewed plants.

   With respect to part 5 regarding performance/preoperational tests for communications, refer to Section 14.2.12.2 item 19. The response to Q040.10 will be revised to reflect that these tests are found in 14.2.12.2. (Ref. Section 9.5.2.3.1)

   This item is closed.

2. In response to the concern regarding communication system functionality following a DBE, we note that the STP design is such that it is not necessary for operators to leave the control room to bring the plant to safe shutdown during or after a seismic event. Additionally, as stated in the response to Q430.77N, the following subsystems will be available during and after a DBE:

   1) Sound powered maintenance jacks
   2) Hand-held radio transceiver
   3) Telephone EPBAX

   (Ref. Section 9.5.2.3.2)

   This item is closed.

3. Section 9.5.2 and the response to Q430.76N have been revised to address Inspection and Testing. (Ref. Section 9.6.2.3.3)

   This item is changed to confirmatory.

4. STP has already provided a response to this concern. Refer to Table 9.5.3-1.

   The STP lighting system is an integrated design that provides adequate emergency station lighting in all areas, from onsite power sources, required for fire fighting, control and maintenance of safety-related equipment, and the access routes to and from these areas.

   This conforms with Standard Review Plan 9.5.3 (NUREG 0800). The areas (working stations) described by STP's response in Q430.78N and Table 9.5.3-1 represent the only areas in the plant for which lighting is necessary to support safe shutdown of the plant or mitigation of consequences of an accident. No other areas are considered to be "vital" with respect to the need for lighting or are necessary to support safe shutdown or accident mitigation activities. STP's responses including the list of subject areas is similar to those of other previously reviewed plants.

   For additional descriptive information related to this concern refer to Section 9.5.3 and the responses to Q430.80N, Q430.81N, and Q430.82N. (Ref. Section 9.5.3.3.1)

   This item is <u>closed</u>.

5. As stated in our response to Q430.82N and described in Section 9.5.3.2, STP utilizes an integrated emergency lighting system to provide adequate emergency station illumination levels. This conforms to Standard Review Plan 9.5.3 (NUREG 0800) which states that "... the emergency lighting system(s) is acceptable if the integrated design of the system(s) will provide adequate emergency station lighting in all areas, from onsite power sources, required for fire fighting, control and maintenance of safety-related equipment, and the access routes to and from these areas...". Ten foot-candles at work stations and two to five at access/egress routes are provided via the integrated use of STP's Essential AC Lighting System and the Emergency DC Lighting System as described in Section 9.5.3. These areas are provided with lighting powered from onsite sources as shown in Table 9.5.3.1. (Ref. Section 9.5.3.3.2).

   This item is <u>closed</u>.

6. Section 9.5.3 has been revised to include a new Section 9.5.3.3. titled "Safety Evaluation".

   Backup dc lighting has been discussed for all areas needing backup lighting as described in Section 9.5.3.2 and Table 9.5.3-1.

Portable dc lighting has been discussed in STP's response to Q430.78N and in the Fire Hazards Analysis Report (FHAR).

Note that the nonsafety-related DG (the TSC DG) is not common to Units 1 and 2. One TSC DG is provided for each unit. The only common DG utilized for lighting is the non-Class 1E DG which powers the yard area lighting which is not necessary for any emergency situation. This DG is independent of the TSC DG's. (Ref. Section 9.5.3.3.4)

This item is closed.

7. The STP design is such that it is not necessary for operators to leave the control room to bring the plant to safe shutdown during or after a seismic event. Note also that the lighting provided in the control room, auxiliary shutdown panel and transfer switch panel areas have backup power from Class 1E DG's and DC lighting from the eight hour sealed beam battery packs. These DG's are also protected from the effects of a seismic event and tornado missile impacts. See also FSAR Section 9.5.3.1 item 2. (Ref. Section 9.5.3.3.4)

   This item is closed.

8. The response to Q430.58N has been revised to address housecleaning. In addition, the diesel and generator control panels are housed in dust-tight enclosures. (Ref. Section 9.5.4.1.3.2)

   This item is closed.

9. The response to Q430.28N has been revised to provide more detailed information on training for the emergency diesel generators. (Ref. Section 9.5.4.1.3.3)

   This item is closed.

10. Section 9.5.5.6 has been revised to include the loading requirements of the DG during testing and troubleshooting. (Ref. Section 9.5.4.1.3.4)

    This item is closed.

11. The response to Q430.102N has been revised to address this concern. (Ref. Section 9.5.4.1.3.5)

    This item is closed.

12. The response to Q430.24N has been revised to incorporate a final equipment check. (Ref. Section 9.5.4.1.3.6)

    This item is closed.

13. The response to Q430.24N has been revised to incorporate a brief discussion of the Preventive Maintenance program. (Ref. Section 9.5.4.1.3.7)

    This item is closed.

14. The concern in the past has been vibrations causing instrumentation problems on DG skid mounted panels. As described in the response to Q430.25N, the panels are not located on the DG skid and they have been seismically tested as part of their equipment qualification program. (Ref. Section 9.5.4.1.3.8)

    This item is changed to confirmatory.

15. Section 9.5.4.1(5) has been revised to reflect the industry standards which are met by the diesel mounted piping. Also see the revised response to Q430.47N. (Ref. Section 9.5.4.2.3.1.1)

    This item is closed.

16. Section 9.5.4.2 has been revised to reflect a description of the fuel oil drain tank and transfer pump. (Ref. Section 9.5.4.2.3.1.2)

    This item is closed.

17. Section 9.5.4.3 has been revised to describe the project's internal corrosion protection program for the FOST and AFOST. (Ref. Section 9.5.4.2.3.2.)

    This item is closed.

18. Section 9.5.4.4 has been revised to reflect the frequency of calibration for the instrumentation.

    This item is closed.

19. The response to Q040.20 provides STP's commitment to the McGuire Tech Specs with the noted exception. Attachment (4) to this letter provides a copy of the Consultant's letter which documents the acceptability of the test method for determining sulfur content. (Ref. Section 9.5.2.3.3.3.1)

    This item is closed.

20. Section 9.5.4.4 has been revised to indicate the frequency of water removal in both the FOST and AFOST. (Ref. Section 9.5.4.2.3.3.2)

    This item is closed.

21. The types of maintenance and testing of the cathodic protection system have been added to Section 9.5.4.3. (Ref. Section 9.5.4.2.3.3.3)

    This item is closed.

22. Refer to Question numbers 40.22, 430.46N, 430.86N, and 430.98N for our responses to this topic. It is our understanding that the NRC has no outstanding questions on the design basis flood for STP. (Ref. Section 9.5.4.2.3.4)

    This item is closed.

23. Section 9.5.4.3 has been revised to reflect the design of the emergency fill connection with respect to tornado protection. (Ref. Section 9.5.4.2.3.5.1)

    This item is closed.

24. A description of the emergency fill connection was transmitted in letter ST-HL-AE-1268. Section 9.5.4.3 and Figure 9.5.4-1 (Amd. 49) reflect the connection which consists of a filter and a locked closed ASME III valve. (Ref. Section 9.5.2.3.5.2)

    This item is closed.

25. The response to Q430.86N has been revised to state that adequate head is available on the tank trucks to pump the oil to the emergency fill connection. (Ref. Section 9.5.4.2.3.5.3)

    This item is closed.

26. Section 9.5.5.1 has been revised to reflect the industry standards which are met by the diesel mounted piping. Also see the revised response to Q430.47N. (Ref. Section 9.5.5.3.1)

    This item is closed.

27. Section 9.5.5.4 has been revised to reflect the frequency of calibration for the cooling water instrumentation. (Ref. Section 9.5.5.3.2)

    This item is closed.

28. The response to Q430.91N has been revised to include a more detailed discussion of this concern. (Ref. Section 9.5.5.3.3)

    This item is closed.

29. The response to Q430.102N has been revised to address this concern. (Ref. Section 9.5.5.3.4)

    This item is closed.

30. Section 9.5.6.1 has been revised to reflect the industry standards which are met by the diesel mounted piping. Also see the revised response to Q430.47N. (Ref. Section 9.5.6.3.1)

    This item is closed.

31. Section 9.5.6.5 has been revised to reflect the calibration frequency of the starting air system instrumentation. (Ref. Section 9.5.6.3.2)

    This item is closed.

32. Section 9.5.6.2 has been revised to reflect the pre- and after filters located in the system to prevent oil carryover from the compressor. (Ref. Section 9.5.6.3.3)

    This item is closed.

33. Section 9.5.6.5 has been revised to indicate the period of inspection for the air dryer. (Ref. Section 9.5.6.3.4)

    This item is closed.

34. The response to Q430.94N has been revised to reflect the fact that no instrument air is required to provide the safety trips or support operation of the diesel in the emergency mode. (Ref. Section 9.5.6.3.5)

    This item is closed.

35. Section 9.5.7.1 has been revised to reflect the industry standards which are met by the diesel mounted piping. Also see the revised response to Q430.47N. (Ref. Section 9.5.7.3.1)

    This item is closed.

36. Section 9.5.7.5 has been revised to include the calibration frequency of the lube oil instrumentation. (Ref. Section 9.5.7.3.2)

    This item is closed.

37. Section 9.5.7.2 has been revised to include the frequency of lube oil inspection. (Ref. Section 9.5.7.3.3)

    This item is closed.

38. The existing response to Q430.99N is acceptable. The direction for lube oil filling will be in a procedure which will clearly identify which connection is to be used and the appropriate plant personnel will be trained in their use. (Ref. Section 9.5.7.3.2)

    This item is closed.

39. Section 9.5.8.1 has been revised to reflect the industry standards which are met by the diesel mounted piping. Also see the revised response to Q430.47N. (Ref. Section 9.5.8.3.1)

    This item is closed.

40. Section 9.5.8.5 has been revised to provide the frequency of calibration of the combustion air intake and exhaust instrumentation. (Ref. Section 9.5.8.3.1)

    This item is closed.

41. The bulk gas storage subsystem has been reanalyzed to take into consideration all gases located at that facility. The results and methodology have been incorporated into FSAR Section 9.5.8.3. A further description of the methodology can be found in attachment #5. (Ref. Section 9.58.3.3) HL&P considers this item closed.

42. As described in Section 9.5.8.3, the ESF transformer fire has been evaluated using the Halitsky model from FSAR reference 9.5.8-1. This model assumes that the smoke emission from the transformer is 100% smoke and determines the amount of dilution in travel to the intake. Since this method is used, the combustion products are not necessary in the analysis. Attachment #5 also provides a reference for this method. Note also that the effects of fires in other buildings have been incorporated in the revised section 9.5.8.3. (Ref. Section 9.5.8.3.4). HL&P considers this item closed.

43. FSAR Section 9.5.8.3 has been revised to include the fire in the D.G. building and its effects on the D.G. A further description of the analysis and the methodology used are provided in attachment #5. (Ref. Section 9.5.8.3.5) HL&P considers this item closed.

44. Section 9.5.8.2 and Q430.60N have been revised regarding bulk hydrogen storage to describe the DG exhaust design. (Ref. Section 9.5.8.3.6)

    This item is closed.

45. The response to Q40.37 has been revised and will appear in Amendment 51. The applicable sections of the Fire Hazards Analysis Report have also been provided for clarity. (Ref. Section 10.2.3.1)

    This item is closed.

46. Table 10.4-4 has been revised to include the spurious opening of the turbine bypass valve. With respect to the two items shown in your Section 10.4.4.3.1:

    a) The opening of a turbine bypass valve is an ANS Condition II event as described in Section 15.1.4. Thus, the effects of the event are provided in the FSAR.

    b) Each turbine bypass line has a drain which automatically will drain any liquid which collects in the line. In the event failure occurred to automatically drain the line, the separate high level alarm would provide indication. In the event, the worst scenario would be failure to pass steam which is equivalent to failure of the valve to open which is included in the FMEA (Table 10.4-4). A description has been added to FSAR Section 10.4.4.2 regarding the drip leg.

    This item is closed.

47. Section 10.4.4 and the response to Q430.105N have been revised to reflect STP's position on the frequency of inspection of the turbine bypass valves. (Ref. Section 10.4.4.3.2.)

    This item is closed.

Response (Continued)

working stations for all transients and accident conditions are also shown on Table Q40.10-1.

3. The type of communication systems available at each of the above identified working stations is shown on Table Q40.10-1.

4. The communications equipment at the locations specified in Table 040.10-1 is capable of performing at the maximum sound levels in those areas. The background sound levels are enveloped by the maximum sound levels.

   STP does not utilize a page party system. Refer to FSAR Section 9.5.2 for a description of the comunications systems. 49

5. The performance requirements and tests that the above onsite working stations communication systems will be subjected to are identified in Section 9.5.2.2.3. Additionally, refer to Section 14.2.12.2, item 13 for preoperational testing.

6. The protective measures taken to assure a functionally operable onsite communications systems are discussed in Section 9.5.2.2 and the response to Q430.77.

system are on the plant site for use by the technicians. Cables for the EPBX system, paging systems, other in-plant telephone systems, microwave channels, and radio systems will be terminated in each building in such a manner as to permit ease in testing and trouble-shooting. Alarms indicate abnormalities in any of the communications systems. Service personnel are dispatched to correct identified faults. A current list of all technicians' business and home telephone numbers, as well as mobile radio numbers, is maintained in the control room. Each week the control room operators are supplied with a list of technicians who are on duty for maintenance of all plant communications systems.

Insert 9.5.2.3 →

9.5.3 Plant Lighting Systems

9.5.3.1 Design Bases

1. The Lighting System is designed so that a single failure of any electrical component assuming loss of offsite power (LOOP), will not terminate the system's ability to illuminate those areas where, during emergency conditions, reactor shutdown is carried out.

2. The lighting subsystems that serve the main control room, the remote shutdown areas and the access/egress routes thereto, and other areas in which the collapse of the Lighting System would physically impact on Class 1E equipment are seismically supported to prevent their collapse during and after a Safe Shutdown Earthquake (SSE). The Lighting System supports for equipment and raceway in close proximity to Category I equipment are designed for seismic concerns, and to prevent structural collapse during and after a SSE. 49

3. Lighting fixtures containing mercury lamps and mercury switches are not used inside the RCB, specific Mechanical Auxiliary Building (MAB) areas and Fuel Handling Building (FHB).

   Lighting fixtures with lamps containing mercury, if used in the Turbine Building over the turbine or portions of the secondary system which can be opened during maintenance operations, and over the condensate polishing demineralizer regeneration equipment area, are provided with solid translucent lamp guards to prevent falling lamps. All MAB lighting fixtures with lamps containing mercury are provided with solid translucent lamp guards.

   The above restrictions also apply to sodium vapor lamp fixtures.

   The design of the integrated Lighting System is based on the applicable portions of the following codes and standards:

- Illumination Engineering Society (IES) Lighting Handbook (1972)
- Occupational Safety and Health Standards (OSHA) 29CFR1910
- National Electric Code (NEC) NFPA 70-1981

9.5.2.3. Inspection and testing

Preventive maintenance activities and operability checks necessary to ensure reliable operation of site emergency communications are under development. A listing of activities and performance frequencies will ~~be provided in a later amendment.~~ These frequencies may be revised based on evaluation of factors such as plant operating experience, industry experience, and vendor recommendations.

available for review prior to operation.

Question 430.76N

In Section 9.5.2.2.3 of the FSAR you state that inservice inspection tests, preventative maintenance, and operability checks are performed periodically to prove the availability of the communication systems. Provide the frequency for these tests. (SRP 9.5.2, Part II and III)

Response

The testing program for the communication systems are under development and frequencies for these activities have not been determined. This information will be provided in a later amendment.

Refer to Section 9.5.2.3.

9.5.3.3 Safety Evaluation: An integrated lighting system consisting of the essential ac lighting system (class 1E powered) backed up by 8 hour battery packs is provided to permit the operators to shut down the unit safely and to maintain it in a safe shutdown condition at any time. The lighting system is designed to provide lighting in those areas used during a reactor shutdown or emergency.

Lighting in the control room, auxiliary shutdown panel room, transfer switch panels, and access/egress to and from these stations are fed from Class 1E buses. The lighting is arranged so that alternate fixtures are fed by redundant buses to maximize the coverage of remaining fixtures in the event of a loss of one Class 1E bus. Physical separation is provided to maintain independence of the redundant essential lighting systems.

If the normal (preferred) source to a Class 1E bus fails, the associated diesel generator is started automatically. During the diesel starting period, the emergency lighting system provides illumination. Lighting in the control room and remote shutdown area is automatically restored during diesel generator sequencing.

~~Based on this design the integrated lighting system [illegible]~~

Thus the integrated lighting system can provide adequate lighting to all vital areas ~~[illegible]~~ (see Table 9.5.3-1) ~~during~~ from onsite power sources.

- Federal Aviation Administration (FAA) Obstruction Marking and Lighting - Advisory Circular No. 70/7460-IF, dated September 27, 1978 49

9.5.3.2 System Description. The Lighting System provides illumination for normal and emergency plant operations, and access/egress routes for fire fighting and safe building evacuation.

The Lighting System is comprised of three separate systems as follows:

1. Normal AC Lighting 49
2. Essential AC Lighting Q430. 82N
3. Emergency DC Lighting

9.5.3.2.1 Normal AC Lighting System: The Normal AC Lighting System provides the major portion of the illumination requirements throughout the plant. This system also provides power for the 120 V convenience receptacles.

Power for this system supplied from the non-Class 1E System. If this power is not available, power for the yard area lighting is provided from a non-Class 1E DG (Shared between Units).

Under normal operating conditions, the normal ac and essential ac lighting systems operate together to provide lighting for the plant.

9.5.3.2.2 Essential AC Lighting System: The Essential AC Lighting System provides the illuminating requirements for the safe shutdown areas, other operating areas and access/egress routes. A minimum of ten footcandles is provided at the work stations in the safe shutdown areas which are: 49

1. Control Room Q430. 78N
2. Auxiliary Shutdown Panel Q430. 79N
3. Transfer Switch Panels as defined in Section 7.4.1.9.2
4. Standby Diesel Generator Control Panels
5. Chiller Control Panels
6. Boric Acid Tank Room
7. Component Cooling Water Surge Tank
8. Essential Cooling Water Traveling Screen Rooms

Two to five footcandles is provided in the access/egress routes between the above work stations.

Power for the Essential AC Lighting System is supplied from two Class 1E and one non-Class 1E system. Upon loss of the normal power supply (i.e., LOOP) the Essential AC Lighting System is automatically connected to the Class 1E (trains A and C) and the non-Class 1E (TSC, 1 per unit) ~~(TSC)~~ DGs. The lighting power sources for the safe shutdown areas and access/egress routes are shown in Table 9.5.3.1. 49 Q430.78N Q430.79N

9.5.3.2.3 Emergency DC Lighting System: The Emergency DC Lighting System consists of lighting supplied from batteries upon loss of the Normal and Essential AC Lighting Systems.

