May 25, 2001

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
Supplementary Information Regarding Resolution Of Unresolved Item 95004-05

In a letter dated May 14, 2001, Consumers Energy Company[1] notified the NRC that discrepancies had been identified in certain information provided to the NRC in a letter dated December 9, 1996. The purpose of this letter is to update the earlier submittal and provide appropriate corrected information.

In Inspection Report 95004 dated May 19, 1996, the NRC opened Unresolved Item 95004-05 regarding concerns with the fire rating of the wall separating the Turbine Building lube oil storage room (west wall) from the adjacent pipe tunnel, and with an opening in the wall between the Turbine Building and the Component Cooling Water (CCW) room in the Auxiliary Building. In a December 9, 1996 letter, Consumers Energy Company notified the NRC that plant modifications had been completed to enhance the fire protection capability of these areas. Specifically, the letter reported that a two-hour fire rated block wall had been constructed between the Turbine lube oil storage room and the adjacent pipe tunnel, and that the existing fire suppression system had been extended to increase the fire suppression coverage on the Turbine Building side of the CCW Room west wall. In addition, the letter also provided responses to the issues raised by the Unresolved Item and copies of two engineering analyses to justify the adequacy of the previous plant configuration that had existed prior to the modifications. Certain information in those responses and the associated engineering analyses has been determined to be outdated and to contain errors.

In a letter dated October 14, 1997, the NRC provided its safety evaluation (SE) of the final disposition of the Unresolved Item. The SE concluded that, "(1) the west wall of the turbine lube oil room, as modified by the licensee, provides reasonable assurance that a fire in the lube oil room will not adversely impact safety-related/post-fire safe shutdown equipment located in the turbine building, and (2) that the fire protection features provided in the vicinity of the common turbine building/CCW pump room wall,

1 On May 15, 2001, the Palisades Operating License was amended to transfer operating authority from Consumers Energy Company to the Nuclear Management Company.

A006

with the additional automatic sprinkler protection and the other factors described above, provide reasonable assurance that a fire in the turbine building will not adversely affect the CCW pumps and will not adversely affect the plant's ability to achieve and maintain post-fire safe shutdown." The SE conclusion addressed the as-modified condition of the plant. The SE did not provide a conclusion for the plant configuration existing prior to the modifications that was addressed by the engineering analyses and Unresolved Item responses.

The analyses submitted in the December 9, 1996, letter have been superseded. The current versions of those analyses are provided as Attachments 1 and 2 to this letter. Please note that these analyses represent, in effect, a description of the current plant configuration that has been updated from the information submitted previously. Additional changes may be made in the future to the existing plant configuration or to these analyses under 10 CFR 50.59.

SUMMARY OF COMMITMENTS

This letter contains no new commitments and no revisions to existing commitments.

Daniel J. Malone
Director, Engineering

CC Administrator, Region III, USNRC
Project Manager, NRR, USNRC
NRC Resident Inspector - Palisades

Attachments

ATTACHMENT 1

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

May 25, 2001

Engineering Analysis EA-APR-01-004

Evaluation of the Effects of a Fire on the West Wall of the Turbine Building Lube Oil Storage Room (Room 132)

CONSUMERS ENERGY

PALISADES NUCLEAR PLANT
ENGINEERING ANALYSIS COVER SHEET

EA-APR-01-004

Total Number of Sheets 17 (was 16)

Title Evaluation of the effects of a fire on the West Wall of the Turbine Building Lube oil Storage Room (Room 132)

INITIATION AND REVIEW

Calculation Status: Preliminary ☐ Pending ☐ Final ☒ Superseded ☐

Rev #	Description	Initiated By	Initiated Date	Init Appd By	Review Method: Alt Calc	Review Method: Detail Rev'w	Review Method: Qual Test	Technically Reviewed By	Technically Reviewed Date	Rev'r Appd By	S/DR Appd
0	Original Issue	RJ Kilroy	5/15/01	JLK		X		EA Dorbeck	5/16/01	JLK	
								Jim Queen	5/16/01		

1.0 OBJECTIVE

The purpose of this engineering analysis is to show the impact of a fire on the west wall of the Turbine Building Lube Oil Storage Room adjacent to the tunnel between the Turbine Building (El. 590'-0") and the Feedwater Purity Building. The analysis will look at the fire protection defense in depth provided both for the Turbine Building Lube Oil Storage Room and adjacent areas. Through these considerations, this analysis will demonstrate the ability of the fire barriers enclosing the Turbine Building Lube Oil Storage Room to prevent a direct exposure fire threat to safety related equipment in the Turbine Building (El. 590'-0").

PALISADES NUCLEAR PLANT
ANALYSIS CONTINUATION SHEET

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Sheet 2 Rev # 0

	Reference/Comment
2.0 ANALYSIS INPUT	
2.1 Drawing M-216 Sheet 4, Fire Protection Plan of Elevation 570'-0" and 590'-0", Revision 9	
2.2 Drawing M-216 Sheet 18, Fire Protection Turbine Building Sections C-C, D-D, and E-E; Revision 2	
2.3 Architectural Drawing C-45 Turbine Building Floor Plans @ 571'-0" and 590'-0", Revision 21	
2.4 Architectural Door Schedule C-65, Revision 26	
2.5 Architectural Drawing C-68 Sheet 1, Concrete Block Details; Revision 6	
2.6 Architectural Drawing C-173, Turbine Building Mezzanine Floor Plan; Revision 6	
2.7 NRC Letter to TC Bordine, dated October 14, 1997; entitled "Palisades Plant Evaluation of Unresolved Fire Protection Inspection Issues Related to the Adequacy of Turbine Building Fire Area Barriers (TAC No. M94148)	
2.8 Palisades Nuclear Plant Fire Protection Program Report (FPPR) Volume 2, Section VIII; List of Changes and Response to Appendix A to Branch Technical Position APCSB 9.5-1 and Regulatory Guide 1.78 and 1.101, Revision 2, dated August 24, 1996.	
2.9 Engineering Analysis EA-FPP-95-011, "Analysis of Combustible Loading for Fire Area 22, Turbine Lube Oil Room"; Revision 1.	
2.10 Engineering Analysis EA-FPP-95-016, "Analysis of Combustible Loading for Fire Areas 23B, Steam Generator Feedpump Area"; Revision 1.	
2.11 Engineering Analysis EA-FPP-95-018, "Analysis of Combustible Loading for Fire Area 23C, Main Generator Seal Oil system Area, and Fire Area 23D, Turbine Building-General"; Revision 2.	