The Emergency DC Lighting System provides illumination at safe shutdown areas including access/egress routes between them, and at the access/egress routes to and from fire areas during fire transients, and accident conditions including a SSE as follows: 49 Q430.78N Q430.82N

1. The eight hour sealed beam battery packs, Holophane M-18-2A-X-SEIS-PT, are supported to withstand a SSE. They are mounted in the safe shutdown areas as listed in Section 9.5.3.2.2, and in the access/egress routes between them.

2. The TSC also uses eight hour battery packs.

3. Lighting from sealed beam lights with at least 90 minute battery packs is provided in other access/egress routes upon loss of normal area lighting.

4. Emergency lighting in the EOF, not within plant boundary, shall consist of eight hour battery packs for ingress/egress.

9.5.4 Diesel Generator Fuel Oil Storage and Transfer System 41

9.5.4.1 Design Bases.

1. The Diesel Generator Fuel Oil Storage and Transfer (DGFOST) System is designed to function during emergency conditions with a concurrent single active or passive failure of any one of its components. 41

2. The onsite storage capacity of the system provides for continuous operation of each DG for at least 7 days at continuous rating. An onsite source of replenishment is available from the Auxiliary Boiler Fuel Oil Storage and Transfer System (see Section 9.5.10). A connection is provided for replenishment from a truck from offsite sources. 41 41

3. The design of the system meets the GDCs 2, 4, 5, and 17 in addition to RG 1.137 and 1.9 as discussed in Sections 3.1 and 3.12, respectively. Also the system conforms to Institute of Electrical and Electronic Engineers (IEEE) Standards 308-1971 and 387-1972. The equipment within the system conforms to the applicable codes and standards of the American Society of Mechanical Engineers (ASME), American Society for Testing and Materials, American National Standards Institute, National Electrical Manufacturer's Association, Diesel Engine Manufacturers Association, IEEE, American Petroleum Institute, National Fire Protection Association, and Nuclear Engineering Liability and Property Insurance Association. Design codes of each individual component are stated in Section 3.2. 41

4. The safety-related portions of the system is designed to seismic Category I requirements and are protected from tornado missiles by missile-proof 41

8

Question 430.58N

Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deleterious materials on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, controls switches - etc.). Describe the provisions that have been made in your diesel generator building design, electrical starting system, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator on demand.

Also describe under normal plant operation what procedure(s) will be used to minimize accumulation of dust in the diesel generator room; specifically address concrete dust control. In your response also consider the condition when Unit 1 is in operation and Unit 2 is under construction (abnormal generation of dust).

Response

Dust accumulation from exterior sources:

The diesel generator (DG) building heating and ventilating system utilizes three 100-percent capacity supply fans, providing air flow of approximately 20,000 ft^3/min to each DG train which function only when the diesel is not operating. During diesel operation, a larger fan providing air flow of approximately 123,000 ft^3/min to each DG train ~~will be~~ is operated. The inlet to the smaller supply fan ~~will be~~ is equipped with a filter having a 40 percent atmospheric dust spot efficiency. Use of the filter will prevent entrance and accumulation of all types of dust (including concrete dust) and other deleterious material on electrical equipment associated with starting of the diesel. See Section 9.4.6, for details. The diesel ~~will be~~ is operated infrequently for either (1) periodic system testing or (2) subsequent to loss of offsite power or a design basis accident. Operation of the diesel in Unit 1 is scheduled when very little concrete work or other abnormal dust-generating activities remain to be done in Unit 2. | 36 | 41

Dust accumulation from interior sources:

All concrete surfaces internal to the DG building except the fuel oil tank compartments and the non-labeled fume tight fire doors will be coated as follows: | 41

1) fluorosilicate concrete hardener on floor.

2) epoxy - polyamide concrete sealer on walls and ceilings.

Combustion air is filtered via an oil bath air filter as reflected in Figure 9.5.8-1. Filters are provided to filter the supply air in the DGB HVAC Systems. For details See Section 9.4.6. | 36 | 41

Insert →

The diesel and generator control panels are housed in dust tight enclosure.

(8)

Insert for Q 430.58N

The STPEGS housekeeping program is under development. The housekeeping zone for the Diesel Generator Building will be provided in a later amendment.

The ~~a~~ preventive maintenance program ~~activity will be~~ developed will require ~~to~~ periodic~~ally inspect~~ inspection for dust and other deleterious materials and ~~clean, as~~ require cleaning as necessary, of the electrical equipment associated with starting the diesel generator.

Procedures governing housekeeping that implement the recommendations of Regulatory Guide 1.89 will be available on site for NRC review prior to fuel load.

(9)

Question 430.28N

Provide a detail discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with the emergency diesel generators.

Response

The training program for supervisors, operators, and maintenance personnel described in Chapter 13 includes training on the ~~emergency~~ standby diesel generators (DGs).

Specific personnel are not exclusively dedicated to the ~~emergency~~ standby DGs. The level of education, experience, numbers, and type of personnel assigned to supervision, operation and maintenance is described in Chapter 13. The criteria stated in Chapter 13 apply to DGs as well as other plant systems and components. 49

The training, education, experience and staffing of Quality Assurance ~~(QA)~~ personnel is described in Chapter 17.

This training ~~is~~ will be

Spell out

The Nuclear Training group will initially provide training to appropriate NPOD, QA, and NTD personnel equivalent or similar to the vendor or manufacturer's training program. Depending on the discipline, this training is expected to last from two to five days involving a combination of classroom, demonstrations/tours, and walk throughs, as appropriate. This training will be completed prior to NPOD assuming operational and maintenance responsibility for the EDG's from Startup. Retraining will be factored in to appropriate requalification or retraining programs as well as integrated into appropriate apprentice training programs. The goal of the initial and retraining programs is to identify specific job responsibilities and train personnel accordingly thus assuring optimum availability of the emergency diesel generator.

Spell out

assign

10

9.5.5.5 Instrumentation Application. The necessary controls are provided with each cooling system to maintain the engine jacket at the proper temperature for all modes of operation. Alarms are provided at the local control panel, with a common DG trouble alarm in the main control room, for 41
low jacket water standpipe level, abnormal jacket water temperature, and low jacket water pressure at the inlet to the engine. The DGCWs indications and 29
alarms are summarized in Table 9.5.5-3 and DG protective trips are discussed Q430.
Insert in Section 8.3.1.1.4.6. ~~Alarm response procedures described in Section 13.5.2.1(5) will be prepared for alarms associated with this system.~~ 50N

9.5.5.6 No Load Operation Actual shop tests performed on a prototype 29 41
KSV-20-T diesel engine showed the engine capable of running at no-load for an Q430.
extended period. Following six hours of no-load operation at rated speed, the 50N
engines were subjected to a 75 percent load test for one hour, followed by a 50 percent load test for one hour. Based on the prototype testing, no adjustments need to be made to the STP engines or controls. The operating procedures require interspersing 15-30 minute periods of operation at 75-100 49
percent load at approximately 6 hour intervals when operating the diesel for longer than six hours at light loads (less than 50 percent).

Insert The engine is capable of accepting full load after as much as 6 hours of low load or no load operation.

9.5.6 Diesel Generator Starting System

9.5.6.1 Design Bases. Each DG is provided with two compressed starting air systems, either of which is capable of starting the engine without power. 41
The starting air system, including the interconnecting piping and the on-engine piping, is designed to seismic Category I, SC 3 requirements, except for the compressors and dryers, which are Non-Nuclear Safety. The on-engine piping is designed to Diesel Engine Manufacturers Association (DEMA) requirements and meets ANSI B31.1. The equipment is located within the DG 49
compartments and is therefore protected from tornado winds, external missiles, flooding, and the effects of moderate-energy line breaks (see Chapter 3).

9.5.6.2 System Description. A schematic of the redundant DG Starting 41
Air System for one diesel engine is shown on Figure 9.5.6-1. Each Starting Air System includes two ac motor-driven air compressors, two air dryers, two air receivers, two starting air valves, all necessary valves and fittings, 29
instrumentation, and control systems. Table 9.5.6.-1 lists major components Q430.
in the DGSS and their design data. 52N

Each redundant air receiver is isolated from the nonsafety-related portions of 29
the Starting Air System by one check valve and a manually operated isolation Q 41
valve. Each receiver has a volume of 83 ft^3 and a design pressure of 275 430.
psig. This is sufficient for five start attempts per receiver without re- 52N
charging. The receiver is constructed of stainless steel. The air compressors are sized to recharge each receiver from minimum pressure to maximum pressure in 17 minutes. Each receiver is provided with a pressure switch to 29
stop and start the compressors as required. Low pressure is alarmed locally Q430.
and as a common trouble alarm in the main control room. High pressure safety 52N 41
relief valves are provided.

From the receiver the air flows to the engine-mounted components through 29
stainless steel interconnecting piping. The on-engine components consist of Q430.
52N

(10)

Insert for Section 9.5.5.5 / Pg. 9.5-48

The operator action required following alarm actuation will be specified in the annunciator response procedure which is currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load.

(10) Insert for Section 9.5.5.6 / Pg. 9.5-48

~~The stated restrictions~~ The above conditions for low-load operation of the diesel generators are applicable when the diesels are operated for any reason, including testing or troubleshooting.

Question 040.30

The diesel generator sets should be capable of operation at less than full load for extended periods without degradation of performance or reliability. Expand your FSAR to include and explicitly define this requirement. (SRP 9.5.5, Part III, item 7).

Response

The diesel generator operating procedures will include instructions to intersperse 15-30 minute periods of operation at 75 percent to 100 percent load at approximately 6 hour intervals when operating the diesel for longer than 6 hours at light loads (less than 50 percent). 49

~~Also~~ See Section 9.5.5.6.

11/29

Question 430.102N

Diesel generators for nuclear power plants should be capable of operating at maximum rated output under various service conditions. No load and light load operations, the diesel generator may not be capable of operating for extended periods of time under extreme service conditions or weather disturbances without serious degradation of the engine performance. This could result in the inability of the diesel engine to accept full load or fail to perform on demand. Provide the following:

a) The environmental service conditions for which your diesel generator is designed to deliver rated load including the following:

Service Conditions

(a) ambient air intake temperature range-F°

(b) humidity, max-%

b) Assurance that the diesel generator can provide full rated load under the following weather disturbances:

(1) A tornado pressure transient causing an atmospheric pressure reduction of 3 psi in 1.5 seconds followed by a rise to normal pressure in 1.5 seconds.

(2) A low pressure storm such as a hurricane resulting in ambient pressure of not less than 26 inches Hg for a minimum duration off two (2) hours followed by a pressure of no less than 26 to 27 inches Hg for an extended period of time (approximately 12 hours).

c) In light of recent weather conditions (subzero temperatures), discuss the effects low ambient temperature will have on engine standby and operation and effect on its output particularly at no load and light load operation. Will air preheating be required to maintain engine performance? Provide curve or table which shows, performance verses ambient temperature for your diesel generator at normal rated load, light load, and no load conditions. Also provide assurance that the engine jacket water and lube oil preheat systems have the capacity to maintain the diesel engine at manufacturer's recommended standby temperatures with minimum expected ambient conditions. If the engine jacket water and lube oil preheat systems' capacity is not sufficient to do the above, discuss how this equipment will be maintained at ready standby status with minimum ambient temperature.

d) Provide the manufacturer's design data for ambient pressure vs engine derating.

e) Discuss the effects of any other service and weather conditions will have on engine operation and output, i.e., dust storm, air restriction, etc. (SRP 8.3.1, Parts II and III; SRP 9.5.5, Part III, SRP 9.5.7, Parts II and III; and SRP 9.5.8, Parts II and III)

11/29

Response (Continued)

a) The diesel generators (DGs) are designed to deliver rated load at:

Ambient air intake temperature: 29 - 95°F
81°F Wet Bulb

b) The engines will continue to maintain 100 percent rated load given the pressure depression at 3 psi in 1.5 seconds followed by a rise to normal pressure in 1.5 seconds. The postulated hurricane resulting in 25" Hg ambient pressure for a time period of 2 hours minimum duration followed by a rise to a pressure of no less than 26" to 27" Hg for a minimum time of 12 hours will not prevent the diesel engine from maintaining 100 percent rated load.

c) Insert It is not anticipated that the temperature at the STP location will be subzero. The lowest recorded temperature is 5°F. Provision for air preheating is included in the engine design. Whenever the turbocharger blower discharge temperature is less than 105°F, heated jacket water will be circulated through the fore section of the intercoolers and will therefore preheat the combustion air either for startup or light load operation. The power to both the jacket water heater and circulation pump motor is Class 1E. The heater and pump are seismically supported and the heater meets the requirements of IEEE 323-1974. The above is also true for the lube oil circulation pump and heater.

The engine jacket water and lube oil coolers are sized to a room ambient temperature down to 50°F minimum. The engine manufacturer assures that the jacket water and lube oil systems will maintain their proper warm standby temperature conditions. Five heaters are provided in each of the three Diesel Generator Building (DGB) engine rooms in order to maintain a minimum temperature of 50°F. In addition Class 1E temperature indication is provided for the rooms to alarm on high temperature.

d) The ability of the diesel engines to deliver rated load at various altitudes is affected by the ability of the turbocharger to develop the required manifold pressures. The turbochargers on these engines are rated for a 3:1 pressure ratio. Based upon this rating, the turbocharger can develop sufficient manifold pressure with a minimum ambient pressure of 25" Hg. Consequently, no engine derating applies with respect to the expected ambient pressure.

e) In order to reduce the potential impact of the external environment, the engine combustion air intake system, including the intake filter, is installed indoors. The air intake filter is installed in a separate room located on the second level of the DGB. Air is drawn from the outside through a louvered/screened opening into the air filter room. The intake air filter is an oil bath type with a screened intake opening. As a result of abnormal climatic conditions, i.e., dust storms, or air restriction (due to foreign objects), the air filter will of course require maintenance sooner than the scheduled maintenance. The air filter is provided with differential pressure indications to ensure that the intake pressure losses do not exceed manufacturer's recommendations. (See also Q430.103N.)

Insert C to Q430.102N:

It is not anticipated that the temperature at the STP location will be subzero. The lowest recorded temperature is 5°F (Houston area), 8°F (Bay City area) and in last 40 years; 11°F (Bay City). The DGB is provided with 5 heaters per room to maintain a minimum room temperature of 50°F, based on an outside temperature of 29°F. Although the outside temperature has gone below 29°F, this temperature represents the 99% design value. Per ASHRAE, therefore, only at 1% of the winter month hours would the temperature be below 29°F. This corresponds to 22 hours per year. The diesel engine manufacturer has identified that their engines can start and operate with an outside temperature of 8°F.

The outdoor service condition of 29°F to 95°F are based on the environmental conditions stated in ASHRAE Handbook of Fundamentals. These conditions are used in the design of the ventilation systems serving the DGB. Provision for air preheating is included in the engine design. Whenever the turbocharger blower discharge temperature is less than 105°F, heated jacket water will be circulated through the fore section of the intercoolers and will therefore preheat the combustion air either for startup or light load operation. Therefore during winter months, jacket water will be heating the combustion air as needed. It is noted that air for startup comes predominantly from the air receivers which are located inside the DGB. Total outside air is used after the engine has reached 280 RPM.

The power to both the jacket water heater and circulation pump motor is Class 1E. The heater and pump are seismically supported and the heater meets the requirements of IEEE 323 (1974). The above is also true for the lube oil circulation pump and heater. The engine jacket water and lube oil coolers are sized to a room ambient temperature down to 50°F minimum. The engine manufacturer assures that the jacket water and lube oil systems will maintain their proper warm standby temperature conditions.

The diesel engine is capable of operating with an outside air ambient temperature between 8°F to 105°F. Humidity has no adverse effect on DG performance. Although low temperature is not alarmed, diesel generator room temperature is available in the control room. In the event of sustained cold weather at the plant site, less than 29°F, administrative procedures will require that DG room temperature is monitored at a frequency of once per shift to allow for appropriate and immediate remedial action. If the minimum ambient room conditions fall below 50°F, the key parameters which affect the operability of the diesel will be monitored and maintained within the required limits.

Class 1E temperature indication is provided in the DGB to alarm on high temperature. This is necessary for determining if the HVAC system is operating to avoid violating environmental qualifications of equipment. A low temperature alarm is not considered necessary since diesel generator room temperature is available in the control room.

Question 430.24N

Periodic testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability, and availability of the unit on demand. Periodic testing coupled with good preventive maintenance practices will assure optimum equipment readiness and availability on demand. This is the desired goal.

To achieve this optimum equipment readiness status the following requirements should be met:

1. The equipment should be tested with a minimum loading of 25 percent of rated load. No load or light load operation will cause incomplete combustion of fuel resulting in the formation of gum and varnish deposits on the cylinder walls, intake and exhaust valves, pistons and piston rings, etc., and accumulation of unburned fuel in the turbocharger and exhaust system. The consequences of no load or light load operation are potential equipment failure due to the gum and varnish deposits and fire in the engine exhaust system.

2. Periodic surveillance testing should be performed in accordance with the applicable NRC guidelines (RG 1.108), and with the recommendations of the engine manufacturer. Conflicts between any such recommendations and NRC guidelines, particularly with respect to test frequency, loading, and duration, should be identified and justified.

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventive maintenance should encompass investigative testing of components which have a history of repeated malfunctioning and require constant attention and repair. In such cases consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test a final equipment check should be made to assure that all electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. After the unit has been satisfactorily started and load tested, return the unit to ready automatic standby service and under the control of the control room operator.

Provide a discussion of how the above requirements have been implemented in the emergency diesel generator system design and how they will be considered when the plant is in commercial operation, i.e., by what means will the above requirements be enforced.

Response

See ~~the response Q40.30 and Q430.50N~~ Section 9.5.5.6 for a description of the loading of the diesel generators (DGs) for testing and troubleshooting.

insert 430.24N

STPEGS has procedural commitments to perform reviews of equipment failures. Based on these reviews design changes are considered which would improve reliability. 49

Maintenance is performed in accordance with written procedures, which require verification or testing to ensure that equipment meets its design requirements prior to being declared operable. Refer to Section 13.5.1.3.

For STP's position on Regulatory Guide RG 1.108, see the response to Q430.31N.

12/13

Insert for Q421.24N

The Preventive Maintenance (PM) program includes directions to review PM documentation for information pertaining to equipment failure trends, frequency, and the root causes of failures. This program will identify and track equipment failures and determine the root causes of failures.

The Maintenance Work Request (MWR) program includes directions to review the MWR package for information pertaining to equipment failure trends, frequency, and the root causes of failures. This program will identify and track equipment failures and determine root causes of failures which require corrective maintenance.