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ANALYSIS CONTINUATION SHEET

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Reference/Comment

2.0 ANALYSIS INPUT (Continued)

2.12 Fire Protection Handbook, 18th Edition, NFPA; 1997

2.13 Palisades Plant Fire Hazards Analysis, Revision 4; dated July 2, 1998.

2.14 Engineering Analysis EA-FPP-96-012, "System Hydraulic Analysis for Lube Oil Storage Room"; Revision 0.

2.15 Engineering Analysis EA-FPP-96-015, "System Hydraulic Analysis for Turbine Building"; Revision 0

2.16 Alarm and Response Procedure ARP-12 "Fire System Flow Scheme EK-28 (C-47)"; Revision 53

2.17 Engineering Analysis EA-APR-95-007 "10 CFR 50 Appendix R Fire Safe Shutdown analysis"; Revision 1

2.18 Engineering Analysis EA-FPP-95-054 "Evaluation of the Effects of a Fire on the West Wall of the Turbine Lube Oil Room Adjacent to the Pipe Tunnel Between the Turbine Building and the Feedwater Purity Building"; Revision 2.

2.19 NRC Standard Review Plan NUREG 0800"Guidelines for Fire Protection for Nuclear Power Plants"; Revision 2 dated July 1981.

2.20 NRC Generic Letter 86-10 "Implementation of Fire Protection Requirements" dated April 24, 1986.

2.21 Piping and Instrumentation Diagram M216 Sheet 2 "Fire Protection System" Revision 52

PALISADES NUCLEAR PLANT
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	Reference/Comment
3.0 ASSUMPTIONS	
3.1 The west wall of the Turbine Building Lube Oil Storage Room is subjected to a single exposure fire per Section A.9 of Reference 2.8.	Reference 2.8
3.2 The automatic wet pipe sprinkler systems provided in the Turbine Building Lube Oil Storage Room and on the 590'-0" elevation of the turbine building are operable at the time of the postulated fire.	
4.0 ANALYSIS	
4.1 General	
General Guidelines for Plant Protection are discussed in the List of Changes and Responses to Appendix A to BTP APCSB 9.5-1 and Regulatory Guide 1.78 and 1.101, Subsection D.1.j. The regulatory position states that concerning compartmentation "...Floors, walls and ceilings enclosing separate fire areas should have a minimum fire rating of 3 hours. Penetrations in those fire barriers, should be sealed or closed to provide a fire resistance rating at least equivalent to the fire barrier itself." It then goes on to state "..."The fire hazard in each area should be evaluated to determine barrier requirements." Also, ... "If barrier fire resistance cannot be made adequate, fire detection and suppression should be provided..."	Reference 2.8
Based on the above statements, it is apparent that the analysis of a specific barrier for acceptability should follow this order of importance:	
a. The capability of the barrier must satisfy the minimum fire rating of three hours. If not then;	
b. The fire barrier must be adequate to withstand the actual combustible loading in the fire areas separated by the barrier. If not then;	

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ANALYSIS CONTINUATION SHEET

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	Reference/Comments
4.1 General (Continued)	
c. The actual configuration must be reviewed in order to take credit for other systems or circumstances the may increase the acceptability of the barrier (e. g. Automatic detection, automatic suppression, manual suppression, etc...),	
This analysis is based upon meeting criterion c above. It shall be used to demonstrate the capability of the fire barrier and its supporting systems to adequately prevent the spread of fire between the Turbine Building Lube Oil Storage Room and the turbine building and/or Feedwater Purity Building Pipe Tunnel.	
Additional regulatory guidance is provided in NUREG 0800, Section 9.5.1, subsection C.7.h , "Turbine Building" which states, in part:	Reference 2.19
"The turbine building should be separated from adjacent structures containing safety related equipment by a fire barrier with a minimum rating of 3 hours.... Openings and penetrations in the fire barrier should be minimized and should not be located where the turbine lube oil or generator hydrogen cooling system creates a direct fire exposure hazard to the barrier. Considering the severity of the fire hazards, defense in depth may dictate additional protection to ensure barrier integrity."	
In summary, the regulatory goal of the Turbine Building Lube Oil Storage Room walls is to prevent a direct exposure fire hazard to either safety related equipment or openings in those fire barriers protecting safety related systems and equipment.	
NRC Generic Letter 86-10 permits the use of engineering evaluations to technically justify fire barrier configurations which are not in strict compliance with the regulatory requirements. Hence this analysis is being written to technically justify the existing configuration of Turbine Building lube Oil Storage Room walls.	Reference 2.20

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ANALYSIS CONTINUATION SHEET

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	Reference/Comments
4.2 Description of Fire Barriers	
As detailed below, the Turbine Building Lube Oil Storage Room is separated from the balance of the turbine building by fire rated barriers. The purpose of these fire rated barriers is to prevent fire propagation into, or out of, the room. Given that the Turbine Building Lube Oil Storage Room has an in-situ fire loading in excess of 3 hours, and the high dollar value of the equipment inside the turbine building proper, this separation is in keeping with regulatory requirements previously discussed as well as standard industrial practices and property protection guidelines.	Refs 2.1 & 2.2 Reference 2.9
The ceiling of the Turbine Building Lube Oil Storage Room consists of an 8-inch poured concrete slab which is considered as an at least a 3 hour rated fire barrier per Figure 7-4g of Reference 2.12. This slab also has concrete access hatches which are considered to have the same fire resistance of the fire barrier in which they are installed.	Reference 2.6 Reference 2.12
The west wall of the Turbine Building Lube Oil Storage Room is constructed of 6-inch, hollow concrete blocks, which is a 2 hour rated barrier, up to the level of the ceiling of the Feedwater Purity Building Pipe Tunnel. Beyond that point, the Turbine Building Lube Oil Storage Room west wall is constructed of a steel beam topped with non fire rated corrugated sheet metal. This configuration is considered acceptable from a fire protection viewpoint because this non fire rated portion of the west wall is an exterior wall. The penetrations in fire rated portion of this barrier are sealed with either caulk and/or grout penetration seals or by substantial steel construction. Hence the portion of the west wall that interfaces with the Feedwater Purity Building Pipe Tunnel is considered to be a 2 hour rated fire barrier.	Refs 2.3 & 2.5
The north, south and east walls of the turbine building lube oil room were constructed of nominal 8-inch, filled concrete blocks as 3 hour rated barriers. Doors 30 and 31, in the south wall of the room, are 3 hour rated fire doors. A single fire damper (CD-24) is also installed in the south wall of the room.	Refs 2.3 & 2.5 Reference 2.4