The procedure for returning the Diesel Generator to an operable status following maintenance will incorporate a final equipment check to assure that electrical circuits are functional.

(14)

Question 430.25N

The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors, and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area. If the floor is not vibration free, the panel shall be equipped with vibration mounts.

Confirm your compliance with the above requirements or provide justification for noncompliance.

Response

The engine and generator control and instrumentation panels are physically located approximately 12 ft from the diesel generator (DG) at an elevation 10 ft above the bottom of the generator. The natural frequency of the DG and foundation system is lower than the machine speed. Also, the ratio of foundation weight to the diesel generator weight is approximately eight. Transmission of vibratory motion from the DG to the engine and generator panel is considered insignificant. Refer to Figure 1.2-10 for the physical location of the panel. 49

In addition the control panels were seismically tested and the Test Response Spectra curves envelope the Required Response Spectra curves by a margin of more than 10 percent. The panels were also ~~vibration aged,~~ tested to the equivalent of 5 Operating Basis Earthquakes (OBEs). 49

Insert

Insert for Q 430.25 N

ii) The location and mounting arrangement of the diesel generator control panel has been reviewed with the manufacturer and he has indicated that the configuration is acceptable from a vibration standpoint. We will provide the NRC with written confirmation from the manufacturer.

enclosing structures. The system is designed to operate during and after the probable maximum flood. 41

in with

8. The system is designed to accommodate periodic testing as outlined in the Technical Specifications. 41

9.5.4.2 System Description. The DGFOST System is shown on Figure 9.5.4-1. Unit 1 is furnished with independent fuel trains, one for each standby DG. Unit 2 is identical. 41 41

Each fuel train consists of a storage tank and the necessary piping, valves, and instrumentation. The fuel oil storage tank (FOST) contains a 7-day supply of fuel (approximately 67,000 gallons) for the standby DG. Seven days is the minimum required for emergency operations. A normally isolated line is connected to the storage tank truck fill line and the Auxiliary Boiler Fuel Storage and Transfer System (see Section 9.5.10). This connection may be used for replenishing the fuel used for testing the DGs. Each FOST is provided with a drain, vent with flame arrester, overflow truck fill line, and inspection manhole cover. 41 2 Q40.12 41

insert B

Since the elevated FOST provides the assured seven day supply without replenishment from the main storage tank, the operation of the system to supply fuel oil to the engine is completely passive. This is the normal operating mode of the system. There are no other modes of operation. 41 44 41 29

The existing STP arrangement is considered technically superior to an arrangement recommended by ANSI standard N195. Each standby DG at STP has a single, elevated tank provided in a separate compartment of the DGB. During the seven day emergency operation the system is completely passive, requiring no transfer pumps and is, therefore, more reliable. There are no buried tanks or piping in the system, thus eliminating the problem of corrosion of components by groundwater and the contamination of fuel oil by groundwater intrusion. Q430.44 41 44

9.5.4.3 System Evaluation. The DGFOST System is designed to seismic Category I, Safety Class (SC) 3 requirements and will withstand a single failure and still perform its functional requirements. Failure of any one FOST System component results in the failure of only one standby DG. The safe shutdown of the reactor coincident with a LOOP is achieved using the remaining two DGs. A failure modes and effects analysis (FMEA) is provided in Table 9.5.5-2. 41 41

Provisions will be made for emergency refueling in case of a flood.

For the emergency fill connection a Safety Class 3 pipe routed through the roof to the FOST fill line will be equipped with an ASME III Class 3 locked closed valve filter and a quick disconnect coupling connected upstream of the valve (see Figure 9.5.4-1). A hose could then be routed to the roof via an existing hose reel for tank filling when the flood level has receded. A sampling point is also provided upstream of the isolation valve which allows checking and flushing the line prior to filling operations from the truck fill. The end of the truck fill connection will be provided with a fill pipe cap and chain. 49 49 29 Q430.44N

15/16

Insert A for Rq. 9.5-42

15

5. The engine mounted components are designed in accordance with the Diesel Engine Manufacturers Association (DEMA) requirements and meets ANSI B31.1, N45.2, seismic Category I and 10CFR50 Appendix B requirements. AN INDICATION of TYPICAL materials used and the margin between design pressure and working pressure for the on-engine piping is shown in Table 9.5.4-1.

Insert B

14

... for the standby DG based on the fuel consumption of the engine (approximately 5-6 gpm at operation). The engine-driven fuel oil transfer pumps, however, actually ~~remove fuel oil from the FOST~~ operate at a rate of approximately 11 gpm. Excess fuel is returned directly to the FOST via ~~a~~ Category I, SC 3 piping ~~and be~~ by the engine driven fuel oil transfer pumps. The drain tank, which is NNS and is not required for operation, is used to collect any other excess oil from the fuel nozzle and injector and return it to the FOST as necessary. The fuel oil drain tank and transfer pump are seismically supported to prevent their collapse during and after an SSE AND the piping is FABRICATED to ANS B31.1 REQUIREMENTS. The effects of fire in the DG building is addressed in the FHAR (Sections 3.4, 4.2 items F.9 & 10).

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
AIR STARTING SYSTEM					
3.500	A-312 GR-TP316 Pipe	0.083	0.0231	908	250
2.375	A-312 GR-TP316 Pipe	0.065	0.0158	1052	250
1.315	A-312 GR-TP316 Pipe	0.065	0.0087	1932	250
1.050	A-312 GR-TP316 Pipe	0.065	0.00694	2448	250
0.50	A-312 GR-TP316 Tube	0.035	0.00331	2788	250
0.313	A-312 GR-TP316 Tube	0.035	0.00207	4617	250
0.25	A-312 GR-TP316 Tube	0.035	0.00165	5927	250

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

15/16

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
AIR STARTING SYSTEM (Cont'd)					
0.325	A-312 GR-TP316 Tube	0.035	0.00215	4430	250
JACKET WATER SYSTEM					
10.750	A-106 GR-B	0.365	.084[3]	1047	60
6.625	A-106 GR-B	0.280	.07575[3]	1312	60
3.500	A-106 GR-B	0.216	.0695[3]	1947	60
2.375	A-106 GR-B	0.154	.06725[3]	2051	60
FUEL OIL SYSTEM					
1.660	A-106 GR-B	0.140	0.001936	2713	35
1.315	A-106 GR-B	0.133	0.001533	3306	35
1.050	A-106 GR-B	0.113	0.001224	3532	35

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

15/16

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
FUEL OIL SYSTEM (Cont'd)					
0.840	A-106 GR-B	0.109	0.000979	4343	35
1.250	A-312 GR-TP316	.083	0.001163	2636	35
1.00	A-312 GR-TP316	.049	0.00093	1917	35
0.75	A-312 GR-TP316	.049	0.000697	2592	35
0.50	A-312 GR-TP316	.0.035	0.000465	2788	35
0.375	A-312 GR-TP316	0.035	0.000349	3792	35
1.315	A-106 GR-B	0.133	0.00438	3306	100
1.050	A-106 GR-B	0.113	0.00350	3532	100
0.840	A-106 GR-B	0.109	0.0028	4343	100

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
LUBE OIL SYSTEM					
8.625	A-106 GR-B	0.322	0.0287	1446	100
6.625	A-106 GR-B	0.280	0.0221	1312	100
3.500	A-106 GR-B	0.216	0.0116	1947	100
2.375	A-106 GR-B	0.154	0.00791	2051	100
1.900	A-106 GR-B	0.145	0.00633	2438	100
1.660	A-106 GR-B	0.140	0.00553	2713	100
1.315	A-106 GR-B	0.133	0.00438	3306	100
1.500	A-269 GR-TP304	0.065	0.00462	1454	100
1.250	A-269 GR-TP304	0.083	0.00385	2272	100

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

15/16

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
LUBE OIL SYSTEM (Cont'd)					
1.000	A-269 GR-TP304	0.049	0.00308	1652	100
0.750	A-269 GR-TP304	0.049	0.00231	2233	100
0.375	A-269 GR-TP304	0.035	0.00115	3368	100
0.250	A-269 GR-TP304	0.035	0.00077	5108	100
INJECTION COOLING SYSTEM					
6.625	A-106 GR-B	0.280	.0735(3)	1312	50
4.500	A-106 GR-B	0.237	.06997(3)	1634	50
1.900	A-106 GR-B	0.145	.06566(3)	2438	50
1.000	A-269 GR-TP304	0.049	0.00154	1652	50
0.500	A-269 GR-TP304	0.035	0.00077	2402	50

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

15/16

TABLE 9.5.4-1
DIESEL ENGINE MANUFACTURER'S STANDARDS

OUTSIDE DIA. (INCHES)	MATERIAL SPECIFICATION	WALL THK. (INCHES)	WALL THK. REQ'D.(1) FOR SYS. PRESS. (IN.)	ANSI B.31.1/ASME III(2) ALLOWABLE PRESS.	SYSTEM WORKING PRESS. (PSI)
INJECTION COOLING SYSTEM (Cont'd)					
0.375	A-269 GR-TP304	0.035	0.000578	3268	50
0.250	A-269 GR-TP304	0.035	0.000385	5108	50
TURBOCHARGE WATER SYSTEM					
2.375	A-106 GR-B	0.154	.06725[3]	2051	60
3.500	A-106 GR-B	0.216	.0695[3]	1947	60

Notes: (1) Wall thickness required to restrain system pressure calculated using equations and procedures from ANSI B31.1-1983 and ASME Codes. Most conservative fabrication and material properties were assumed.
(2) Maximum system pressures allowed for as delivered pipe using method and equations from ANSI B31.1 and ASME Codes. Most conservative fabrication and material properties were assumed.
(3) Included corrosion allowance (1/16") for carbon steel pipes for water and air systems.

15/16

(17)

(For these reasons)

The FOSTs are constructed of carbon steel and made to ASME III specifications.
The tank is located indoors and is provided with exterior protection
(painted). During operation the water content of the fuel oil will be moni-
tored (Section 9.5.4.4) to ensure both operability of ~~the diesels as well as~~ 49
to minimize corrosion of the internal fuel oil system. Internal coatings will
not be added to the FOSTs~~. since a sufficient corrison allowance (0.336") exists in the tank walls.~~ This will alleviate any concern with peeling of
internal coatings and the potential for clogging of the tank discharge. Insert A

Selection of suitable materials compatible with the type of fuel required to
operate the DGs ensures that the system will not be subject to material corro- 41
sion. The basic material of construction for the piping and components in
contact with fuel oil is carbon steel.

Insert B

(every 31 days)

The auxiliary fuel oil storage tank (AFOST) (see Section 9.5.10) will be pro-
tected by an exterior coating to reduce the possibility of corrosion. The
periodic removal of water from the bottom of the tank will help minimize the
possibility of internal corrosion. Sampling and analysis for particulate 49
matter will also be used to detect instability and oxidation of stored fuel
oil which would contribute to corrosion. Appropriate actions will be taken if
significant corrosion products are detected during the periodic testing.

29
Steel Structures Painting Council Surface Preparation Standard, this standard Q430 41
coupled with project specific requirements will be utilized for preparation of .34
the tank surface and application of the coating respectively. N

Buried piping from the yard AFOST and from the external truck fill connection 2
is protected from corrosion by both cathodic protection and coating. Cathodic Q40.15
protection is by the impressed current method. Protective coating consists of 40
coal tar epoxy spray applied per project specific requirements.

Means are provided for detecting and controlling a fuel spill. Each DG room 44
is equipped with an instrumented drain sump. A high level alarm located in Q430.
the main control room will indicate a leak (whether fuel oil, lube oil, cool- 41N
ing water, etc.) in the DG room. Once a leak has been detected it can be
isolated external to the DG room by a shutoff valve in the fuel oil storage
tank room thus preventing further leakage.

The system is designed to withstand environmental design conditions, including 2
earthquake, hurricane, and tornado loadings (see Chapter 3). Q40.15

Each FOST is located within a flood- and missile-proof seismic Category I 41
compartment. Each of the three compartments is physically separated so that a
failure of one fuel oil train will not affect the remaining two trains. In
addition, the compartments are designed so that in the event of a fire, it
will be contained within the compartment. Refer to Figure 1.2-3 and 1.2-4 for
the Plot Plans, and Figure 1.2-10 for the General Arrangement of the DGB. 41

9.5.4.4 <u>Inspection and Testing Requirements</u>. Components of the system
have been inspected and tested by the manufacturer. After installation and
before initial plant operation, the DGFOST System is inspected, tested, and
operated. For the remainder of the plant life, the DG systems will be tested
regularly to ensure performance under emergency conditions. Inservice

INSERT A

PERIODIC (every 31 days) drainage of water accumulation, the use of high quality fuel (water and sediment content less than 0.05% volume), and keeping the fuel oil tanks full (ie 7 day supply) (except during testing), assures that internal corrosion will be negligible.

INSERT B

THE INTERIOR IS COATED, EXCEPT THE LOWER 18 INCHES, WITH EITHER AMERON OR DIMETCOTE D-3 FOR A THICKNESS OF 3 TO 5 MILS. THE LOWER 18 INCHES IS COATED WITH EITHER AMERCOAT NO. 66 OR AMERON FOR A THICKNESS OF 16 MILS.

18/21

The FOSTs are constructed of carbon steel and made to ASME III specifications. The tank is located indoors and is provided with exterior protection (painted). During operation the water content of the fuel oil will be monitored (Section 9.5.4.4) to ensure both operability of the diesels as well as to minimize corrosion of the internal fuel oil system. Internal coatings will not be added to the FOSTs since a sufficient corrison allowance (0.336") exists in the tank walls. This will alleviate any concern with peeling of internal coatings and the potential for clogging of the tank discharge. 49

Selection of suitable materials compatible with the type of fuel required to operate the DGs ensures that the system will not be subject to material corrosion. The basic material of construction for the piping and components in contact with fuel oil is carbon steel. 41

The auxiliary fuel oil storage tank (AFOST) (see Section 9.5.10) will be protected by an exterior coating to reduce the possibility of corrosion. The periodic removal of water from the bottom of the tank will help minimize the possibility of internal corrosion. Sampling and analysis for particulate matter will also be used to detect instability and oxidation of stored fuel oil which would contribute to corrosion. Appropriate actions will be taken if significant corrosion products are detected during the periodic testing. 49

Steel Structures Painting Council Surface Preparation Standard, this standard coupled with project specific requirements will be utilized for preparation of the tank surface and application of the coating respectively. 29 Q430.34N 4

Buried piping from the yard AFOST and from the external truck fill connection is protected from corrosion by both cathodic protection and coating. Cathodic protection is by the impressed current method. Protective coating consists of coal tar epoxy spray applied per project specific requirements. 2 Q40.15 40

Insert

Means are provided for detecting and controlling a fuel spill. Each DG room is equipped with an instrumented drain sump. A high level alarm located in the main control room will indicate a leak (whether fuel oil, lube oil, cooling water, etc.) in the DG room. Once a leak has been detected it can be isolated external to the DG room by a shutoff valve in the fuel oil storage tank room thus preventing further leakage. 44 Q430.41N

The system is designed to withstand environmental design conditions, including earthquake, hurricane, and tornado loadings (see Chapter 3). 2 Q40.15

Each FOST is located within a flood- and missile-proof seismic Category I compartment. Each of the three compartments is physically separated so that a failure of one fuel oil train will not affect the remaining two trains. In addition, the compartments are designed so that in the event of a fire, it will be contained within the compartment. Refer to Figure 1.2-3 and 1.2-4 for the Plot Plans, and Figure 1.2-10 for the General Arrangement of the DGB. 41

9.5.4.4 <u>Inspection and Testing Requirements</u>. Components of the system have been inspected and tested by the manufacturer. After installation and before initial plant operation, the DGFOST System is inspected, tested, and operated. ~~For the remainder of the plant life, the DG systems will be tested regularly to ensure performance under emergency conditions.~~ Inservice 41

Insert

(18) Insert for Sect. 9.5.4.4, Q. 9.5-43

The initial calibration frequency for the instruments associated with the diesel fuel oil storage and transfer system will be at least once every 18 months. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience, and vendor recommendations.

The operator action required following alarm actuation will be specified in the annunciator response procedures which are currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load.

(2) Insert for Section 9.5.4.3 / Pg. 9.5-43

Current plans for maintenance and testing of the cathodic protection system serving the fuel oil piping include regular checks of rectifier output and periodic potential surveys. ~~No description has been provided in the FSAR because~~ This system is non-safety related and the system it protects is non-safety related. Alternate fill connections are provided for the seven day fuel oil tanks serving the ~~ESF~~ standby diesel generators as stated in ~~Section~~ previous paragraphs. Specifically the truck fill and emergency fill connections ~~are~~ will provide a backup ~~as the~~ means of filling the tank.

18/21

Question 430.42N

Describe the instruments, controls, sensors and alarms provided for monitoring the diesel engine fuel oil storage and transfer system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer, and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the system interlocks provided. (SRP 9.5.4, Part III, Item 1.)

Response

Refer to Section 9.5.4.~~3,~~ 4 and Figure 9.5.4-1, ~~and the response to Q40.34.~~ 49

Question 040.20

Discuss the precautionary measures that will be taken to assure the quality and reliability of the fuel oil supply for emergency diesel generator operation. Include the type of fuel oil, impurity and quality limitations as well as diesel index number or its equivalent, clould point, entrained moisture, sulfur, particulates and other deleterious insoluble substances; procedure for testing newly delivered fuel, periodic sampling and testing of onsite fuel oil (including interval between tests), interval of time between periodic removal of condensate from fuel tanks and periodic system inspection. In your discussion include reference to industry. (or other) standards which will be followed to assure a reliable fuel oil supply to the emergency generators. (SRP 9.5.4, Part III, items 3 and 4).

Response

1. STP intends to use the McGuire Technical Specifications with the following exception:

   ASTM D4294-83, Sulfur in Petroleum Products by Non-Dispersive X-Ray Fluorescence Spectrometry, will be included in the STPEGS Technical Specifications in addition to ASTM D2622-82, Sulfur in Petroleum Products X-Ray Spectrographic Method. These two analytical procedures are similar in measurement methodology.

   Both methods utilize x-rays to excite the sample. The fundamental difference lies in the method of detection. ASTM D2622-82 describes a general purpose wavelength to dispersive X-ray spectrograph. It uses detector positioning to quantify the sulfur K-alpha radiation (a specific wavelength of radiation which is manifested due to the presence of sulfur). K-alpha radiation is dispersed from an analyzing crystal at a specific angle. ASTM D4294-83 describes a dedicated non-wavelength dispersive sulfur X-ray analyzer. It uses a filter to allow only a narrow band pass of X-rays, which includes the sulfur K-alpha radiation, to reach the detector. 49

   The wavelength dispersive spectrograph is designed to detect low levels in general, and can detect as low as 10 ppm sulfur. The non-wavelength dispersive analyzer's sensitivity is 100 ppm, but is well suited for the 1000 ppm or greater level of sulfur normally found in no. 2 diesel fuel oil.

   Dedicated sulfur analyzers employing the non-wavelength dispersive technique drastically reduce the cost of sulfur analyses, when compared to the general purpose wavelength dispersive spectrograph required by ASTM D2622-82.

Insert

2. The quality of the fuel oil supply will be verified in accordance with applicable industry standards as discussed in Section 9.5.4.4.

Insert for Q040.20

It should be noted that ~~In addition Mr. K.R. Strauss,~~ the consultant used by SNUPPS to revise their Technical Specifications, was contacted on this matter and his professional recommendation was requested. He ~~Mr. Strauss~~ concurred that the proposed test method satisfies the intent of ASTM 2622-82 and could be used as an alternate test method for sulfur. This recommendation has been documented and is available for NRC review.

inspection will be performed in accordance with ASME Boiler and Pressure Vessel (B&PV) Code, Section XI. The quality of the fuel oil used for the operation of the Standby Diesel Generators (SBDGs) will be checked by the following methods: 41 Q40.20 Q430.45N

1. When the fuel oil is transferred from the AFOST to the DGFOST, the quality of the fuel oil in the AFOST will be verified by one of two methods:

   a) Taking a composite multi-level sample of the fuel oil in the AFOST, prior to addition to the DGFOST, and testing the sample for the parameters identified in Technical Specification Section 4.8.1.1.2 item d, or

   b) sampling the contents at each supply truck prior to addition to the AFOST and testing for the parameters identified in Technical Specification Section 4.8.1.1.2 item d. 49

2. When the fuel oil is added directly to the DGFOST from a supply truck a sample will be taken and tested for the parameters identified in Technical Specification Section 4.8.1.1.2 item d.

3. The sample is tested for the following in accordance with ASTM D975-81:

   a) API Gravity or Specific Gravity 41 Q40.20

   b) Kinematic viscosity Q430.45N

   c) Flashpoint

   d) Clear and bright appearance

Within 30 days of obtaining the sample, the fuel oil will be tested for conformance with the other properties as specified in ASTM D975-81, Table 1.

5. The sulfur analysis will be in accordance with ASTM D1552-79, ASTM-D2622-82, and ASTM D4294-83. 49

6. Once in storage, the DGFOST and the AFOST fuel oil is sampled periodically in accordance with ASTM D2276-78 and verified that particulate contamination is within limits. 41 Q40.20 Q430.45N

Insert

9.5.4.5 Instrumentation Application. The three DGs are provided with independent fuel oil supply systems. Each fuel oil supply system is provided with its own instrumentation. Applicable portions of the fuel system instrumentation are designed to seismic Category I requirements, as defined in Section 3.2. 41

Each DGFOST is provided with level indication in the main control room at the local panel and locally at the tank. High-level, low-level and low-low-level alarms are provided for each tank. These alarms annunciate in the main control room (common trouble alarm) and at the local panel. 41

Insert for Sect. 9.5.4.4 / Pg 9.5-44

Water removal and sampling for total particulates for the yard AFOST will be by administrative procedure at the same periodic interval as the diesel generator fuel oil storage tanks (ie at least every 31 days). Periodic removal of water from the DGFOST will be in accordance with the Technical Specifications.

enclosing structures. The system is designed to operate during and after the probable maximum flood. 41

5. The system is designed to accommodate periodic testing as outlined in the Technical Specifications. 41

9.5.4.2 System Description. The DGFOST System is shown on Figure 9.5.4-1. Unit 1 is furnished with independent fuel trains, one for each standby DG. Unit 2 is identical. 41 41

Each fuel train consists of a storage tank and the necessary piping, valves, and instrumentation. The fuel oil storage tank (FOST) contains a 7-day supply of fuel (approximately 67,000 gallons) for the standby DG. Seven days is the minimum required for emergency operations. A normally isolated line is connected to the storage tank truck fill line and the Auxiliary Boiler Fuel Storage and Transfer System (see Section 9.5.10). This connection may be used for replenishing the fuel used for testing the DGs. Each FOST is provided with a drain, vent with flame arrester, overflow truck fill line, and inspection manhole cover. 41 2 Q40.12 41

Since the elevated FOST provides the assured seven day supply without replenishment from the main storage tank, the operation of the system to supply fuel oil to the engine is completely passive. This is the normal operating mode of the system. There are no other modes of operation. 41 44 41 29 Q430.44

The existing STP arrangement is considered technically superior to an arrangement recommended by ANSI standard N195. Each standby DG at STP has a single, elevated tank provided in a separate compartment of the DGB. During the seven day emergency operation the system is completely passive, requiring no transfer pumps and is, therefore, more reliable. There are no buried tanks or piping in the system, thus eliminating the problem of corrosion of components by groundwater and the contamination of fuel oil by groundwater intrusion. 41 44

9.5.4.3 System Evaluation. The DGFOST System is designed to seismic Category I, Safety Class (SC) 3 requirements and will withstand a single failure and still perform its functional requirements. Failure of any one FOST System component results in the failure of only one standby DG. The safe shutdown of the reactor coincident with a LOOP is achieved using the remaining two DGs. A failure modes and effects analysis (FMEA) is provided in Table 9.5.5-2. 41 41

Provisions will be made for emergency refueling in case of a flood.

For the emergency fill connection a Safety Class 3 pipe routed through the roof to the FOST fill line ~~will be~~ is equipped with an ASME III Class 3 locked closed valve, filter and a quick disconnect coupling connected upstream of the valve (see Figure 9.5.4-1). A hose could then be routed to the roof via an existing hose reel for tank filling when the flood level has receded. A sampling point is also provided upstream of the isolation valve which allows checking and flushing the line prior to filling operations from the truck fill. The end of the truck fill connection will be provided with a fill pipe cap and chain. 49 49 29 Q430.44N

Insert K

Insert K

It is considered improbable that a missile would strike the fill connection since it is only four inches in diameter and less than 2 feet high and is protected by the DGB roof layout. The DG FOST's are normally filled from the AFOST rather than from the outside connections. The DG FOST's would not require fuel oil addition in the first few days following a tornado event and could be filled from any one of three sources (emergency fill, normal truck fill, and the AFOST) which are available. The postulation of a tornado concurrent with the design basis flood (prohibiting access) is not a credible event and is not a design basis for STP.

Question 040.21

What provisions have been made in the design of the emergency diesel engine fuel oil storage and transfer system to minimize the entrance of deleterious material into the system during recharging, by operator error or natural phenomena? (SRP 9.5.4, Part III, item 4).

Response

Strainers are provided in the lines which carry fuel oil from both sources of replenishment: the temporary truck fill connection and the Fuel Oil Storage System (See Figures 9.5.4-1 and 9.5.10-1). Sampling of the fuel oil as described in Section 9.5.4.4 will prevent entrance of deleterious material into the system during initial and subsequent fills. Section 9.5.4.3 also discusses how the entrance of deleterious materials into the system is precluded. 49 41

As seen in Figure 9.5.4-1, The emergency fill connection described in Section 9.5.4.3 will be provided with a ~~means of~~ strainer for removing deleterious material prior to filling of the tank. 49

Question 430.86N

In Section 9.5.4.3 of the FSAR you state that the emergency flood protected fill connection for the fuel oil storage tanks is located on the DG building roof. It is also stated that "a hose could then be routed to the roof via an existing hose reel for tank filling when the flood level has receded". Provide the following:

a. State whether the "existing hose reel" is located inside or outside the DG building. Describe any other uses (fire protection, etc.) associated with this hose and hose reel.

b. Assuming the emergency fill connection must be used to refill the fuel oil storage tanks, describe how fuel oil will be delivered to the site during flood conditions and the procedures that will be used in refilling and storage tanks during flood conditions and non-flood conditions. The procedures should include fuel hose routing and fire watches. (SRP 9.5.4, Parts I, II, and III).

Response

a. Present plans are not to provide a permanent existing hose reel in the Diesel Generator Building (DGB), but to utilize a hose from the fuel delivery service (i.e., truck).

b. Plant procedures will detail the method for refilling the storage tanks using the emergency fill connection. The procedure will include provisions for routing the hose up to the roof from outside the building. The truck pump can supply sufficient head to transfer the fuel oil from the truck to the storage tank.

The method for delivery of fuel oil to the site will be via standard fuel-oil tank truck, even in the event of flood conditions. Insert The duration of ~~impassable flood water levels~~ around the site is such that the on-site seven day fuel oil capacity is adequate to endure the maximum flood event.

Hydrology studies for STP show that the limiting flood event, the breech of upstream dams (see Section 2.4, event 7), results in flood levels that increase gradually to approximately four ft above grade and decrease gradually afterwards. However, the total duration of flood water levels which exceed the local grade elevation is only two and one-half days. For further discussion of external flooding see Section 2.4.

Insert for Q430.86N

Local fuel oil distributors utilize Roper rotary pumps on their fuel oil trucks. The pump vendor has verified that the pumps have sufficient discharge head to transfer the fuel oil from the truck to the storage tank using the emergency fill connection. A procedure for emergency filling of the fuel oil storage tanks will be in place prior to fuel load.

26

9.5.5 Diesel Generator Cooling Water System 29

9.5.5.1 Design Bases. The DG Cooling Water System (DGCWS) is designed Q43
to circulate sufficient quantities of cooling water to dissipate heat given 49
off by the air coolers, lube oil coolers, and engine water jackets, under full
load conditions. 29

The DGCWS is designed to seismic Category I and SC 3 requirements. In addi- Q43 49
tion, each DG and its associated Closed-Loop Cooling Water System are located
in a physically separated tornado-, flood-, and missile-proof structure in the 41
DGB, and are protected from the effects of moderate-energy line breaks. 49

Insert 2

9.5.5.2 System Description. The DGCWS consists of a Closed-Loop Cooling 41
Water System and an Open-Loop Cooling Water System. A schematic diagram for
both systems is shown on Figure 9.5.5-1. Major components and design data are 29 Q43
provided in Table 9.5.5-1. 49

9.5.5.2.1 Closed-Loop Cooling Water System: A forced-circulation Jacket
Closed-Loop Cooling Water System is furnished for each DG to provide cooling
of the engine by means of a water jacket and to supply heat to the combustion
air, if necessary, via two air heaters/intercoolers. 41

This system consists of the following components:

1. Engine-driven jacket water pump
2. AC motor-driven jacket water standby pump
3. AC motor-driven circulation pump 29 Q43 49
4. Jacket water cooler
5. An automatic thermostatic valve
6. Jacket water standpipe
7. Combustion air heaters/intercoolers (one for each cylinder bank)
8. Electric water heater
9. Local control panel
10. Required instrumentation and piping 41

During normal operation, the engine-driven jacket water pump circulates water
through the jacket water cooler, then through the engine water jackets and
combustion air heaters/intercoolers back to the standpipe.

The standpipe provides a reserve to compensate for minor system leakages at 29
pump shaft seals and valve stems. There is no normal consumption of jacket Q4
water. The standpipe also serves to maintain adequate NPSH on the jacket 27
water pumps and to provide a holdup volume for jacket water to allow for Q4 29

39

9.5.5.5 Instrumentation Application. The necessary controls are provided with each cooling system to maintain the engine jacket at the proper temperature for all modes of operation. Alarms are provided at the local control panel, with a common DG trouble alarm in the main control room, for low jacket water standpipe level, abnormal jacket water temperature, and low jacket water pressure at the inlet to the engine. The DGCWs indications and alarms are summarized in Table 9.5.5-3 and DG protective trips are discussed in Section 8.3.1.1.4.6. Alarm response procedures described in Section 13.5.2.1(5) will be prepared for alarms associated with this system. 41 29 Q430.

9.5.5.6 No Load Operation Actual shop tests performed on a prototype KSV-20-T diesel engine showed the engine capable of running at no-load for an extended period. Following six hours of no-load operation at rated speed, the engines were subjected to a 75 percent load test for one hour, followed by a 50 percent load test for one hour. Based on the prototype testing, no adjustments need to be made to the STP engines or controls. The operating procedures require interspersing 15-30 minute periods of operation at 75-100 percent load at approximately 6 hour intervals when operating the diesel for longer than six hours at light loads (less than 50 percent). 29 Q430. 50N 41 49

9.5.6 Diesel Generator Starting System and N45.2

9.5.6.1 Design Bases. Each DG is provided with two compressed starting air systems, either of which is capable of starting the engine without power. The starting air system, including the interconnecting piping and the on-engine piping, is designed to seismic Category I, SC 3 requirements, except for the compressors and dryers, which are Non-Nuclear Safety. The on-engine piping is designed to Diesel Engine Manufacturers Association (DEMA) requirements and meets ANSI B31.1. The equipment is located within the DG compartments and is therefore protected from tornado winds, external missiles, flooding, and the effects of moderate-energy line breaks (see Chapter 3). 41 49

Insert 1

9.5.6.2 System Description. A schematic of the redundant DG Starting Air System for one diesel engine is shown on Figure 9.5.6-1. Each Starting Air System includes two ac motor-driven air compressors, two air dryers, two air receivers, two starting air valves, all necessary valves and fittings, instrumentation, and control systems. Table 9.5.6.-1 lists major components in the DGSS and their design data. 41 29 Q430. 52N

Each redundant air receiver is isolated from the nonsafety-related portions of the Starting Air System by one check valve and a manually operated isolation valve. Each receiver has a volume of 83 ft^3 and a design pressure of 275 psig. This is sufficient for five start attempts per receiver without recharging. The receiver is constructed of stainless steel. The air compressors are sized to recharge each receiver from minimum pressure to maximum pressure in 17 minutes. Each receiver is provided with a pressure switch to stop and start the compressors as required. Low pressure is alarmed locally and as a common trouble alarm in the main control room. High pressure safety relief valves are provided. 29 Q 430. 52N 41 29 Q430. 52 N 41

From the receiver, the air flows to the engine-mounted components through stainless steel interconnecting piping. The on-engine components consist of 29 Q430. 52N

(35)

9.5.6.5 Instrumentation. Controls and alarms are provided at the local panel for 29 Q430. 51N

1. Independently starting and stopping the compressors. 41

2. Opening each starting air valve. 41

3. Alarming low starting air pressure with a common DG alarm in the main control room.

Indication of starting air pressure upstream of the starting air valves is provided in the control room and locally.

The DG starting air system indications and alarms are summarized in Table 9.5.6-2. Instruments are checked during periodic testing of the engine. 29 41 Calibrations are routinely performed and alarms verified operable as described Q430. in Section 13.5.2. 51N

9.5.7 Diesel Generator Lubrication System

9.5.7.1 Design Bases. The DG Lubrication System is designed to provide a self-contained lube oil system for each DG engine. The system is safety-related and consequently is designed to seismic Category I, SC 3, ~~and DEMA~~ up to the engine mounted components. ~~requirements~~.

Insert 3

The equipment is located within the DG compartments and therefore is protected from tornado winds, external missiles, flooding, and the effects of moderate-energy line breaks (see Chapter 3). 41

9.5.7.2 System Description. The lubrication system of each engine includes a direct engine-driven lube oil pump, an ac motor-driven lube oil standby pump, an ac motor-driven circulation pump, lube oil filters and strainers, a lube oil cooler, a thermostatic valve, an electric lube oil heater, and all necessary valves, fittings, piping, and instrumentation. The standby pump and circulation pump motors are powered from 480 V Class 1E motor control centers. A schematic of the DG Lubrication System is shown on Figure 9.5.7-1. 41 29 41 Q430. 54N

Table 9.5.7-1 lists the major components in the lubrication system and their design data.

The engine-driven lube oil pump has sufficient capacity to ensure adequate lubrication of all wearing parts as required. The ac motor-driven lube oil standby pump has sufficient capacity to replace the engine-driven pump should it fail. The lube oil pumps take oil from the lube oil sump through a strainer and deliver it to the thermostatic valve. This valve controls the lube oil temperature by bypassing a portion of the lube oil flow around the lube oil cooler. From the thermostatic valve and the lube oil cooler, the lube oil flows first through a full-flow oil filter and then through a duplex lube oil strainer. The lube oil then flows to the various engine components requiring lubrication and/or oil cooling and returns to the engine lube oil sump. 41

Insert 1 (30)

The DG has also been subjected to 10CFR50 Appendix B QA plan. (See Table 9.5.4-1)

Insert 2 (26)

The engine mounted components are designed in accordance with the Diesel Engine Manufacturers Association (DEMA) requirements and meet~~s~~ ANSI B31.1 N45.2 seismic Category I requirements and 10CFR50 Appendix B QA. (See Table 9.5.4-1)

Insert 3 (35)

Same as insert 2.

~~the engine m~~

Question 430.47N

The FSAR text, Figure 9.5.4-1 through 9.5.8-1, and Table 3.2-1 states that the components and piping systems for the diesel generator auxiliaries (fuel oil system, cooling water, lubrication, air starting, and intake and combustion system) that are mounted on the auxiliary skids are designed seismic Category I and are ASME Section III Class 3 quality. The engine mounted components and piping are designed and manufactured to DEMA standards, and are seismic Category I. This is not in accordance with Regulatory Guide 1.26 which requires the entire diesel generator auxiliary systems be designed to ASME Section III Class 3 or Quality. Group C. Provide the industry standards that were used in the design, manufacture, and inspection of the engine mounted piping and components. Also show on the appropriate P&ID's where the Quality Group Classification changes from ASME Section III Class 3 (Quality Group C).

Response

Regulatory Guide (RG) 1.26, Revision 3, states:

> "Other systems not covered by this guide, such as instrument and service air, diesel engine and its generators and auxiliary support systems, diesel fuel, emergency and normal ventilation, fuel handling, and radioactive waste management systems, should be designed, fabricated erected, and tested to quality standards commensurate with the safety function to be performed."

The engine mounted components and piping ~~for the diesel generators auxiliaries are considered part of the engine; their design and function are integrated with the engine rather than the skid piping. Therefore, they are designed and manufactured to standards applicable to the engine (DEMA) and are seismic Category I. It is noted that the engine mounted piping is manufactured to ANSI B31.1 standards.~~ The DEMA standards provide assurance that these auxiliaries are designed, fabricated, erected, and tested to quality standards commensurate with the safety function to be performed. In addition to DEMA tests, the engine is qualified by a reliability test. 49

Insert Q430.47N

Amended Figures 9.5.5-1, 9.5.7-1, 9.5.4-1, 9.5.6-1, and 9.5.8-1 show quality group changes.

- from the engine block to the engine interface are considered part of the engine assembly and are seismically qualified to Category I requirements. This piping and associated components such as valves, manufactured [illegible], fittings, etc... are designed, ~~to~~ manufactured and tested in accordance with the guidelines and requirements of DEMA, ANSI B31.1, ANSI N45.2 and 10CFR 50 Appendix B [illegible]. (See table 9.5.4-1).