PALISADES NUCLEAR PLANT
ANALYSIS CONTINUATION SHEET

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	Reference/Comment
4.2 Description of Fire Barriers (Continued)	
Visual inspection of the Turbine Building Lube Oil Storage Room has determined that the penetration seals in the north, south and east walls of the room are either grout, steel plate or nominal 8-inch (7-5/8 inch actual) thick penetration seals with damming material. Typically, steel plates (unless specifically analyzed for a specific fire duration) and non grouted penetration seals less than 8 inches thick do not qualify as full 3 hour rated seals; But would qualify as 2 hour rated seals. Furthermore, the exact type of fill and construction of these penetration seals cannot be determined for further analysis. Hence, these seals are considered to be 2 hour rated seals for conservatism.	
Therefore, based on the above information, it is concluded that the Turbine Building Lube Oil Storage Room is separated from the balance of the plant by fire barriers with a minimum fire resistance rating of 2 hours.	
The Appendix R Analysis assumes that a postulated plant fire will be extinguished within 1 hour. Hence the provision of 2 hour rated fire barriers to separate the Turbine Building Lube Oil Storage Room from the balance of the turbine building does not adversely impact the fire protection program or the post fire safe shutdown (Appendix R) analysis.	Reference 2.17
4.3 Fire Barrier Exposure Fire Threat	
The combustible loading on the turbine building side of the lube oil room walls is a maximum of approximately 61 minutes (with no credit for fire suppression). There is no specific combustible loading calculation for the pipe tunnel. However, inspection of the area has determined that the combustible loading in the tunnel is low and would easily be bounded by the calculated fire duration for the Turbine Building. Given that the Turbine Building Lube Oil Storage Room is separated from the balance of the Turbine Building and the Feedwater Purity Building Pipe Tunnel by 2 hour rated barriers, a fire that originates in either the Feedwater Purity Building Pipe Tunnel or in the Turbine Building in the vicinity of the Turbine Building Lube Oil Storage Room will not be of sufficient intensity	Refs 2.10 & 2.11

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	Reference/Comment
or duration to challenge those 2 hour rated walls. As previously stated, the Appendix R analysis assumes that this fire will be extinguished within 60 minutes. Hence, the greater fire threat to the integrity of the Turbine Building Lube Oil Storage Room is a fire from within the lube oil room. As documented below, in Section 4.4, the turbine building is adequately protected from a fire in the Turbine Building Lube Oil Storage Room by a defense in depth approach to fire protection.	Reference 2.17
4.4 Turbine Building Lube Oil Storage Room Defense in Depth	
The Turbine Building Lube Oil Storage Room is provided with fire rated barriers that enclose the room and will then confine the resultant fire to the room of origin. The bottom 17.5 inches of these walls are designed as a diked area to contain the contents of a single oil tank. Because the dike was not sized to accommodate the full oil inventory of the room or an oil spill with fire suppression water or foam, no credit for this diked portion of the room is taken in this analysis.	Refs 2.1 & 2.2
An automatic wet pipe sprinkler system has been provided in the Turbine Building Lube Oil Storage Room. Analysis has shown that this system is capable of protecting the room with a spray density of 0.51 gpm per square foot over the entire floor surface area. Whereas, the recommended spray density for this type of fire hazard is 0.3 gpm per square foot. Hence, this sprinkler system will be able to provide cooling of both the burning oil the air in the room. This is acceptable because sprinkler systems are intended to control fire and limit their growth by removing the heat from the protected area until the fire brigade arrives to actually extinguish the fire.	Refs 2.1 & 2.13 Reference 2.14
Actuation of the water flow alarm for this sprinkler system will cause an alarm to come in on Panel C-47 in the Main Control Room. Once the alarm is received, an operator will be dispatched to inspect the area for a fire and then if required, the plant fire brigade will be sent to extinguish the fire.	Reference 2.21 Reference 2.16
Furthermore, manual fire fighting equipment such as hose stations, portable fire extinguishers, a 30 gallon AFFF type foam cart, and a portable	

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Reference/Comment

ventilation unit are all located in close proximity to the Turbine Building Lube Oil Storage Room. Additional AFFF foam is located in two separate fire depots, one on the turbine deck (elevation 625'-0") and one in the feedwater purity building. This fire fighting equipment will then be utilized by the fire brigade to actually extinguish the fire. The plant fire brigade is trained both in the operation of this equipment in the extinguishment of oil pool fires using both water from manual hose stations and foam. Although AFFF foam is the preferred extinguishing agent for oil spill fires.

Because that portion of the west wall of Turbine Building Lube Oil Storage Room that extends above the Feedwater Building Pipe Tunnel is constructed of non fire rated sheet metal, it is expected to fail during the fire. Then because the products of combustion (smoke and hot gases) rise, they will be exhausted out through the failed west wall opening and NOT down into the feedwater purity building pipe tunnel or the turbine building itself. Additional ventilation of the smoke and hot gasses from the room for manual fire fighting purposes will be then be accomplished using the portable ventilation unit.

Consequently, defense in depth is provided against the spread of a fire in the Turbine Building Lube Oil Storage Room beyond the room of origin in the form of confinement of the fire by rated fire barriers; automatic detection of the fire via water flow alarms; the automatic activation of fire fighting/suppression water to spray down and cool the fire; ventilation of the smoke and hot gases through the failed sheet metal exterior wall; and the suppression of the fire by trained fire brigade members.

4.5 Feedwater Purity Building Pipe Tunnel and Turbine Building Exposure Fire Threat

As previously stated, the combustible loading in the Turbine Building and Feedwater Purity Building Pipe Tunnel in close proximity to the Turbine Building Lube Oil Storage Room is low to moderate with a maximum duration of approximately 61 minutes and does not pose a significant exposure fire threat to the Turbine Building Lube Oil Storage Room. Most of the combustibles in this immediate area consist of cable trays located

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	Reference/Comment
several feet above the floor or lube oil encased within mechanical equipment which are not expected to present a direct exposure fire threat to the Turbine Building Lube Oil Storage Room walls.	
Furthermore, an automatic wet pipe sprinkler system has been provided in the Turbine Building on the south (partial coverage) and east sides of the Turbine Building Lube Oil Storage Room. Analysis has shown that this system is capable of protecting this room with a spray density of 0.37 gpm per square foot over the entire floor surface area. Whereas, the recommended spray density for this type of fire hazard is 0.3 gpm per square foot. Hence, this sprinkler system will be able to provide cooling of both the burning oil the air in the room. This is acceptable because sprinkler systems are intended to control fire and limit their growth by removing the heat from the protected area until the fire brigade arrives to actually extinguish the fire.	Refs. 2.1 & 2.13 Reference 2.15
Actuation of the water flow alarm for this sprinkler system will cause an alarm to come in on Panel C-47 in the Main Control Room. Once the alarm is received, an operator will be dispatched to inspect the area for a fire and then if required, the plant fire brigade will be sent to extinguish the fire.	Reference 2.21 Reference 2.16
Because the products of combustion (smoke and hot gases) rise, they will be dissipated throughout the large volume of the turbine building. The large volume of this area will ensure a mixing of the products of combustion and cooler air Additional ventilation of the smoke and hot gasses from the turbine building for manual fire fighting will be then be accomplished by using the portable ventilation unit.	
Therefore adequate assurance exists that a Turbine Building or Feedwater Purity Building Pipe Tunnel fire cannot spread into the Turbine Building Lube Oil Storage Room. This position is based on the fact that the combustible loading in these areas is a maximum of approximately 61 minutes whereas, the fire barriers separating the Turbine Building Lube Oil Storage Room from both the Feedwater Purity Building Pipe Tunnel and the Turbine Building are 2 hour rated barriers. Furthermore, as detailed above fire protection defense in depth has been provided to quickly detect and extinguish fires in either the Feedwater Purity Building Pipe Tunnel or the Turbine Building.	Refs. 2.10 & 2.11

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	Reference/Comment
4.6 Protection of Safe Shutdown Capability	
The analysis provided in the preceding pages documents the fact that a fire that originates in the Turbine Building Lube Oil Storage Room will not spread beyond that room and affect safety related/post-fire safe shutdown equipment located in the Turbine Building. This analysis also documents that a fire that originates in either the turbine building or Feedwater Purity Building Pipe Tunnel cannot propagate into the Turbine Building Lube Oil Storage Room.	
The Appendix R analysis documents that the Turbine Building Lube Oil Storage Room does not contain any safe shutdown related components. Although a fire in that room could cause the loss of instrument air. This is consistent with the Appendix R analysis which automatically assumes that instrument air is lost in any plant area that contains instrument air system circuits, components or piping. The Appendix R analysis documents that the post turbine building fire safe shutdown strategy assumes the loss of instrument air due to the fire in that area. Hence even if a fire were postulated to spread from the Turbine Building Lube Oil Storage Room to the turbine building itself, or vice versa, this scenario would not an result in an unanalyzed condition. Consequently, the post fire safe shutdown strategy for a turbine building is not adversely affected by this scenario.	Reference 2.17 Reference 2.17
The Feedwater Purity Building and its associated pipe tunnel do not contain any safe shutdown related systems or equipment. The pipe tunnel is open to the turbine building. Hence a fire in the pipe tunnel could spread to the turbine building. However, because the Feedwater Purity Building and its associated pipe tunnel do not contain any safe shutdown related systems or equipment this scenario would not adversely impact the post fire safe shutdown strategy for a turbine building.	Reference 2.17
Finally, based on the information presented above, the conclusions in the Appendix R analysis that a fire in either area cannot prevent the safe shutdown capability of the plant has not changed.	Reference 2.17

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5.0 CONCLUSIONS

This analysis has documented that a fire that originates in the Turbine Building Lube Oil Storage Room cannot spread into the turbine building. This position is based on the 2 hour rated fire barriers that enclose the lube oil room are adequately constructed for the hazards present.

This analysis has also documented that the 2 hour rated fire barrier separating the Feedwater Purity Building Pipe Tunnel from the Turbine Building Lube Oil Storage Room is adequate to ensure that a fire cannot propagate between these two areas. The portion of this wall that is constructed of non fire rated corrugated sheet metal is not a valid fire propagation path because fires and their associated products of combustion travel upwards away from the pipe tunnel roof.

Finally, based on the information presented above, the conclusion stated in the NRC Letter, dated October 14, 1997; entitled "Palisades Plant Evaluation of Unresolved Fire Protection Inspection Issues Related to the Adequacy of Turbine Building Fire Area Barriers (TAC No. M94148), that "The west wall of the turbine lube oil room [as modified by Consumers Energy] provides reasonable assurance that a fire in the lube oil room will not adversely impact safety related/post-fire safe shutdown equipment located in the turbine building," has been validated.

Reference 2.19

Note: The wall modification referred to above by the NRC was the construction of the 2 hour rated west wall in the Turbine Building Lube Oil Storage Room. The original construction of the wall was non fire rated sheet metal above the dike.