Insert Q430.47N

~~As a result~~ ~~Genericalby~~, Diesels are subject to low working stresses for the application which results in a high operational reliability.

Generally

Table 9.5.5-1 lists the capacity and discharge head of the pumps and rating of the jacket water heaters. 41

9.5.5.2.2 Open-Loop Cooling Water System: The Open-Loop Cooling Water System is a subsystem of the Essential Cooling Water System (ECWS) (see Section 9.2.1). It provides cooling water for the Closed Cooling Water System (CCWS), the lube oil cooler, the fuel oil cooler, the governor oil cooler, and the combustion air intercoolers (one cooler per cylinder bank). 41

Each DG has its own separate Open-Loop Cooling Water System, which is supplied with cooling water by separate trains of the ECWS. There are no interconnections of individual trains of the Open-Loop Cooling Water System. 41

During operation, full cooling water flow is supplied to all of those components serviced by the Open-Loop Cooling Water System. The flows and heat loads for the various components are given in Table 9.5.5-1. The values are based on an ECWS supply temperature of 115°F. The total flow of the Open-Loop Cooling Water System is 1,500 gal/min with a full load total heat load of 13,244,400 Btu/hr. 41

9.5.5.3 System Evaluation. Each DG has an independent Cooling Water System with an independent source of water to the jacket water cooler. The DGCWS meets the single-failure criterion so that if a failure in one Cooling Water System prevents the associated DG from operating, the remaining DGs are not affected. The DG Closed Cooling Water System pumps are powered from a Class 1E source. A failure modes and effects analysis is provided in Table 9.5.5-2. 41 29 Q430.49N 41

In the event of LOOP, the ECWS will begin operation within a specific time lapse (see Section 8.3) from initial startup of the DG. The time lapse will be within a safe margin of the point at which the DG would require the cooling capability of the coolers. 41

The DGCWS is capable of operating for a minimum of seven days without makeup from any source with the diesel generator operating at rated load. Beyond the seven-day period, makeup water if required can be provided. Sufficient instrumentation is provided to alert the operator to low water level, and adequate time is available for operator action. For these reasons, no seismic Category I system is required to provide assured makeup water for the DGCWS. Cooling water chemistry is maintained within the manufacturer's specifications to preclude corrosion and fouling. 29 Q430 49N 2 | 4 Q40.28 29 Q430 49N

9.5.5.4 Inspection and Testing Requirements. The DGCWS will be inspected and tested during the scheduled operational tests of the DGs. The cooling water in the closed-loop system will be periodically analyzed and treated as necessary to maintain the desired water quality. Inservice inspection will be performed in accordance with ASME B&PV Code, Section XI. 41

Insert

Instrumentation provided to monitor cooling water temperature, pressure, and standpipe level will be periodically calibrated and alarms verified operable as described in Section 13.5.2. 29 Q430 49N

Note: Keep same Q
Change bar

(27)

Insert for Sect. 9.5.5.4 / Pg. 9.5-47

The initial calibration frequency for the instruments associated with the diesel cooling water system (e.g. that instrumentation required to monitor cooling water temperature, pressure, and standpipe level) will be at least once every 18 months. This frequency may be revised based or evaluations of factors such as plant operating experience, industry experience, and vendor recommendations.

27

Question 430.49N

Describe the instrumentation, controls, sensors and alarms provided for monitoring of the diesel engine cooling water system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system, and where the alarms are annunciated. Identify the temperature, pressure, level and flow (where applicable) sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the systems interlocks provided. (SRP 9.5.6, Part III, item IC).

Response

STET

and

Refer to Section~~s 9.5.5.4 and 9.5.5.5;~~ Figure 9.5.5-1; and Table 9.5.5-3; ~~and to the response to Q40.34.~~ 49

Question 430.91N

Recent licensee event reports have shown that tube leaks are being experienced in the heat exchangers of diesel engine jacket cooling water systems with resultant engine failure to start on demand. Provide a discussion of the means used to detect tube leakage and to corrective measures that will be taken. Include jacket water leakage into the lube oil system (standby mode), lube oil leakage into the jacket water (operating mode), jacket water leakage into the engine air intake and governor systems (operating or standby mode). Provide the permissible inleakage or outleakage in each of the above conditions which can be tolerated without degraded engine performance or causing engine failure. This discussion should also include the effects of jacket water/service water systems leakage. (SRP 9.5.5, Parts II and III)

Response

The jacket water system is completely separate from and does not interface (provide cooling) with the lube oil and governor systems. The ECW system provides cooling water to these system coolers.

It is noted that a major cause of the reported tube leaks (see IE Information Notice 79-23) was attributed to inadequate tubesheet thicknesses and poor tube to tube sheet attachments. The STP lube oil and jacket water cooler tubesheets are greater than 1" in thickness (vs. 1/8" reported in IE Information Notice 79-23) and the tubes are rolled (vs. soldered and epoxy reported in IE Information Notice 79-23). Another potential cause of tube leaks is the quality of water used for cooling. The essential cooling water (ECW) quality has been evaluated in Section 9.2.1.2.3. The STP diesel engine manufacturer is not aware of any tube leaks in these coolers on diesel engines they have supplied. They have supplied 36 diesel engines to the nuclear industry. Ten of these engines have been operated over ten years and there have been no reports of tube leaks. Based upon the construction of these coolers, tube leakage is considered improbable.

IN THE UNLIKELY EVENT OF TUBE LEAKS, e.g. LUBE OIL
INTO ECW, UNUSUAL AMOUNTS OF MAKEUP REQUIRED IS AN
INDICATION THAT THE SYSTEM SHOULD BE CHECKED FOR LEAKAGE.
THE LUBE OIL SUMP TANK LEVEL GAUGE CAN BE USED TO
CHECK LUBE OIL LEVEL FOR ABNORMAL CHANGES. FOR A JACKET
WATER / ECW LEAK, JACKET WATER WOULD LEAK INTO ECW
RESULTING IN LOWERING THE JACKET water standpipe LEVEL.
THIS WOULD ALARM (IN THE CONTROL ROOM) RESULTING IN OPENING
OF THE JACKET WATER FLOW CONTROL VALVE and resupplying
the standpipe. Corrective measures could then be initiated.
ADDITIONALLY, THE COOLING WATER, LUBE OIL, AIR INTAKE
SYSTEMS will BE INSPECTED ~~IN ACCORDANCE WITH~~ as described in 9.5.5.4, 9.5.7.4
AND 9.5.8.4 RESPECTIVELY.

9.5.6.5 Instrumentation. Controls and alarms are provided at the local panel for 29 Q430.51N

1. Independently starting and stopping the compressors. 41

2. Opening each starting air valve. 41

3. Alarming low starting air pressure with a common DG alarm in the main control room.

Indication of starting air pressure upstream of the starting air valves is provided in the control room and locally.

The DG starting air system indications and alarms are summarized in Table 9.5.6-2. Instruments are checked during periodic testing of the engine. ~~Calibrations are routinely performed and alarms verified operable as described in Section 13.5.2.~~ 29 41 Q430.51N

9.5.7 Diesel Generator Lubrication System

9.5.7.1 Design Bases. The DG Lubrication System is designed to provide a self-contained lube oil system for each DG engine. The system is safety-related and consequently is designed to seismic Category I, SC 3, and DEMA requirements.

The equipment is located within the DG compartments and therefore is protected from tornado winds, external missiles, flooding, and the effects of moderate-energy line breaks (see Chapter 3). 41

9.5.7.2 System Description. The lubrication system of each engine includes a direct engine-driven lube oil pump, an ac motor-driven lube oil standby pump, an ac motor-driven circulation pump, lube oil filters and strainers, a lube oil cooler, a thermostatic valve, an electric lube oil heater, and all necessary valves, fittings, piping, and instrumentation. The standby pump and circulation pump motors are powered from 480 V Class 1E motor control centers. A schematic of the DG Lubrication System is shown on Figure 9.5.7-1. 41 29 41 Q430.54N

Table 9.5.7-1 lists the major components in the lubrication system and their design data.

The engine-driven lube oil pump has sufficient capacity to ensure adequate lubrication of all wearing parts as required. The ac motor-driven lube oil standby pump has sufficient capacity to replace the engine-driven pump should it fail. The lube oil pumps take oil from the lube oil sump through a strainer and deliver it to the thermostatic valve. This valve controls the lube oil temperature by bypassing a portion of the lube oil flow around the lube oil cooler. From the thermostatic valve and the lube oil cooler, the lube oil flows first through a full-flow oil filter and then through a duplex lube oil strainer. The lube oil then flows to the various engine components requiring lubrication and/or oil cooling and returns to the engine lube oil sump. 41

Insert for Section 9.5.6.5/ Pg. 9.5-50

The initial calibration frequency for the instruments associated with the diesel starting air system will be at least once every 18 months. These frequencies may be revised based on evaluations of factors such as plant operating experience, industry experience, and vendor recommendations.

The operator action required following alarm actuation will be specified in the annunciator response procedure which is currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load.

Regarding the air dryers, each starting system air dryer is equipped with a moisture indicator which will be checked monthly, in accordance with the vendor's recommendation. In addition we will follow the vendor recommendation to sample, inspect, and replace (as required) the dryer desiccant at least once every 12 months. ~~These frequencies may be revised based on evaluation of factors such as plant operating experience, industry experience, and vendor recommendations.~~ These activities will be governed by plant procedures.

two strainers, four pilot-solenoid, air-operated starting valves, two rotary air distributors, and the air headers for the left and right cylinder banks. The on-engine piping is also stainless steel.

The Starting Air System also supplies instrument air for essential and nonessential engine controls and air for the air motor on the maintenance barring device.

Carry-over of moisture, oil and corrosion products to the starting air valves 29 Q430.52N is prevented by filters at the compressor inlet, desiccant driers at the compressor discharge, and traps in the air receiver drains. In addition, other 49 inline filters are provided as indicated in Figure 9.5.6-1. Furthermore, stainless steel is used for all surfaces exposed to starting air.

Each air compressor serves one receiver tank. The compressors start when the air receiver pressure is 240 psig falling and stops when the pressure reaches 250 psig. The compressors are powered from a 480 V Non-Class 1E Motor Control Center.

A check valve between the air dryer and air receiver ensures that a broken 29 Q430.52N line will not result in a sudden loss of air. Pressure relief valves between the compressor and dryer and on the receiver are set at 265 psig. The relief valves in the air receivers can be manually tripped for test or for blowing down the receiver pressure.

Compressed air from the starting air receivers is applied to the starting air control valves, which are controlled by the starting air solenoid valves. When the starting air control valves open, starting air is supplied to both banks of air start valves and air distributors. One start valve is located in each cylinder head and all are controlled by the air distributors.

Alarm response procedures described in Sections 13.5.2.1 and 13.5.2.2 are prepared for alarms associated with this system. Information will be available to the operator to provide guidance in alarm response.

9.5.6.3 <u>System Evaluation</u>. The starting system for each DG is completely independent of the starting systems of the two other DGs. Consequently, failure of one starting system will result in failure of that DG only. The remaining DGs will be able to safely shut down the plant or mitigate the effects of a LOCA coincident with a LOOP. A failure modes and effects analysis (FMEA) is provided in Table 9.5.5-2. 41

9.5.6.4 <u>Inspection and Testing Requirements</u>. Periodic tests are performed to ensure system operability. Inspection and scheduled maintenance will be performed periodically using the manufacturer's recommendations and 41 procedures. Inservice inspection will be performed in accordance with the requirements of ASME B&PV Code, Section XI.

The Starting Air System will be periodically tested as a minimum during the 41 regularly scheduled tests of the DGs. Testing can be performed without affecting normal plant operation.

Question 430.51N

Describe the instrumentation, controls, sensors and alarms provided for monitoring the diesel engine air starting system, and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors, and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer describe any operator actions required during alarm conditions to prevent harmful effects to the diesel engine. Discuss system interlocks provided. Revise your FSAR accordingly. (SRP 9.5.6, Part III, item 1).

Response

Refer to Sections 9.5.6.2 and 9.5.6.5; Table 9.5.6-2, and Figure 9.5.6-1, ~~and the response to Q40.34.~~ 49

31/33

Question 430.95N

Expand your FSAR to discuss the procedures that will be followed to ensure the air dryers are working properly and the frequency of checking/testing. (SRP 9.5.6, Parts II and III)

Response

~~A preventive maintenance task has been established to sample and inspect the air dryer desiccant annually.~~

See section 9.5.6.5

two strainers, four pilot-solenoid, air-operated starting valves, two rotary air distributors, and the air headers for the left and right cylinder banks. The on-engine piping is also stainless steel.

The Starting Air System also supplies instrument air for essential and nonessential engine controls and air for the air motor on the maintenance barring device. The air driers have a pre-and after filter to prevent oil from saturating and contaminating the dryer desicant and carryover to the starting air system.

Carry-over of moisture, oil and corrosion products to the starting air valves 29 Q430.52N
is prevented by filters at the compressor inlet, desiccant driers at the compressor discharge, and traps in the air receiver drains. In addition, other 49
inline filters are provided as indicated in Figure 9.5.6-1. Furthermore, stainless steel is used for all surfaces exposed to starting air.

Each air compressor serves one receiver tank. The compressors start when the air receiver pressure is 240 psig falling and stops when the pressure reaches 250 psig. The compressors are powered from a 480 V Non-Class 1E Motor Control Center.

A check valve between the air dryer and air receiver ensures that a broken 29 Q430.52N
line will not result in a sudden loss of air. Pressure relief valves between the compressor and dryer and on the receiver are set at 265 psig. The relief valves in the air receivers can be manually tripped for test or for blowing down the receiver pressure.

Compressed air from the starting air receivers is applied to the starting air control valves, which are controlled by the starting air solenoid valves. When the starting air control valves open, starting air is supplied to both banks of air start valves and air distributors. One start valve is located in each cylinder head and all are controlled by the air distributors.

Alarm response procedures described in Sections 13.5.2.1 and 13.5.2.2 are prepared for alarms associated with this system. Information will be available to the operator to provide guidance in alarm response.

9.5.6.3 System Evaluation. The starting system for each DG is completely independent of the starting systems of the two other DGs. Consequently, failure of one starting system will result in failure of that DG only. The remaining DGs will be able to safely shut down the plant or mitigate the effects of a LOCA coincident with a LOOP. A failure modes and effects analysis (FMEA) is provided in Table 9.5.5-2. 41

9.5.6.4 Inspection and Testing Requirements. Periodic tests are performed to ensure system operability. Inspection and scheduled maintenance will be performed periodically using the manufacturer's recommendations and procedures. Inservice inspection will be performed in accordance with the requirements of ASME B&PV Code, Section XI. 41

The Starting Air System will be periodically tested as a minimum during the regularly scheduled tests of the DGs. Testing can be performed without affecting normal plant operation. 41

Question 430.94N

Diesel generators in many cases utilize air pressure or air flow devices to control diesel generator operation and/or emergency trip functions such as air operated overspeed trips. The air for these controls is normally supplied from the emergency diesel generator air starting system. Provide the following:

a) Expand your FSAR to discuss any diesel engine control functions supplied by the air starting system or any air system. The discussion should include the mode of operation for the control function (air pressure and/or flow), a failure modes and effects analysis, and the necessary P&ID's to evaluate the system.

b) Since air systems are not completely air tight, there is a potential for slight leakage from the system. The air starting system uses a nonseismic air compressor to maintain air pressure in the seismic Category I air receivers during the standby. condition. In case of an accident, a seismic event, and/or loop, the air in the air receivers is used to start the diesel engine. After the engine is started, the air starting system becomes nonessential to diesel generator operation unless the air system supplies air to the engine controls. In this case the controls must rely on the air stored in the air receivers, since the air compressor may not be available to maintain system pressure and/or flow. If your air starting system is used to control engine operation, with the compressor not available, show that a sufficient quantity of air will remain in the air receivers, following a diesel engine start, to control engine operations for a minimum of seven days assuming a reasonable leakage rate. If the air starting system is not used for engine control describe the air control system provided and provide assurance that it can perform for a period of seven days or longer. (SRP 9.5.6, Part III)

Response

1. Air is needed to start the engine and once the engine is operating in the emergency mode, air pressure is no longer required for control function including the maintenance barring device. It should be noted that only two (2) protection trips will stop the engine when operating in the emergency mode: 1) generator differential, 2) overspeeding. One of which, overspeed, uses air to isolate the fuel supply. In the event air is lost a manual operated control is provided. INSERT

2. Not Applicable, See 1. above.

INSERT

It should be noted that there are only Two (2) protection Trips when operating in the emergency mode: 1) generator differential and 2) overspeeding. If a generator differential exists the generator is stripped from the bus mechanically. However, the engine is stopped using air to isolate the fuel supply. In the event air is lost a manual operated control is provided. Although air is needed to stop the engine, it is not needed to satisfy the system protection since the bus is stripped mechanically. In the event an overspeed exists the engine is stopped by the combustion air is blocked to the turbocharger via mechanical operation of a butterfly valve. The fuel supply is stopped in the same manner as for the generator differential with the use of the air controlled valve.

remaining DGs will be adequate to safely shut down the plant or mitigate the effects of a LOCA during LOOP conditions. A failure modes and effects analysis is provided in Table 9.5.5-2. 41

9.5.7.4 Inspection and Testing Requirements. The DG Lubrication System will be inspected and tested during the regularly scheduled tests of the DGs. Inservice inspection shall be performed in accordance with the ASME B&PV Code, Section XI.

9.5.7.5 Instrumentation. A common trouble alarm will be provided in the main control room and individual alarms in the local panel for low oil pressure, high and low oil temperature, high and low lube oil level, high filter and high strainer differential pressures. Indication is provided in the main control room and locally for oil pressure and oil temperature at the inlet to the engine. Indication is also provided locally for lube oil level in the crank case. The Lube Oil System indications and alarms are summarized in Table 9.5.7-2. 29 Q430.54N 41 2 Q40.33 41

Insert ~~Instruments are checked, calibrations are routinely performed and~~ alarms are verified operable as described in Section 13.5.2. 29 Q430.54N

The DG protective trips are discussed in Section 8.3.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

9.5.8.1 Design Bases. The Diesel Generator Combustion Air Intake and Exhaust System (DGCAIES) is designed to supply the DG engine with a sufficient quantity of combustion air to enable it to perform its safety function and to then discharge the exhaust gases so that the gases do not dilute the combustion air sufficiently to affect the operation of the DG engine. The on-engine piping and components are design to DEMA requirements. 41

The following components are designed in accordance with manufacturer's standards:

1. Expansion joints
2. Oil-bath air intake filter and silencer
3. Exhaust silencers 41
4. Air heaters/air coolers
5. Turbochargers
6. Valve for overspeed shutdown

All components are designed to seismic Category I requirements. In addition, each DG and its associated Combustion Air Intake and Exhaust System is located in a physically separated, tornado-, flood-, and missile-proof structure, and is protected from the effects of moderate line breaks (see Chapter 3). 41

36

Insert for Section 9.5.7.5 / Pg. 9.5-52

The initial calibration frequency for the instruments associated with the diesel lubrication system will be at least once every 18 months. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience, and vendor recommendations.