Reference/Comment

EA-APR-01-004
Sheets 13-17 not included

ATTACHMENT 2

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

May 25, 2001

Engineering Analysis EA-APR-01-005

Evaluation of the Effects of a Fire on the West Wall of the Component Cooling Water Pump Room (Room 123)

CONSUMERS ENERGY

PALISADES NUCLEAR PLANT
ENGINEERING ANALYSIS COVER SHEET

EA-APR-01-005

Total Number of Sheets 20

Title Evaluation of the effects of a fire on the West Wall of the Component Cooling Water Pump Room (Room 123)

INITIATION AND REVIEW

Calculation Status: Preliminary ☐ Pending ☐ Final ☒ Superseded ☐

Rev #	Description	Initiated By	Initiated Date	Init Appd By	Review Method: Alt Calc	Review Method: Detail Rev'w	Review Method: Qual Test	Technically Reviewed By	Technically Reviewed Date	Rev'r Appd By	S/DR Appd
0	Original Issue	RJ Kilroy	5/16/01	JLK		X		EA Dorbeck	5/22/01		
								JL Kuemin	5/23/01	~~RAW~~	

1.0 OBJECTIVE

The purpose of this engineering analysis is to show the impact of a Turbine Building fire on the barrier forming the west wall of the Component Cooling Water Pump Room (elevations 590'-0" and 607'-0"). Specifically, this analysis will consider the equivalent fire resistance of the barrier; combustible loading in the Turbine Building within the immediate area of this barrier; automatic fire detection and suppression; and manual fire fighting activities. Through these considerations, this analysis will demonstrate through defense in depth, the ability of the barrier forming the west wall of the Component Cooling Water Pump Room (El 590'-0" and 607'-6") to prevent the spread of fire from the Turbine Building to the Component Cooling Water Pump Room (elevations 590'-0" and 607'-6").

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ANALYSIS CONTINUATION SHEET

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	Reference/Comment

2.0 ANALYSIS INPUT

2.1 Drawing M-216 Sheet 4, "Fire Protection Plan of Elevation 570'-0" and 590'-0," Revision 9

2.2 Drawing M-216 Sheet 6, "Fire Protection Plan of Elevation 607'-0" and 611'-0," Revision 7

2.3 Drawing M-216 Sheet 7, "Fire Protection Plan of Elevation 625'-0," Revision 13

2.4 Architectural Drawing C-45, "Turbine Building Floor Plans @ 571'-0" and 590'-0," Revision 21

2.5 Architectural Drawing C-104, "Auxiliary Building Wall Modifications & Pipe Restraints Block Wall @ EL 625 and MFPR Opening @ EL 590," Revision 31

2.6 Architectural Drawing C-615, "Auxiliary Building Foundation and Floor Plans at EL. 590'-0," Revision D

2.7 NRC Letter dated October 14, 1997, entitled "Palisades Plant Evaluation of Unresolved Fire Protection Inspection Issues Related to the Adequacy of Turbine Building Fire Area Barriers" (TAC No. M94148)

2.8 Palisades Nuclear Plant Fire Protection Program Report (FPPR) Volume 2, Section VIII; List of Changes and Response to Appendix A to Branch Technical Position APCSB 9.5-1 and Regulatory Guide 1.78 and 1.101, Revision 2, dated August 24, 1996.

2.9 Engineering Analysis EA-FPP-95-016, "Analysis of Combustible Loading for Fire Area 23B, Steam Generator Feedpump Area," Revision 1.

2.10 Engineering Analysis EA-FPP-95-018, "Analysis of Combustible Loading for Fire Areas 23C, Main Generator Seal Oil system Area, and Fire Area 23D, Turbine Building-General," Revision 2.

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	Reference/Comment
2.11 Engineering Analysis EA-FPP-95-028, "Analysis of Combustible Loading or Fire Area 16 Component Cooling Pump Room," Revision 1.	
2.12 Fire Protection Handbook, 18th Edition, NFPA, 1997	
2.13 Palisades Plant Fire Hazards Analysis, Revision 4, dated July 2, 1998.	
2.14 Engineering Analysis EA-FPP-96-015, "System Hydraulic Analysis for Turbine Building," Revision 0	
2.15 Alarm and Response Procedure ARP-12, "Fire System Flow Scheme EK-28 (C-47)," Revision 53	
2.16 Engineering Analysis EA-APR-95-007, "10 CFR 50 Appendix R Fire Safe Shutdown Analysis," Revision 1	
2.17 Engineering Analysis EA-FPP-95-050, "Evaluation of the Effects of a Fire on the West Wall of Component Cooling Water Pump Room (Fire Area 16)," Revision 2.	
2.18 NRC Standard Review Plan NUREG 0800, Revision 2 dated July 1981.	
2.19 NRC Generic Letter 86-10, "Implementation of Fire Protection Requirements," dated April 24, 1986.	
2.20 Vendor Drawing M3.05-392-1, "Piping Oil Drain Guard (Sub Assembly) 24" Guard," Revision 4	
3.0 ASSUMPTIONS	
3.1 The west wall of the Component Cooling Pump Room is subjected to a single exposure fire per Section A.9 of Reference 2.8.	Reference 2.8
3.2 The automatic wet pipe sprinkler systems provided on the 590'-0" elevation of the turbine building are operable at the time of the postulated fire.	

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	Reference/Comments
4.0 ANALYSIS	
4.1 General	
General Guidelines for Plant Protection are discussed in the List of Changes and Responses to Appendix A to BTP APCSB 9.5-1 and Regulatory Guide 1.78 and 1.101, Subsection D.1.j. The regulatory position states that concerning compartmentation "...Floors walls and ceilings enclosing separate fire areas should have a minimum fire rating of 3 hours." It then goes on to state "...The fire hazard in each area should be evaluated to determine barrier requirements." Also, ... "If barrier fire resistance cannot be made adequate, fire detection and suppression should be provided..."	Reference 2.8
Based on the above statements, it is apparent that the analysis of a specific barrier for acceptability should follow this order of importance:	
a. The capability of the barrier must satisfy the minimum fire rating of three hours. If not then;	
b. The fire barrier must be adequate to withstand the actual combustible loading in the fire areas separated by the barrier. If not then;	
c. The actual configuration must be reviewed in order to take credit for other systems or circumstances the may increase the acceptability of the barrier (e. g. Automatic detection, automatic suppression, manual suppression, etc...),	
This analysis is based upon meeting the requirements of criterion c above. It shall be used to demonstrate the capability of the fire barrier and its supporting systems to adequately prevent the spread of fire across the barrier separating the Component Cooling Water Pump Room (Fire Area 16) from the Turbine Building Feedwater Pump Area (Fire Area 23B).	

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	Reference/Comment
NRC Generic Letter 86-10 permits the use of engineering evaluations to technically justify fire barrier configurations which are not in strict compliance with the regulatory requirements. Hence this analysis is being written to technically justify the existing configuration of the barrier separating the Component Cooling Water Pump Room (Fire Area 16) from the Turbine Building Feedwater Pump Area (Fire Area 23B).	Reference 2.19
4.2 Description of the Fire Barrier and Adjacent Area	
The Component Cooling Water (CCW) Pump Room includes three elevations; 590'-0", 607'-6" and 625'-0". This analysis will focus on the west wall of the Component Cooling Water (CCW) Pump Room between elevations 590'-0" and the underside of the 625'-0" floor slab. This wall is a 24 inch thick poured concrete which is considered as an at least a 3 hour rated fire barrier per Figure 7-4b of Reference 2.12. However, this wall has a pressure relief opening at elevation 590'-0". It is this opening, that will be the subject of this analysis.	Refs, 2.1, 2.2 & 2.3 Reference 2.5 Reference 2.12
The subject pressure relief opening (Door 196A) which is located on the 590'-0" elevation is 9 feet high by 7 feet wide. The lower 5 feet of the relief opening consists of water tight steel blowout panels that are fixed in place for flood protection. These steel plates form an effective radiant energy shield to block line of sight heat transfer from a fire in the Turbine Building into the CCW Pump room. The remaining upper portion of this pressure relief area is open with metal bars to provide security protection. This opening is provided for pressure capability for a postulated main steam or main feedwater line breaks in the CCW Room.	Reference 2.6
Visual inspection of the barrier shows that there three major penetrations and several minor penetrations in this barrier. The three major penetrations contain two main steam lines and two main feedwater lines that penetrate the west and southwest segments of the wall. This evaluation will concentrate on the three major penetrations. The basis for this position is that the evaluation of the major penetrations will envelope the minor penetrations.	

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	Reference/Comment
One main feedwater penetration is located approximately 5 feet above the 590'-0" floor elevation. This penetration has Kaowool and insulation installed in portions of the annular gap around the pipe to provide a fire resistant seal, but this configuration does not meet the requirements for a fire rated seal. The annular opening for the pipe is 2 inches, or less, in width. Hence the 24-inch thick wall when combined with the narrow annulus for the piping penetration forms an effective radiant energy shield to block line of sight heat transfer from a fire in the Turbine Building into the CCW Pump room. The second main feedwater piping penetration which is located approximately 12 feet above the floor elevation, does not contain any sealant material. The annular opening for this penetration varies with a maximum width of 6 inches. Hence the 24 inch thick wall, when combined with the 12 foot height above the floor of the relatively narrow annulus for the piping penetration, forms an effective radiant energy shield to block line of sight heat transfer from a fire on the 590'-0" elevation of the Turbine Building into the CCW Pump room. The two main steam lines penetrate the barrier through a blockout area located beginning approximately seven feet above the 607'-6" elevation and rising up approximately seven feet to about two feet from the underside of the 625' elevation floor in the Turbine Building. These 36-inch main steam lines extend through a single large square opening that has a surface area of approximately 84 square feet. Other pipes are also routed through this opening. This blockout is itself almost completely covered by massive steel main steam line piping supports on the Turbine Building side of the wall. Hence, the 24-inch thick wall, when combined with the massive steel support and the main steam lines extending through the opening form an effective radiant energy shield to block line of sight heat transfer from the turbine building into the CCW Pump room. Finally, there are some smaller pipe penetrations in this wall. Most are filled with Kaowool, others have no sealant. However, given that the annulus space between these pipe and the wall is approximately three inches, or less. Fire propagation through a three inch wide, 24-inch deep annulus that is devoid of combustible materials is not considered a credible event.	

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Furthermore, the 24-inch thick wall when combined with the narrow annulus for these piping penetrations forms an effective radiant energy shield to block line of sight heat transfer from a fire in the Turbine Building into the CCW Pump room. In summary, the west wall of the CCW Pump room provides either a 3 hour rated fire barrier or a radiant energy shield up to a 5 foot high level above the 590'-0" elevation. The unsealed piping penetrations detailed above also provide an almost continuous line of sight radiant shield for a floor based fire at the 590'-0" elevation within 20 feet of the penetrations due to the 24 inch wall thickness and the size of the penetrating pipes and steel supports filling most of the opening areas. Furthermore, visual inspection of the CCW Pump Room has determined that there are no significant combustibles located within 20 feet of any of the unsealed openings or the pressure relief panel that could be affected by radiant heat transfer from the Turbine Building through unsealed openings. The floor of the Turbine Building Feedwater Pump Area adjacent to the CCW Pump Room is constructed of concrete. However, the Turbine Building Mezzanine floor at the 607'-6" elevation is open metal grating. This would allow any smoke or hot gases produced at the 590'-0" level elevation to rise freely to the ceiling of the 607'-6" elevation, which is the underside of the 625'-0" elevation. The are two separate access stairways in the vicinity of the pressure relief opening. One open stairway runs from the 590'-0" level to the open grating on the 607'-6" elevation. And a second open stairway runs from the open grating on the 607'-6" level to the 625'-0" operating floor. These stairways and open grating would allow the venting of smoke and hot gasses from a fire in the vicinity of the pressure opening on the 590'-0" level to rise above the 625' elevation to the Turbine Building ceiling without any significant build up of heat in any one area. Another grated floor exists on the 625' operating floor approximately six feet west of the stairway and an open area also exists on the 625' elevation to the south of the stairway above to the Feedwater Pump lube oil reservoirs. These open areas will also allow venting of smoke and hot gasses up to the ceiling of the Turbine Building.	