The operator action required following alarm actuation will be specified in the annunciator response procedure which is currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load.

(36)

Question 430.54N

Describe the instrumentation, controls, sensors, and alarms provided for monitoring the diesel engine lubrication oil system and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors, and alarm system and where the alarms are annuniciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator action required during alarm conditions to prevent harmful effects to the diesel engine. Discuss systems interlocks provided. Revise your FSAR accordingly. (SRP 9.5.7, Part III, item IC).

Response

Refer to Sections 9.5.7.2, 9.5.7.5, Table 9.5.7-2, and Figure 9.5.7-1, ~~and the response to Q40.34.~~ 49

Pressure relief valves are provided on the discharge of the oil pumps and on the engine supply header. A pressure regulator regulates oil pressure to the turbocharger. Oil flow is not monitored. 29 Q430. 54N

Protective functions (including interlocks) for the DGs are discussed in Section 8.3.1. The low lube oil pressure protective function remains operational during periodic testing of the DGs. However, during operation of the DG this trip is automatically bypassed. The bypassed protective function is alarmed in the main control room. 41 Q430. 54N

The oil strainer may be manually bypassed for cleaning during operation. If necessary for plant protection, the filter can be manually bypassed for a short duration.

Alarm response procedures described in Sections 13.5.2.1 and 13.5.2.2 are prepared for alarms associated with this system. Information will be available to the operator to provide guidance in alarm response. 29 Q430. 54N

The system also includes a standby prelubricating and preheating system to keep the engine ready for quick starts. It consists of an ac motor-driven circulation pump, which takes suction from the engine lube oil sumps, and an electric heater which comes on when lube oil temperature is 120°F falling and turns off at 130°F rising, and an electric heater, which heats the lube oil to operating temperature. 41 From the heater, the lube oil flows through the main oil filter and then to the various engine components requiring lubrication. This pump starts when the engine rpm falls below 280. 41

Essential cooling water at a flowrate of 300 gal/min is the source of cooling water for the lube oil coolers. Normal inlet temperature for this water is 95°F while the normal outlet temperature is 115°F. Maximum inlet temperature is 115°F while the maximum outlet temperature is 135°F. Heat removal rate is approximately 2,960,000 Btu/hr for the above conditions which is technically compatible with the engine manufacturer recommendations. 41 29 Q 430 53 N

41

The engine is equipped with two low oil pressure shutdown switches to stop the engine, in the test mode, in case oil pressure drops to 30 psig, which could result from insufficient oil inventory. 49 One of these switches is located in the main header and the other one is located downstream of the turbocharger pressure regulator. System leakage is routed to floor drains which are piped to individual sumps which are then pumped to the oily waste system for processing. 41

A sample of the lube oil is taken prior to the initial fill for analysis. Subsequent samples are obtained from the prefilter drain or instrument bleeding connections. 41 If the sample fails to meet specifications, the lube oil is drained through the permanent connections from the auxiliary skid routed outside the DGB to a truck via a fill station. A fill connection is also provided at this station.

Insert

9.5.7.3 System Evaluation. The lube oil system for each DG is completely independent of the lube oil systems of the other DGs. Therefore, failure of one lube oil system will result in loss of only one DG. The

(37) / 38

Insert for Section 9.5.7.2 / Pg. 9.5-51

The initial frequency for sampling the diesel lube oil will be at least monthly. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience, and vendor recommendations. This sampling will be governed by plant procedures which will be in place prior to fuel load. The appropriate plant personnel will be trained in their use.

Question 430.100N

In Section 9.5.7.2 of the FSAR you state to ensure quality lube oil is present in the lube oil system and that it is within manufacturer's specifications, the lube oil will be sampled at regular intervals. Specify the sampling intervals (SRP 9.5.7, Part II)

Response

~~This information is under development and will be provided in a later amendment.~~

See Section 9.5.7.2.

Question 430.99N

Assume an unlikely event has occurred requiring operation of a diesel generator for a prolonged period that would require replenishment of lube oil without interrupting operation of the diesel generator. Provide the following:

a) What provisions will be made in the design of the lube oil system to add lube oil to the sump. These provisions shall include procedures or instructions available to the operator on the proper addition of lube oil to the diesel generator as follows:

1. How and where lube oil can be added while the equipment is in operation,

2. Particular assurance that the wrong kind of oil is not inadvertently added to the lubricating oil system, and

3. That the expected rise in level occurs and is verified for each unit of the lube oil added.

b) Verification that these operating procedures or instructions will be posted locally in the diesel generator rooms.

c) Verification that personnel responsible for the operation and maintenance of the diesel are trained in the use of these procedures. Verification of the ability of the personnel on the use of the procedures shall be demonstrated during preoperational tests and during operator requalification.

d) Verification that the color coded, or otherwise marked, lines associated with the diesel-generator are correctly identified and that the line or point for adding lube oil (when the engine is on standby or in operation) has been clearly identified. (SRP 9.5.7, Parts II & III)

Response

a) A plant procedure will be written for the addition of lube oil to an operating diesel generator. This procedure will address how to add lube oil and the type of lube oil to be used and will require the operator to verify the expected rise in oil level.

b) The plant procedure for adding lube oil will be available for use at the operator's work station.

c) Training on the Engineered Safety Feature (ESF) Diesel Generators (DGs) will provide operators with sufficient knowledge of the Diesel Engine Oil

Response (Continued)

System such that they can safely follow the procedure for oil addition during engine operation.

d) The plant procedure for adding lube oil will contain adequate instructions such that special markings will not be required.

remaining DGs will be adequate to safely shut down the plant or mitigate the effects of a LOCA during LOOP conditions. A failure modes and effects analysis is provided in Table 9.5.5-2. 41

9.5.7.4 Inspection and Testing Requirements. The DG Lubrication System will be inspected and tested during the regularly scheduled tests of the DGs. Inservice inspection shall be performed in accordance with the ASME B&PV Code, Section XI.

9.5.7.5 Instrumentation. A common trouble alarm will be provided in the main control room and individual alarms in the local panel for low oil pressure, high and low oil temperature, high and low lube oil level, high filter and high strainer differential pressures. Indication is provided in the main control room and locally for oil pressure and oil temperature at the inlet to the engine. Indication is also provided locally for lube oil level in the crank case. The Lube Oil System indications and alarms are summarized in Table 9.5.7-2. 29 Q430.54N 41 2 Q40.33 41

Instruments are checked, calibrations are routinely performed and alarms are verified operable as described in Section 13.5.2. 29 Q430.54N

The DG protective trips are discussed in Section 8.3.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

9.5.8.1 Design Bases. The Diesel Generator Combustion Air Intake and Exhaust System (DGCAIES) is designed to supply the DG engine with a sufficient quantity of combustion air to enable it to perform its safety function and to then discharge the exhaust gases so that the gases do not dilute the combustion air sufficiently to affect the operation of the DG engine. The on-engine piping and components are design to DEMA requirements and meets ANSI B31.1, N45.2 and 10CFR50 Appendix B Quality Assurance. 41
The following components are designed in accordance with manufacturer's standards:

1. Expansion joints
2. Oil-bath air intake filter and silencer
3. Exhaust silencers 41
4. Air heaters/air coolers
5. Turbochargers
6. Valve for overspeed shutdown

All components are designed to seismic Category I requirements. In addition, each DG and its associated Combustion Air Intake and Exhaust System is located in a physically separated, tornado-, flood-, and missile-proof structure, and is protected from the effects of moderate line breaks (see Chapter 3). 41

40

3. A single failure of the fire protection system could result in the unavailability of the sprinkler system for a given engine compartment. The compartment ventilation system continues to be operational ensuring a purge of the smoke from the affected compartment. The smoke is exhausted approximately 30 ft south and 43 ft above the elevation of the combustion air intake louvers and, therefore, will tend to rise rather than be drawn down to the air intake louvers. Aspects of fire fighting are identical to those identified in 2 above. Until the closure of the thermal link dampers the smoke will be vented on the north side of the DGB via the oil room exhaust fan and duct. The exhaust gas will be hot and will rise, and as the gas rises, dilution will occur. 30 Q430.56N 41 49

An analysis using the methods of James Halitsky in "Gas Diffusion Near Buildings" was performed (See Reference 9.5.8-1). The results indicate that the following reductions would occur in the oxygen level of the combustion air intake.

1. ESF Transformer Fire - During the period from the start of the fire until the time it is extinguished, smoke could potentially be carried around to the north side of the DGB. The distance from the nearest ESF transformer to the closest air intake is about 30 ft by the Halitsky method the oxygen deficiency caused by a single ESF transformer fire is 16 percent. The engines will operate at oxygen deficiencies of up to 20 percent. 49 Q430.61N

2. Engine Room Compartment Fire - By the above method the oxygen deficiency for the remaining DGs would not exceed 11 percent during a fire in an adjacent engine compartment.

3. FOST Room Fire - By the above method the oxygen deficiency for the DGs would not exceed 5.3 percent as the result of a FOST room fire.

9.5.8.4 Inspection and Testing Requirements. The DGCAIES will be inspected and tested during the regularly scheduled tests of the DGs. The instrumentation provided to monitor the combustion air and exhaust temperature receives periodic calibration and inspection to verify accuracy.

9.5.8.5 Instrumentation. Alarms will be provided in the main control room and the local panel for intake air filter high differential pressure and for a failed turbocharger bearing. Indication is provided at the local control panel for intake air manifold temperature, turbocharger inlet and outlet air temperature, individual cylinder exhaust temperature, and intake air manifold pressure. 2 41 Q40.34

Insert

9.5.9 Auxiliary Steam System

9.5.9.1 Design Bases. The Auxiliary Steam (AS) System is designed to operate independently from the main turbine thermal cycle steam systems. The system is shown on Figures 9.5.9-1 through 9.5.9-4. The AS system includes two boilers with a design capacity of 290,000 lbs/hr of steam at 235 psig and 419°F. 41

(40)

Insert for Sect. 9.5.8.5 / Pg. 9.5-53b

The initial calibration frequency for the instruments associated with the combustion air intake and exhaust system will be at least once every 18 months. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience, and vendor recommendations.

The operator action required following alarm actuation will be specified in the annunciator response procedure which is currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load.

Question 040.34

Describe the instrumentation, controls, sensors, and alarms provided in the design of the diesel engine combustion air intake and exhaust system to warn the operators when design parameters are exceeded. (SRP 9.5.8, Part III, item 1 and 4).

Response

See Section 9.5.8.5. ~~In addition:~~

1. The calibration program for the instrumentation, controls, sensors, and alarms is under development and frequencies for these activities have not been determined. This information will be available for review prior to fuel load.

2. The operator action required following alarm actuation will be specified in the annunciator response procedure which is currently under development. These actions will be consistent with the manufacturer's guidelines. This procedure will be available for review prior to fuel load. 49

41/42/43

Air from outside the DGB is drawn through fixed louvers and the intake air filter. These louvers are surrounded by a missile wall barrier such that an external missile cannot penetrate and cause damage to any of the DG components. The louvers are located above the design flood level.

Carbon Dioxide and gaseous Hydrogen are any of

Liquid nitrogen ~~is~~ stored in outdoor tanks at the STP site in the Bulk Gas Storage Facility. An analysis has been performed which shows that in the unlikely event of an instantaneous rupture of these tanks the resulting gas concentrations at the DG air intake would not adversely affect DG operation. Under these conditions, the engine is still capable of carrying its rated load. The following assumptions were used in the analysis: 41

7. The DG's will operate at an oxygen deficiency of up to 20 percent

1. Distance from the tanks to the DG air intake, 486 ft

2. 11,000 gallons of liquified N_2, 50,000 standard cubic feet (SCF) Liquid CO_2, 20,000 SCF H_2 49

3. Plume dispersion equations using the methodology in NUREG-0570

4. Pasquill Type F meteorology

5. Air intake 65 ft above grade

6. Briggs plume rise equations for lighter-than-air gases

Insert "A"

The following is an assessment of the influence of diesel exhaust gases and smoke from fires in nearby buildings which could affect the operation of the DG's:

1. As shown in Figure 1.2-10 the diesel exhaust is discharged to atmosphere through the north wall of the diesel generator building. ~~Analysis results indicate an insignificant reduction in the oxygen level of the combustion air would occur as the result of predominant southerly or northerly winds directing a portion of the exhaust gases to the elevation of the air intake. This dilution would not affect engine operation.~~ The only gaseous fire extinguishing medium for STP is halon used in the relay room, the computer room, the TSC computer room in the EAB, the Administration Building and the radwaste control room in the MAB. Release of halon from these buildings would be a controlled operation. No fire extinguishing gaseous medium is used for fire protection for the DGB. 36 30 Q43 56

Insert "B"

2. From a geometrical standpoint, the combustion air intake louvers on the north side of the DGB are 90° with respect to the auxiliary ESF transformers which are approximately 20 ft east and 10 ft south of the building. The transformers are supplied with an automatic deluge system. A class B fire could result from an oil spill or internal shorts. Thirty minute response time and thirty minute fire brigade action would result in extinguishing the fire via existing fire hydrants or fire department connections with access to the deluge valve immediately adjacent to the DGB, in case of a single failure of the automatic deluge system.

Insert "D" from pg 9.5-53b

3. A single failure of the fire protection system could result in the unavailability of the sprinkler system for a given engine compartment or FOST room. The compartment ventilation system continues to be operational ensuring a purge of the smoke from the affected compartments. The smoke is exhausted approximately 30 ft south and 43 ft above the elevation of the combustion air intake louvers for all DG compartments except the FOST rooms. (Aspects of fire fighting are identical to those identified in 2 above.) Until the closure of the thermal link dampers the smoke will also be vented from the FOST on the north side of the DGB via the oil room exhaust fan and duct. This exhaust will be bounding for the effects of compartment fires inside the D.G. building. INSERT "C" 30 Q430.56N 41

An analysis using the methods of James Halitsky in "Gas Diffusion Near Buildings" was performed (See Reference 9.5.8-1). The results indicate that the following reductions would occur in the oxygen level of the combustion air intake. Insert "I" to pg 9.5-53c

1. ESF Transformer Fire - During the period from the start of the fire until the time it is extinguished, smoke could potentially be carried around to the north side of the DGB. The distance from the nearest ESF transformer to the closest air intake is about 30 ft. By the Halitsky method the oxygen deficiency caused by a single ESF transformer fire is 16 percent. ~~The engines will operate at oxygen deficiencies of up to 20 percent.~~ 49 Q430.61N

2. Engine Room Compartment Fire - By the above method the oxygen deficiency for the remaining DGs would not exceed 11 percent during a fire in an adjacent engine compartment.

3. FOST Room Fire - By the above method the oxygen deficiency for the DGs would not exceed 5.3 percent as the result of a FOST room fire.

9.5.8.4 Inspection and Testing Requirements. The DGCAIES will be inspected and tested during the regularly scheduled tests of the DGs. The instrumentation provided to monitor the combustion air and exhaust temperature receives periodic calibration and inspection to verify accuracy.

9.5.8.5 Instrumentation. Alarms will be provided in the main control room and the local panel for intake air filter high differential pressure and for a failed turbocharger bearing. Indication is provided at the local control panel for intake air manifold temperature, turbocharger inlet and outlet air temperature, individual cylinder exhaust temperature, and intake air manifold pressure. 2 Q40.34 41

9.5.9 Auxiliary Steam System

9.5.9.1 Design Bases. The Auxiliary Steam (AS) System is designed to operate independently from the main turbine thermal cycle steam systems. The system is shown on Figures 9.5.9-1 through 9.5.9-4. The AS system includes two boilers with a design capacity of 290,000 lbs/hr of steam at 235 psig and 419°F. 41

41/42/43

Insert "A"

The results indicate that the nitrogen and hydrogen concentrations at the DG intake will be negligible, due to the buoyancy of the plumes, the carbon dioxide concentration is found to be limiting and will result in approximately 19.3% reduction of the oxygen concentration at the DG intake.

Insert "B"

A southerly wind would cause the DG exhaust to be captured in the auxiliary building wake cavity. But the DG exhaust would undergo a 55 fold dilution within this wake cavity and therefore would not adversely impact DG operation.

It should be noted credit was not taken in these evaluations for the buoyancy of the hot DG exhaust. Smoke from fires in buildings surrounding the DG building are bounded by the MK 3 exhaust which undergoes at least a 10.5 fold dilution in the building wake cavity and therefore will not adversely affect DG operation.

Insert "C"

Smoke exhausted from this outlet would be diluted by a factor of 39 in the building wake cavity and therefore will not affect DG operation. Furthermore, the fire dampers will close within a few seconds, so these conditions will exist for only a limited period of time.

44

Question 430.60N

Figure 1.2-10 shows the diesel generator exhaust stack extending above the roof. The FSAR text does not specify whether this portion of the exhaust stack is protected from tornado missiles. Separation of the exhaust stacks does not constitute adequate protection. It is our position that the diesel generator exhaust stacks be tornado missile protected.

Response

~~The response will be provided upon finalization of design.~~ 49

FIGURE 1.2-10 HAS BEEN MODIFIED TO REFLECT THE ~~NEW~~ revised DESIGN. THE DIESEL GENERATOR EXHAUST NOW EXITS THE NORTH WALL of THE DGB AT ELEVATION 95'-8". For further discussion see Section 9.5.8.2.

9.5.8.2 System Description. A schematic of the DGCAIES is shown on Figure 9.5.8-1. The relative location of system equipment in the facility is shown on Figure 1.2-10.