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	Reference/Comment
4.3 Description of Turbine Building Combustible Loading	
The Turbine Building area adjacent to the CCW Pump Room is part of Fire Area/Zone 23B, the Turbine Building Feedwater Pump Area. The overall fire loading in this area results in an equivalent maximum fire duration of 61 minutes. This fire duration envelops the adjacent Fire Zones 23C and 23D on the 590'-0" level of the Turbine Building.	Refs 2.9 and 2.10
Based on field walk downs, the primary in-situ combustibles in the Turbine Building Feedwater Pump Area include two 480 volt motor control centers (MCC-3 and MCC-4) with associated cable trays and two 750 gallon capacity lube oil reservoir tanks (Tanks T-21A and T-21B). The minimum distance from the MCCs to the pressure relief opening is approximately 30 feet. While the lube oil reservoir tanks are located greater than 70 feet from the pressure relief opening. The lube oil reservoirs are also greater than 30 feet away from the nearest feedwater pipe penetration in the west wall of the CCW Pump Room. There are no significant combustibles located above the floor on the 590'-0" elevation adjacent to any of the openings discussed in Section 4.2 of this evaluation.	
Floor drains are located in this area around the lube oil reservoir tanks and in the space between the tanks and the pressure relief opening and the feedwater line penetration. The floor is sloped away from the CCW wall and the drains would carry any spilled lube oil to the Turbine Building sump away from the area of concern. Possible drainage of a lube oil reservoir would also drain off to the valve pit and the east side of the condenser and the heater drain pump pit.	
The guarded turbine lube oil piping runs along the north and east sides of the turbine. The turbine lube oil supply is contained within pipes that are themselves contained within a lube oil guard drain pipe. The exterior guard drain piping contains lube oil that is approximately 150 ^{0}F that is not pressurized and that gravity drains back to the lube oil tanks. The drain pipe is not under thermal or pressure stress. There is no degradation mechanism, no potential for cracking, and no potential for wastage, in the guard drain pipe.	Reference 2.20

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A break of the turbine lube oil supply pipe concurrent with a break in the guard drain pipe is not postulated to occur. Postulated leakage in the non-pressurized guard pipe would be expected to be very small in size and not leak a substantial amount of oil before it was identified by local observation (e.g., an operator on rounds). The leakage would be contained away from the CCW Pump Room pressure relief opening in the same manner as described above for leakage out of the feedwater pump lube oil reservoirs, i.e., leakage would be captured in floor drains to the turbine building sump or in the valve and heater drain pump pits below the 590'-0" elevation of the Turbine Building.	
The combustible loading at 607'-6" elevation in the vicinity of the pressure relief opening is low and cannot support a fire of sufficient intensity or duration to present an exposure fire threat to the CCW Pump Room walls.	
Because the floor at 607'-6" of the Turbine Building is open metal grating, open pool fires resulting from spills of combustible liquids is not postulated on this level. Hence, an exposure fire that could result in sustained direct flame impingement on the CCW Pump Room west and south west walls is not considered credible.	
Transient combustibles are administratively controlled throughout the plant. The area immediately adjacent to the pressure relief opening is blocked by the access stairway to the 607'-6" elevation. Furthermore, the floor area to the west of the pressure relief also contains three air receiver tanks (T-8A, T-8B & T-8C) the Steam Generator Blowdown Pumps (P-98A/B) the flash tank (T-29) and the piping associated with this equipment. The presence of the stairway and these components effectively precludes the storage of combustible materials. The remainder of the area near the pressure relief opening is a walkway to the stairway which would not be suitable for storage or the staging of materials as this would block an already limited access pathway.	
A feedwater heater (E-6A) and its associated piping generally blocks the area adjacent to the feedwater pipe penetrations such that it would be impractical to store any significant amount of transient combustibles below the feedwater pipe penetrations.	

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A flammable liquids storage locker that meets the requirements of NFPA 30, is located within 3.5 feet of the southwest feedwater piping penetration to house chemicals used for water treatment. This condition does not cause an exposure hazard to the feedwater piping penetration due to the fire rated design of the storage locker. No additional transient combustible controls, above those already in place, are deemed necessary for this area due to the height of the pressure relief steel plates and the piping penetration openings above the floor.	
4.4 Combustible Loading Summary	
As discussed above, the transient combustible loading in the vicinity of the CCW Pump Room west wall is negligible and does not pose an exposure fire hazard to either the pressure relief openings or the piping penetrations. The equipment congestion and lack of open floor space near the west wall of the CCW Pump Room also ensures credible transient combustibles used in this area will not present an exposure fire hazard to the CCW Pump Room.	
As previously discussed, visual inspection of the CCW Pump Room has shown that there are no significant combustibles located within 20 feet of any of the unsealed openings or the pressure relief panel that could be affected by radiant heat transfer from the Turbine Building through the unsealed openings.	
The in-situ combustible loading of 61 minutes in the Turbine Building Feedwater Pump Area could pose an exposure hazard to the pressure relief opening and piping penetrations. However, the greater than 30 foot separation of the in-situ combustibles from any of these openings, combined with the floor slope away from the CCW Pump Room West Wall and floor drains to limit pool fire spread significantly decreases the concern for potential fire spread across the non-fire rated openings into the adjacent CCW Pump Room. The lack of significant combustibles on the CCW Pump Room side of the non-fire rated openings for over 20 feet behind the openings further decreases the concern for potential fire spread or smoke and hot gas	Refs 2.9 and 2.10

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damage to equipment in the CCW Pump Room. The equipment located in the CCW Pump Room are substantial metal components that are not vulnerable to smoke and hot gas damage. The largest credible Turbine Building Fire near the CCW Pump Room would be a Main Feedwater Pump lube oil fire from a rupture or leak of the reservoir. Such a fire would vent smoke and hot gasses through out the Turbine Building without an appreciable buildup near the CCW Pump Room west wall openings. The remaining hazard would be from the radiant energy of such a postulated fire. Based on the spacing of floor drains located in the area around the lube oil reservoir, the size of a combustible liquid pool fire pool fire should be limited to the area adjacent to the Main Feedwater Pump. The only CCW Pump Room opening which may directly expose cable located in conduit to the radiant energy of such a fire would be the pressure release opening. These target cables, which are associated with an Auxiliary Feedwater Pump, are protected by metallic conduit and are located about two feet behind and four feet to the side of the pressure release opening. The greater than 50 feet separating the fire from the target conduits would ensure there would not be sufficient energy in such a fire to damage conduit enclosed IEEE-383 cable located behind the pressure release opening. Radiant energy from a fire decreases exponentially as the square of the distance increases. In addition there are only limited areas with an unobstructed line of sight path between the Main Feedwater Pump area and the pressure release opening due to equipment such as the feedwater heater located beside the pressure release opening. There are no intervening combustibles between the postulated Main Feedwater Pump lube oil pool fire and the CCW Pump Room openings.	

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	Reference/Comment
4.5 Defense in Depth against a Turbine Building Fire	
A. Suppression	
The Turbine Building Feedwater Pump Area contains partial automatic suppression above the 607'-6" elevation. The sprinkler system also provides coverage for the area adjacent to the pressure relief opening on the 590'-0" level. The automatic suppression is provided over the combustible hazard areas such as the cable trays near the MCCs and the Main Feedwater Pump lube oil reservoir area on the 590'-0" elevation. The floor grating at the 607'-6" elevation is open so the sprinkler spray will be able to reach the postulated fire down below on the 590'-0" floor level. The grating will affect the spray pattern but not prevent is downward flow from the ceiling of the 607'-6" elevation down to the floor of the 590'-0" elevation. Sprinkler heads located below metal grating and cable trays are provided with collector plates to collect heat to melt their fusible link and actuate the sprinkler head. Analysis has shown that this system is capable of protecting the Turbine Building Feedwater Pump Area with a spray density of 0.37 gpm per square foot over the entire floor surface area. Whereas, the recommended spray density for this type of fire hazard is 0.3 gpm per square foot. Hence, this sprinkler system will be able to provide cooling of the combustibles in the room. This is acceptable because sprinkler systems are intended to control fire and limit their growth by removing the heat from the protected area until the fire brigade arrives to actually extinguish the fire.	Refs. 2.1 & 2.2 Reference 2.14
The Turbine Building Feedwater Pump Area is also supplied with two hose stations that are capable of reaching the pressure relief opening. In addition a wheeled dry chemical extinguisher is located close to the flammable liquids storage locker. A 30 gallon AFFF foam cart for fighting combustible liquids fires is provided nearby on the south side of the Turbine Building Lube Oil Room. Additional AFFF foam is located in two separate fire depots, one on the turbine deck (elevation 625'-0") and one in the feedwater purity building. Outside access to the Main Feedpump Area is provided by the roll-up door on the South side of the Turbine Building. This opening provides the fire brigade with access to a hydrant hose house. Finally, portable fire extinguishers are also located strategically throughout the turbine Building	

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	Reference/Comment
This fire fighting equipment will be utilized by the fire brigade to extinguish the fire. The plant fire brigade is trained both in the operation of this equipment in the extinguishment of class A fires and oil pool fires using both water from manual hose stations and foam. Although AFFF foam is the preferred extinguishing agent for oil spill fires.	
B. Detection	
The sprinkler system is provided with water flow alarms. Actuation of the water flow alarm for this sprinkler system will cause an alarm to come in on Panel C-47 in the Main Control Room. Once the alarm is received, an operator will be dispatched to inspect the area for a fire and then if required, the plant fire brigade will be sent to extinguish the fire. The detection system on the 590'-0" level of the CCW Pump Room also provides a measure of early warning capability of a fire in the vicinity of the pressure relief opening.	Reference 2.15
C. Ventilation	
Because the products of combustion (smoke and hot gases) rise, they will be dissipated throughout the large volume of the turbine building. The large volume of this area will ensure a mixing of the products of combustion and cooler air. Additional ventilation of the smoke and hot gasses from the turbine building for manual fire fighting will be then be accomplished by using the portable ventilation units provided adjacent to the Turbine Building Lube Oil Room and the turbine building corridor outside Cable Spreading Room.	
D. Summary	
Consequently, defense in depth is provided against the spread of a fire in the Turbine Building Feedwater Pump Area into the CCW Pump Room in the form of confinement of the fire; automatic detection of the fire via water flow alarms and detectors in an adjacent area; the automatic activation of fire	

Reference/Comment

fighting/suppression water to spray down and cool the fire; ventilation of the smoke and hot gases; and the suppression of the fire by trained fire brigade members.

5.0 CONCLUSION

The west wall of the CCW Pump Room provides reasonable assurance that a fire which originates in the Turbine Building Feedwater Pump Area will not propagate into the CCW Pump Room. The analysis documents that a realistic in-situ or transient combustible fire in the Turbine Building Feedwater Pump Area will not propagate across the pressure relief openings or various piping penetrations such that equipment in the CCW Pump Room could be damaged.

The key factors in this defense in depth for this area include:

The construction features of the pressure relief opening with water tight metal plates on the lower 5 feet of the opening and physical location of the piping penetrations at least 5 above the floor level protect against floor based fires.

The location of in-situ combustibles at least 20 feet away from both sides from these openings (greater than 40 feet overall separation) and the location of floor drains in the intervening space to remove the most likely fuel in the Turbine Building Feedwater Pump Area.

The large area volume and ceiling height above the openings in the Turbine Building Feedwater Pump Area to dissipate smoke and hot gasses from the fire.

The inherent protection from the radiant energy afforded by surrounding equipment near the pressure relief opening provides shielding from credible exposure fires.

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	Reference/Comment
The practical limitations on the location and amount of transient combustibles that may be stored near the barrier openings due to permanent equipment or stair structure. The lack of significant intervening combustible materials or smoke and hot gas sensitive equipment within 20 feet of either side of the barrier. Localized automatic sprinkler protection over the fire loading concentration areas in the Turbine Building and the automatic sprinkler protection adjacent to the pressure relief opening with a water flow alarm to the control room for prompt notification at a continuously manned location ensuring prompt fire brigade response. If smoke from the Turbine Building fire enters the CCW Pump Room the smoke detectors provided therein will provide an alarm to the control room for prompt notification at a continuously manned location ensuring prompt fire brigade response. Portable smoke removal fans are available to the fire brigade to support smoke removal from the fire. An on-site five person fire brigade that has been trained in fighting flammable liquid fires is available to respond at any time and has equipment such as nearby hose stations, wheeled dry chemical fire extinguishers and foam carts specifically suited for fighting lube oil fires.	

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Sheets 16-20 not included