Each DGCAIES consists of:

1. Combustion air intake filter and silencer (oil-bath type)

2. Exhaust silencer | 41

3. Combustion air manifold

4. Exhaust manifold

5. Turbocharger

6. Air heaters/air coolers (one each per cylinder bank)

7. Connecting piping and expansion joints

8. Overspeed shutdown valve

Outside air for combustion is drawn into the building through a separate missile protected opening above the maximum flood level. Intake air velocity is limited to prevent the entry of rain or snow, thus eliminating the possibility of clogging the air intake or otherwise degrading performance. All portions of the DGCAIES, except for the air intake opening and the end of the exhaust pipe, are located within the DGB. | 2 Q40.35

Air is drawn in through the combustion air intake filter and silencer and flows through the connecting piping and expansion joints to the overspeed shutdown valve and into the compressor stage of the turbocharger. From the turbocharger, the air flows through the air heaters/intercoolers and into the combustion air manifolds, where it becomes available to the power cylinders on demand. | 41

The exhaust gases are released into the exhaust manifold and into the turbine of the turbocharger. The exhaust gases expand through the turbocharger turbine and flow through the interconnecting piping and expansion joints to the exhaust silencer. From the silencer, the exhaust gases are routed out of the DGB, via a ~~beveled exhaust with a bird screen~~ horrizontal pipe approximately 65 ft above grade (See Figure ~~2.1-10~~). INSERT (A) | 2 Q40.3 | 44 | 49

The overspeed shutdown valve located in the turbocharger is controlled by the engine overspeed protection device. Upon a signal from the overspeed protection device, the overspeed shutdown valve closes, shutting off the combustion air supply to the engine, thus providing a positive shutdown. | 41

9.5.8.3 Safety Evaluation. The Combustion Air Intake and Exhaust System for each DG is completely independent of the Intake and Exhaust System of the other two DGs. Consequently, failure of one Intake and Exhaust System will result in the failure of only that DG. The remaining DGs will be able to safely shut down the plant or mitigate the effects of an LOCA in the event of a coincident LOOP. | 41

Insert A for Section 9.5.8.2 / Q9.5-53

The exhaust pipe is beveled at the discharge to prevent entry of rain, snow and freezing rain into the exhaust pipe. It should be noted that ice, snow and freezing rain are considered insignificant since STP is located in a subtropical maritime climate (refer to FSAR Section 2.3.1.2.3 and 2.3.1.2.4). The effects of dust accumulation on the exhaust is not considered significant based on the height of the exhaust above the ground (approximately 65 ft.) and the layout of the facilities in the area of the exhaust. The discharge is also provided with a bird screen.

(New ¶) "The exhaust which extends 2 feet from the building is designed w/ a break-off section. In the unlikely event a missile strikes the exhaust the break-off section will separate flush with the building thereby not inhibiting engine exhaust performance.

Question 040.37

Describe with the aid of drawings, the bulk hydrogen storage facility including its location and distribution system. Include the protective measures considered in the design to prevent fires and explosions during operations such as filling and purging the generator, as well as during normal operations.

Section 4.2, Item

b

Response

Bulk hydrogen storage is discussed in the Fire Hazards Analysis Report. The location of the bulk gas storage area is north of the Unit 2 turbine and is shown on Figure 3-49 of the FHAR. ~~Section~~ D.2.~~b~~ provides protective measures for safety-related systems from fires and explosions from the bulk gas storage area. 51

In order to preclude the possibility of hydrogen explosions in the generator, the generator is purged with CO_2 prior to filling with hydrogen before operation or prior to opening the generator to the atmosphere following shutdown.

In addition, generator vents are equipped with flame arrestors to prevent flame from being carried into the generator or vent pipe during hydrogen venting.

4.2 COMPARISON TO APPENDIX A OF APCSB 9.5-1

APPENDIX A OF APCSB 9.5-1	STP POSITION
D.2. Control of Combustibles	D.2. Control of Combustibles
D.2.a. Safety-related systems should be isolated or separated from combustible materials. When this is not possible because of the nature of the safety system or the combustible material, special protection should be provided to prevent a fire from defeating the safety system function. Such protection may involve a combination of automatic fire suppression, and construction capable of withstanding and containing a fire that consumes all combustibles present. Examples of such combustible materials that may not be separable from the remainder of its system are: (1) Emergency diesel generator fuel oil day tanks (2) Turbine generator oil and hydraulic control fluid systems (3) Reactor coolant pump lube oil systems.	D.2.a. Safety-related systems are normally separated from combustible materials. Where this is not possible, special precautions are taken to ensure that a postulated fire will not affect more than one of the three trains of safe shutdown equipment.
D.2.b. Bulk gas storage (either compressed or cryogenic), should not be permitted inside structures housing safety-related equipment. Storage of flammable gas such as hydrogen, should be located outdoors or in separate detached buildings so that a fire or explosion will not adversely affect any safety-related systems or equipment.	D.2.b. Bulk gas storage is defined as a single tank in excess of 400 cubic feet, and is not permitted within safety-related structures. An area is designated for the location of bulk gas containers, north of the Unit 2 Turbine Building (See Figure 3-49). 1

APPENDIX A OF APCSB 9.5-1

D.2.b.(Cont'd)

(Refer to NFPA 50A, "Gaseous Hydrogen Systems.")Care should be taken to locate high pressure gas storage containers with the long axis parallel to building walls. This will minimize the possibility of wall penetration in the event of a container failure. Use of compressed gases (especially flammable and fuel gases) inside buildings should be controlled. (Refer to NFPA 6, "Industrial Fire Loss Prevention.")

STP POSITION

D.2.b. (Cont'd)

Hydrogen used in Seismic Category I structures is supplied by lines which are Seismic Category II/I to maintain structural integrity. Only seal-welded piping is used.

Only two appreciable quantities of high-pressure gas cylinders are located within any safety-related building. One set is the cylinders used to store the Halon 1301 for the fire protection of the computer room and relay room. These cylinders are installed in a small room in the Electrical Auxiliary Building. The walls, floor, and ceiling of this room are made of reinforced concrete. The other set of high-pressure cylinders is used to store the breathing air. | 1

Small quantities of flammable gas stored in high pressure cylinders are used in the rad-chem lab and the counting rooms at Mechanical Auxiliary Building El. 41'. Only those cylinders in service will be located there; spare cylinders will be stored remote from Safety Category I buildings.

The use of other compressed gases within safety-related buildings, particularly those gases used for welding or cutting, will be administratively controlled.

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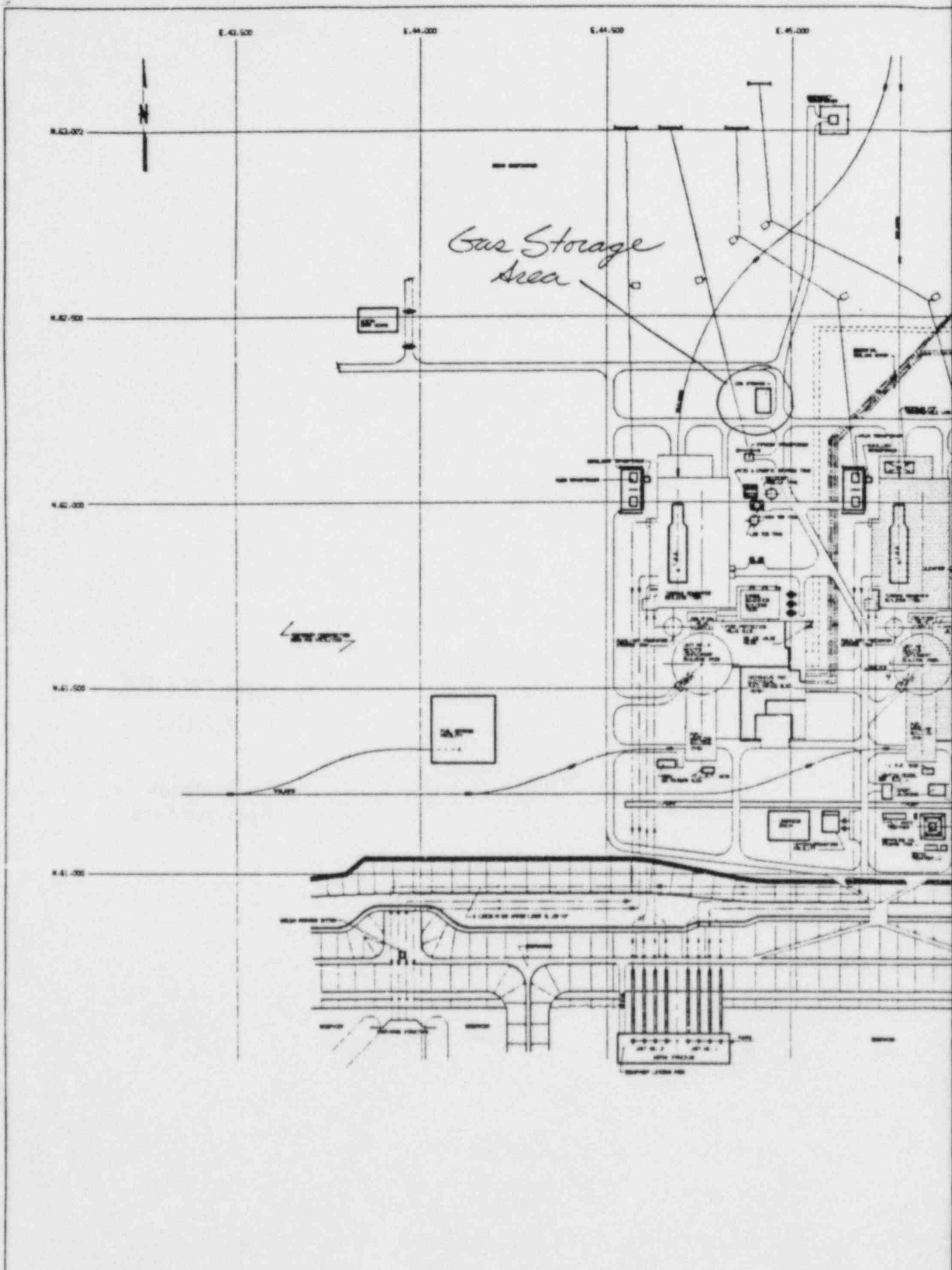

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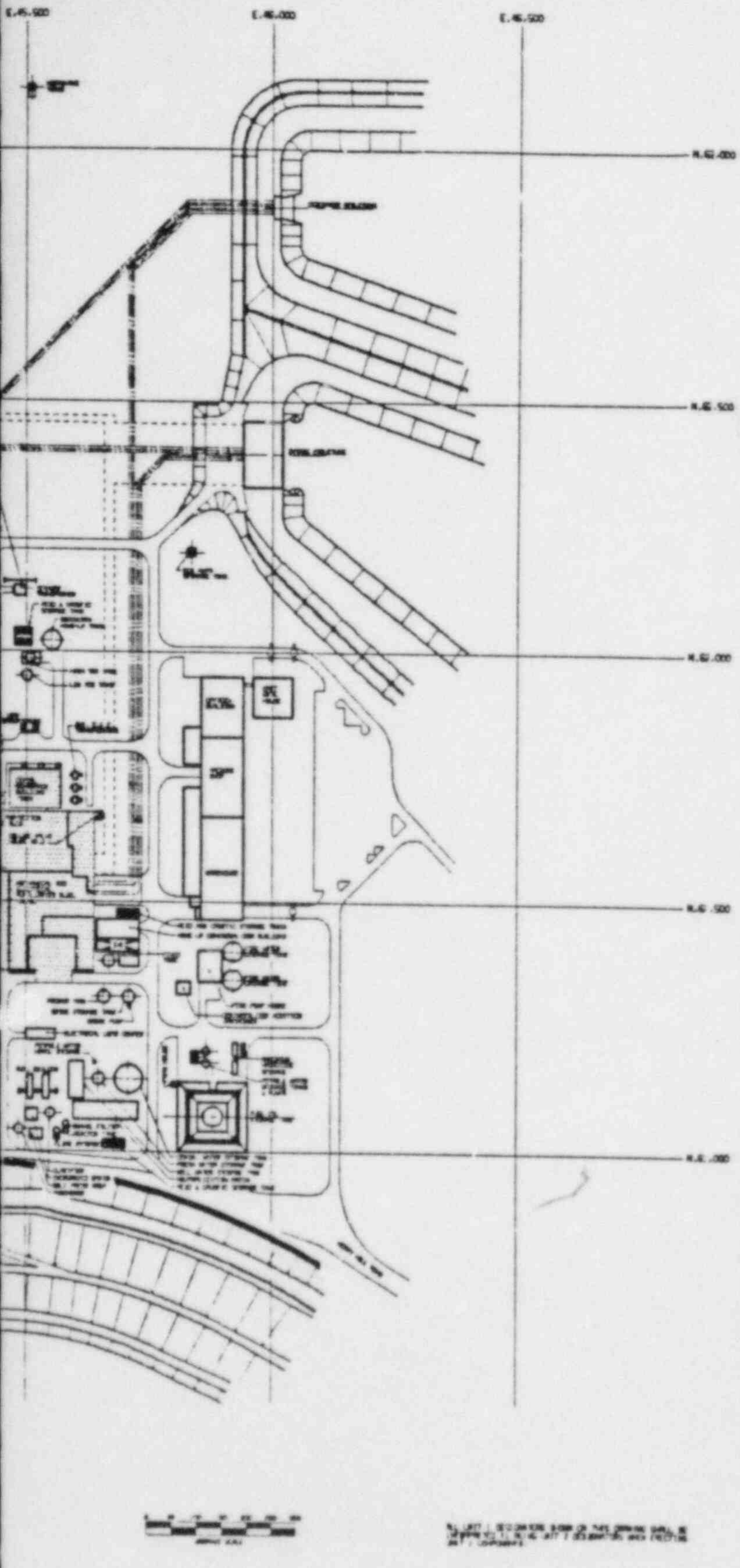

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FIGURE 3-49

Table 10.4-4

Failure Mode and Effects Analysis for the Turbine By-Pass System

Description of Component	Safety Function	Plant Operating Mode*	Failure Mode(s)	Method of Failure Detection	Failure Effect on System Safety Function Capability	General Remarks
Turbine Bypass Control Valves (12) Normally closed	None 1) Allows steam to be bypassed to the condensers	~~1-5~~ 1-3	1) A single valve fails to open on signal	a. Position indicator b. Computer alarm	1) None-other valves serve as back-up	
	2) Maintain the steam line integrity	1-3	2) Failure to remain closed or to close on signal		2) None Steam Generators can be isolated by closure of the MSIV & all FW isolation valves	Each valve has redundant solenoid valves powered by separate power sources.
Instrument Air			Loss of instrument air		None-Valves fail closed and steam is dumped to the atmosphere thru the relief valves	

*Plant modes
1. Power Operation
2. Start-up
3. Hot Standby
4. Hot Shutdown
5. Cold Shutdown
6. Refueling

 (46)

All bypass valves fail closed on loss of control plower/instrument air. They are prevented from opening if the condenser is not available. Condenser availability is defined as adequate vacuum in at least two of the condenser 39
shells and when at least one circulating water pump is running. If the condenser is not available, excess steam pressure is relieved to the atmosphere through the SG power relief valves and/or safety valves. Turbine Bypass System control is discussed in Section 7.7.1. An adequate drainage system is provided upstream of each bypass valve. The bypass lines are normally stagnant and therefore produce condensate continuously. This condensate is automatically removed to permit proper system operation. INSERT

10.4.4.3 <u>Safety Evaluation</u>. The Turbine Bypass System is designed as a NNS Class System. It is not required for any safety function, but it is included to provide operational flexibility and to minimize steam relief to the atmosphere.

The effects of a malfunction of the Turbine Bypass System equipment and the 2
effects of such failures on other systems and components are analyzed in Q40.39
Section 15.1. A component failure mode and effects analysis is presented in 39
Table 10.4-4.

10.4.4.4 <u>Tests and Inspections</u>. During unit operation, each bypass valve will be periodically tested. The isolation valves will be closed and the bypass valves checked for performance and timing with remote operation. The bypass valves will also be operated during startup and during shutdown.

The turbine bypass lines will be examined prior to operation (Chapter 14) 39
according to ANSI B31.1. The turbine bypass lines will be hydrostatically tested to confirm leaktightness.

10.4.4.5 <u>Instrumentation Application</u>. The turbine bypass control is 39
discussed in Section 7.7.1.8, and a block diagram of the control system is shown on Figure 7.7-8.

Provisions have been made to control the steam dump valves from the control 39
room by utilizing a steam dump control mode selector switch. A steam header pressure controller is provided to modulate the dump valves during startup, cooldown, or hot standby operation. A control switch in the control room provides for bypassing the low Reactor Coolant System T_{avg} interlock during cooldown. Load rejection and turbine trip controllers are provided to reduce the effects of the transient imposed upon the Reactor Coolant System during sudden load rejections or turbine trips.

Each steam dump valve is provided with status lights in the control room to indicate when the valve is fully opened or closed. Interlocks are provided to block the bypass of steam to the condenser through the dump valves when inadequate condenser vacuum in two of three condenser shells exists or circulating water flow is lost.

10.4.5 Circulating Water System

10.4.5.1 <u>Design Bases</u>. The objective of the CWS is to supply 907,400 gal/min of cooling water from the reservoir to the condenser to remove the steam cycle rejected heat (See Section 2.4.11.5) and return the water to the 39

EACH TURBINE BYPASS LINE HAS A 10" DIAMETER DRIP LEG EXTENDING APPROXIMATELY 5 FEET BELOW THE LINE. EACH DRIP LEG HAS TWO LEVEL SWITCHES. ONE SWITCH AUTOMATICALLY OPENS AN AIR OPERATED VALVE TO DUMP WATER AT A PREDETERMINED LEVEL. A MANUAL BYPASS VALVE AROUND THE DUMP VALVE IS PROVIDED AS AN ALTERNATE. THE SECOND LEVEL SWITCH OPERATES A HIGH ALARM IN THE CONTROL ROOM IN THE EVENT THE DUMP VALVE FAILS TO OPERATE.

All bypass valves fail closed on loss of control plower/instrument air. They are prevented from opening if the condenser is not available. Condenser availability is defined as adequate vacuum in at least two of the condenser 39 shells and when at least one circulating water pump is running. If the condenser is not available, excess steam pressure is relieved to the atmosphere through the SG power relief valves and/or safety valves. Turbine Bypass System control is discussed in Section 7.7.1. An adequate drainage system is provided upstream of each bypass valve. The bypass lines are normally stagnant and therefore produce condensate continuously. This condensate is automatically removed to permit proper system operation.

10.4.4.3 Safety Evaluation. The Turbine Bypass System is designed as a NNS Class System. It is not required for any safety function, but it is included to provide operational flexibility and to minimize steam relief to the atmosphere.

The effects of a malfunction of the Turbine Bypass System equipment and the 2 effects of such failures on other systems and components are analyzed in Q40.39 Section 15.1. A component failure mode and effects analysis is presented in 39 Table 10.4-4.

Insert 10.4.4.4 Test and Inspections. ~~During unit operation, each bypass valve will be periodically tested.~~ 2 The isolation valves will be closed and the bypass valves checked for performance and timing with remote operation. The bypass valves will also be operated during startup and during shutdown.

The turbine bypass lines will be examined prior to operation (Chapter 14) 39 according to ANSI B31.1. The turbine bypass lines will be hydrostatically tested to confirm leaktightness.

10.4.4.5 Instrumentation Application. The turbine bypass control is 39 discussed in Section 7.7.1.8, and a block diagram of the control system is shown on Figure 7.7-8.

Provisions have been made to control the steam dump valves from the control 39 room by utilizing a steam dump control mode selector switch. A steam header pressure controller is provided to modulate the dump valves during startup, cooldown, or hot standby operation. A control switch in the control room provides for bypassing the low Reactor Coolant System T_{avg} interlock during cooldown. Load rejection and turbine trip controllers are provided to reduce the effects of the transient imposed upon the Reactor Coolant System during sudden load rejections or turbine trips.

Each steam dump valve is provided with status lights in the control room to indicate when the valve is fully opened or closed. Interlocks are provided to block the bypass of steam to the condenser through the dump valves when inadequate condenser vacuum in two of three condenser shells exists or circulating water flow is lost.

10.4.5 Circulating Water System

10.4.5.1 Design Bases. The objective of the CWS is to supply 907,400 gal/min of cooling water from the reservoir to the condenser to remove the steam cycle rejected heat (See Section 2.4.11.5) and return the water to the 39

Insert for Section 10.4.4.4 / Pg. 10.4-9

In accordance with the vendor recommendations, the inservice tests and inspections of the turbine bypass system will be conducted at least once every 18 months. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience and vendor recommendations.

Question 430.105N

In section 10.4.4.4 you have discussed tests and initial field inspection and inservice testing and inspection, but not the frequency of inservice testing and inspection of the turbine bypass system. Provide this information in the FSAR. (SRP 10.4.4, Part 1)

Response

The inservice tests and inspections of the turbine bypass system will be conducted at least once every 18 months.

The turbine bypass, as stated in Section # 10.4.4.3, is NNS. It is not required for any safety function and is included to provide operational flexibility and to minimize steam relief to the atmosphere.

Insert

The FMEA in Table 10.4-4 addresses the potential failure of the turbine bypass valves.

In accordance with the vendor recommendations, the inservice tests and inspections of the turbine bypass system will be conducted at least once every 18 months. This frequency may be revised based on evaluations of factors such as plant operating experience, industry experience and vendor recommendations (as stated in FSAR Section 10.4.4.4).

It is noted that normal startup and shutdown within the 18 month period will utilize the turbine bypass system and therefore provide assurance that the system is operating properly.

Insert for Q430.105N

The opening of a turbine bypass valve is an ANS Condition II event and is enveloped by the analysis in Section 15.1.4 of the FSAR.

Attachment 3

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Attachment 4

Kurl H. Strauss

CONSULTANT
PETROLEUM FUELS

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(914) 454-1454

August 5, 1985

Mario Rivera
Houston Lighting and Power Co.
PO Box 289
Wadsworth, TX 77483

Dear Sir:

In your telephone call of August 2, 1985 you requested my opinion regarding the use of ASTM D4294 (Sulfur in Petroleum Products by Non-Dispersive X-Ray Fluorescence Spectrometer) to establish the sulfur content of diesel fuel against the requirements of ASTM D975.

The test method scope of D4294 indicates its measurement range to be from 0.01 to 5 weight% sulfur. This compares to a range of 0.001 to 5 weight% for the other currently acceptable X-ray method, ASTM D2622.

Although D2622 is more sensitive than D4294 by an order of magnitude that increased sensitivity is not important in determining specification compliance against D975. Comparing precision levels of the two methods at 0.5% sulfur which is the maximum allowable level in D975 the following results are obtained:

Test Method	Repeatability	Reproducibility
D2622	0.03%	0.08%
D4294	0.03%	0.07%

In view of the comparable precision of the two methods at the sulfur level of interest, ASTM D4294 is a satisfactory alternate to ASTM D129, D1552 or D2622 for the determination of sulfur content of diesel fuel for emergency diesel fuel oil systems in nuclear power plants.

Very truly yours,

Kurt H Strauss

Attachment 5

SUMMARY OF DIESEL GENERATOR PERFORMANCE METHODOLOGY

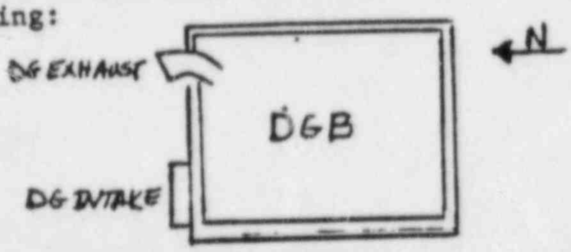
Introduction

This analysis will demonstrate that the function of the diesel generator air intake system will not, under any meteorological or accident condition, be degraded to an extent which will cause diesel generator malfunction. This is defined as a displacement of oxygen content in air of more than 20 percent, which is equivalent to an oxygen concentration of 16.7%. The following cases were analyzed:

- Recirculation of diesel generator exhaust
- Fire inside the diesel generator building
- Fire inside the turbine generator building, the Mechanical auxiliary building, and the electrical auxiliary building
- Storage tank rupture - N_2, CO_2, or H_2

Recirculation of Diesel Generator Exhaust

The diesel generator exhausts are 8 meters above the diesel generator intakes on the same side (north side) of the diesel generator building:



Hence, there is a possibility that the diesel generator exhaust could be recirculated into the diesel generator air intakes. If the oxygen cencentration of the inlet air is reduced by more than 20 percent, the efficiency of the diesel generators (DGs) will be affected.

Factors to be considered in this evaluation are the exhaust temperature and exit velocity, local air turbulence caused by building wakes, and the relative exhaust/intake locations. Under calm conditions, the buoyancy of the hot exhaust (950°F) and the high exhaust velocity (165 ft/sec) would preclude any entrainment of the exhaust into the DG air intake. However, under certain wind conditons (wind speed greater than 3 m/sec), building wakes are created by the surrounding buildings and could cause capture of the DG exhaust within the wake cavity. The classic Gaussian plume dispersion equations do not apply in this case. Therefore, the following equation is used to calculate the concentration of the diesel exhaust captured within the building wake cavity:

$$C = \frac{k\, V_e}{A_p\, u} \qquad \text{(Equation 1)}$$

where C = concentration (vol/vol)

k = coefficient ranging from 0.2 to 2.0
for conservative results, k was assumed to be 2.0

A_p = cross-sectional area of the building causing the building wake

u = wind speed (assumed to be 3 m/sec or greater in order to create a wake effect)

V_e = volumetric flow rate of exhaust or smoke

This is a modification of the equation shown in Randerson (1984) which gives the concentration within wake cavities as:

$$X = \frac{k\,Q}{A_p\,u} \qquad \text{(Equation 2)}$$

where X = concentration (gm/m^3)

Q = source term (gm/sec)

and other factors are the same as in Equation 1. Since we do not know the exact composition of the constituents in the diesel exhaust or fires, we simply replace the Q term with V_e to give a volume for volume concentration instead of an actual concentration in gm/m^3. Similar equations for determining concentrations in the area created by a building wake appear in Slade (1968) and the ASHRAE Handbook (1985).

Next, the conditions which cause building wakes near the DG building were identified. These correspond to a wind speed of 3 m/sec or greater (EPA, 1977) from the west, south or southeast direction. The buildings which create the wakes are the turbine generator building for the west wind and the auxiliary building for the other wind directions. The worst case conditions result with a wind from the south and a wake created by the auxiliary building. This building has the smallest cross sectional area and therefore the DG exhaust would be less diluted under these conditions. Using Equation 1 and the conservative assumption that the DG exhaust is at ambient temperature (the plume is not buoyant) and all of the exhaust is captured in the wake cavity, the DG exhaust will undergo a 55 fold dilution in the building wake cavity. Therefore, the operation of the diesel generators will not be adversely affected by this case.

Another case which was evaluated was assuming a wind coming from the north, which does not create a building wake, but could push the DG exhaust back toward the DG air intake. We know that greater than a 5 fold dilution of the DG exhaust is necessary so as not to displace the oxygen concentration in air by more than 20 percent. Using the following equation (Randerson, 1984) which calculates the dilution from exhuast vents on roofs and sides of buildings:

$$D_{min} = \frac{0.11\,u\,s^2}{V_e} \qquad \text{(Equation 3)}$$

This is greater than the 5 fold dilution threshold which is equivalent to a 20% oxygen displacement.

where D_{min} = minimum dilution needed (5)
u = wind speed (10 m/sec or 33 ft/sec)
V_e = volumetric flow rate of DG exhaust (55,500 ft^3/min)
s = distance between exhaust and intake points (ft)

we rearranged the terms to determine the distance travelled by the jet plume which would give a five fold dilution. This calculated value (36 ft) was divided by two since the jet plume must travel back the same distance to be at the DG air intake. The jet center line velocity was then calculated, according to the following equation (Perry & Chilton, 1973):

$$V_c = \frac{k\, D_o\, V_o}{s} \qquad \text{(Equation 4)}$$

where V_c = jet center line velocity, ft/sec
V_o = initial jet velocity, ft/sec
D_o = diameter of jet, ft
s = distance from jet discharge, ft
k = 6.2 for V_o = 33 to 120 ft/sec

The calculated jet center line velocity at a distance of 18 feet is 153 ft/sec. Therefore, a wind speed of 153 ft/sec or 47 m/sec is necessary to stop and oppose the jet plume. At lower wind speeds, the jet plume will travel a greater distance and more dilution will occur. Therefore, this case will also not adversely affect operation of the DG intake air system:

Fire Inside Diesel Generator Building

A failure of the fire protection system could result in the unavailability of the sprinkler system for a given engine compartment or FOST room. The FOST compartment ventilation system would continue to operate to purge smoke from the affected FOST compartment. The smoke is exhausted from the FOST at a location about 5 m above the DG intake system until the fire dampers close. For fires in all other DG compartments, the smoke would be exhausted at a location 30 feet south and 43 feet above the DG air intake louvers. This second situation is not the limiting condition and is bounded by the previous analysis, because of the volumetric flow rate and long distance from the DG intake. Thus the engine compartment fire is not evaluated. However, the case where smoke is exhausted 5 m above the DG intake will be examined in more detail below.

The ventilation exhaust from the north DG FOST compartment is 1500 cfm. Using Equation 3, a wind speed of 2 m/sec and a separation distance of 5 m, the minimum dilution at the DG intake is a factor of 7.8, which is above the threshold value of 5 which affects DG operation. Furthermore, the fire dampers will close within a few seconds and the smoke will no longer be exhausted.

Fires In Surrounding Buildings

Smoke exhausted from the normal HVAC systems of the turbine generator building, the mechanical auxiliary building and the electrical auxiliary building could potentially be entrained into the DG intake, thereby adversely affecting DG operation. According to Equation 1, the worst case concentration would occur with the largest volumetric flow rate and smallest cross-sectional area of the building. These values correspond to a volumetric flow rate of 290,500 cfm from the mechanical auxiliary building and a building wake created by the auxiliary building (wind from the south or southeast). The calculated smoke concentration will undergo a 10.5 fold dilution within the building wake cavity and therefore will not adversely affect DG performance. Fires in the turbine generator builidng and electrical auxiliary building result in even lower smoke concentrations.

Storage Tank Rupture

An analysis was also performed to determine the effect of a storage tank rupture of nitrogen, carbon dioxide and hydrogen on oxygen concentrations at the DG intake. The tanks are located outside at a distance of about 161 m from the DG intake. For the liquid nitrogen and gaseous hydrogen tank accidents, Briggs (1969) plume rise equations were used to take into account the buoyancy of lighter-than-air gases and the equations given in NUREG-0570 were applied to determine plume concentrations at the DG intake. For the carbon dioxide tank accident, the Bechtel standard TOXGAS program, which also uses the equations given in NUREG-0570, was run to determine the carbon dioxide concentration at the DG intakes. The results are presented below. The limiting oxygen concentration is 16.7%. In all cases, ~~no adverse impact on DG operation will result from these accidents.~~ of tank rupture the oxygen concentration is above the threshold limit.

Note: This method has been discussed with Dr. J Wing of the NRC and has been used successfully on other ~~Jobs~~ nuclear projects.

Storage Tank Rupture Storage Tank Rupture	Concentration at DG Intake (%)	Calculated Oxygen Concentration at the DG Intake (%)
Nitrogen	0.0	21.0
Carbon Dioxide	19.3%	16.9
Hydrogen	0.0	21.0

Ref.
Briggs, G.A., 1969, Plume Rise. U.S. Atomic Energy Commission

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Atmospheric Science and Power Production

Darryl Randerson, Editor

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Note: the Halitsky model (Ref 9.5.8-1 in the FSAR) can also be found in this paper page 299.

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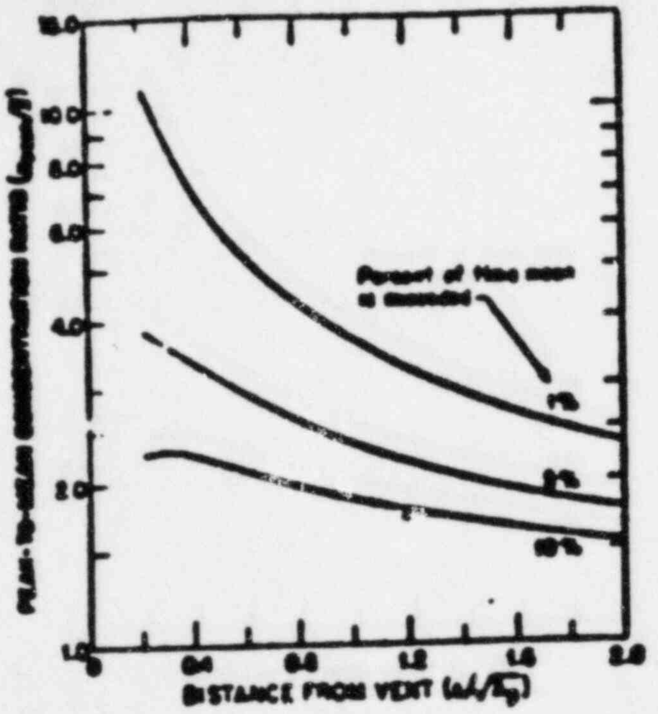

Fig. 7.34 Peak-to-mean concentration ratios for flush-mounted roof vents. (From D. J. Wilson, Contamination of Building Air Intakes from Nearby Vents, University of Alberta Department of Mechanical Engineering Report No. 18, University of Alberta, Edmonton, Alberta, Canada, 1976.)

effluent, as estimated from Eqs. 7.22, is a mean value suitable for averaging times of an hour or so. To estimate likely peak concentrations, he recommends

$$D_{peak} = f_s D_{mean} \qquad (7.23)$$

where the safety factor f_s = 0.2 to 0.5 for nonhazardous but annoying effluents (e.g., kitchen odors); for toxic materials the safety factor is f_s = 0.1. These results are all based on wind-tunnel studies; it is essential that field data be obtained to further validate these expressions.

7-8.2.1.3 Concentrations Within the Wake Cavity. As pointed out by Barry (1964) and Meroney (1982), most of the expressions proposed for concentration estimates within the cavity proper take the form

$$\chi = \frac{Q}{cUA_p} \qquad (7.24)$$

where the coefficient c is given values between 0.5 and 2.0. The effluent is presumed to be evenly mixed in the wake. Equivalently K = constant (=1/c), with values between 0.2 and 2.0. A glance at Halitsky's (1963a, b) results (e.g., Figs. 7.31), where the concentrations on the lee face should be fairly representative of the cavity as a whole, indicates that these are indeed reasonable values. However, little understanding of the physical mechanisms that generate this result is conveyed, and, in particular, there is nothing to explain why the result might vary from one building to another.

Briggs's (1973) recommendation is takes some account of the effective stack height and the building size. He defined the concentration coefficient in terms of the smaller building dimen-

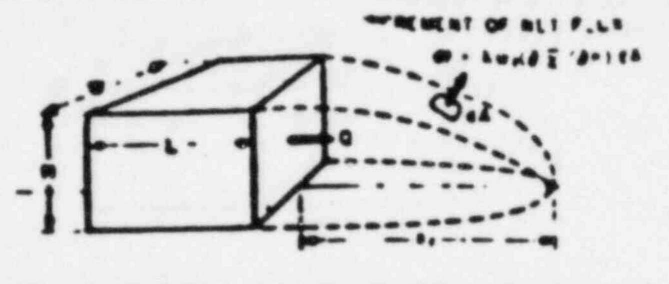

Fig. 7.35 Conceptual model of recirculating wake cavity with mass transfer confined to turbulent exchanges across the shear layer bounding the cavity. The cavity volume is V_c, and it is bounded by an active surface of area A_c. Effluent from a source of strength Q is fully entrained into the cavity.

sion $\tilde{L}$, $K = \chi U \tilde{L}^2/Q$. Consider the differential stack height $h' - H$, where h' is given by Eq. 7.15. If this is greater than $0.35\tilde{L}$, then K generally is less than unity in the cavity. However, if $h' - H < 0.35\tilde{L}$, K is typically 1.5 and perhaps as large as 3.0.

A slightly more physical hypothesis is based on Vincent's (1977, 1978) ideas. As detailed in earlier sections, the cavity "bubble" is not, strictly speaking, a closed zone of recirculation with material transfer possible only across the turbulent shear layer bounding the region. Advection into and from the cavity can occur as well (see Fig. 7.15). Vincent's (1978) experiments suggest, however, that the bulk of the material transfer is conducted by the turbulent exchange processes across the boundary and only relatively minor contributions result from direct advection. Therefore, the cavity is modeled, at least to a first approximation, as a volume V_c bounded by an active surface of area A_c (Fig. 7.35). Material is emitted into this volume at a rate Q; it is mixed thoroughly to an average concentration $\bar{\chi}$ by the circulations within the bubble, and it is finally lost from the region because of turbulent transfer through the active surface. The net flux of matter through the boundary is approximated by $\lambda w_t \partial\bar{\chi}/\partial n$, where λ is the turbulent mixing length, w_t is a turbulent transport velocity, and n is the local normal to the surface A_c. The mass balance equation is

$$\frac{d}{dt}\left(\bar{\chi}V_c\right) = Q - \lambda w_t \int_{A_c} \frac{\partial\bar{\chi}}{\partial n}\, dA$$

where $\bar{\chi}$ is the average concentration within the cavity. The integral is approximated by $\bar{\chi}A_c/\delta$, where δ is the thickness of the bounding shear layer across which the concentration changes from an internal value ($\bar{\chi}$) to an external value (0). The equation becomes

$$\frac{d\bar{\chi}}{dt} + \frac{\bar{\chi}}{t_d} = \frac{Q}{V_c} \qquad (7.25a)$$

where t_d is a characteristic diffusion time

$$t_d = \frac{1}{w_t}\,\frac{\delta}{\lambda}\,\frac{V_c}{A_c} \qquad (7.25b)$$

Case 1, constant source: At $t = 0$, $\bar{\chi} = 0$ and Q = constant, then

$$\bar{\chi} = \frac{Qt_d}{V_c}\left(1 - e^{-t/t_d}\right) \qquad (7.26a)$$