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Dominion

April 15, 2004

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.	04-070
NSS&L/DF	R2
Docket No.	50-423
License No.	NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)

Pursuant to 10 CFR 50.90, Dominion Nuclear Connecticut, Inc. (DNC) hereby requests to amend Operating License NPF-49 for Millstone Unit 3 (MP3) to address resolution of fire suppression system design concerns for the cable spreading area (CSA).

During original plant licensing, MP3 requested a deviation from the requirements of Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," Revision 2, July 1981, to allow an automatic CO_2 fire suppression system to be installed in the Cable Spreading Area (CSA) in lieu of the recommended fixed water suppression system. DNC is in the process of converting the existing CO_2 system to a manually actuated system. Once actuated, the CSA CO_2 system will function as originally designed to deliver the appropriate amount of CO_2 extinguishing agent to meet the original design concentrations and soak times without further operator intervention. This change is being made to improve personnel safety by providing manual control of CO_2 discharge in the CSA.

The CSA CO_2 system actuation will be performed in accordance with established plant procedures as deemed necessary by the Millstone onsite fire brigade assessment of the fire type and size. It is expected that manual fire suppression actions (i.e., application of hose streams, water or CO_2 based extinguishers, etc.) will be effective in extinguishing and limiting the amount of fire damage for the majority of predicted fire scenarios. Preservation of the total flooding CO_2 system ensures that the full range of postulated fire conditions can be effectively addressed without compromising the ability to achieve and maintain safe shutdown of the plant.

This license amendment request is submitted in direct response to an NRC request to review and approve the planned changes to the MP3 fire protection program. The NRC staff has also advised DNC that a license amendment application is the only form appropriate to support that review. While DNC is accommodating the staff request, it should be noted that DNC has reviewed the associated changes against the requirements of 10 CFR 50.48, 10 CFR 50 Appendix A, General Design Criterion 3, and the specific requirements of the Millstone Unit 3 operating license. DNC has judged the changes to be fully compliant with those requirements. Upon completion of

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the planned modifications and administrative controls associated with the changes, as outlined in the attachments to this submittal, MP3 will no longer be reliant on a dedicated compensatory fire watch for the CSA.

Conclusions
The planned changes do not involve a significant impact on public health and safety and do not involve a Significant Hazards Consideration pursuant to the provisions of 10 CFR 50.92 (see Significant Hazards Consideration in Attachment 1).

Site Operations Review Committee and MSRC
The Site Operations Review Committee and Management Safety Review Committee have reviewed and concurred with the determinations.

State Notification
In accordance with 10CFR50.91(b), a copy of this license amendment request is being provided to the State of Connecticut.

If you should have any questions regarding this submittal, please contact Mr. David W. Dodson at (860) 447-1791, extension 2346.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachments:
1. Evaluation of Planned Changes
2. Updated Response to Question 1 from DNC Letter Titled Response to Request for Additional Information Dated Jan 23, 2004
3. Fire Frequency Analysis for Millstone Unit 3 Cable Spreading Area
4. Marked-Up Pages

Commitments made in this letter: None

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Serial No. 04-070
Docket No. 50-423
Subject: License Amendment Request Regarding a Change to the Fire Protection Program

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President – Nuclear Engineering, of Dominion Nuclear Connecticut, Inc. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 15th day of April, 2004.

My Commission Expires: 3/31/08.

Maggie McClure
Notary

Seal

ATTACHMENT 1

MILLSTONE POWER STATION, UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)
EVALUATION OF PLANNED CHANGES

Evaluation of Changes

1.0 DESCRIPTION

Pursuant to 10 CFR 50.90, Dominion Nuclear Connecticut, Inc. (DNC) hereby requests to amend Operating License NPF-49 for Millstone Unit 3 (MP3).

During original plant licensing, MP3 requested a deviation from the requirements of Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," Revision 2 July 1981, to allow an automatic carbon dioxide (CO_2) system to be installed in the Cable Spreading Area (CSA) and used as primary fire suppression in lieu of the recommended fixed water suppression system. The deviation was approved by the NRC in September 1985.[1] The planned changes would allow a manually actuated CO_2 fire suppression system to be used in conjunction with manual fire fighting in the CSA. The current NRC approved deviation documented in the MP3 Fire Protection Evaluation Report would be superceded by these planned changes. This change to the fire protection program is being submitted to improve personnel safety by providing improved (manual) control over CO_2 discharge in the CSA and thereby significantly decreasing the likelihood of inadvertent CO_2 discharge.

An update to License Condition 2.H. on page 8/9 of the Operating License is requested to indicate that the CO2 system is a manually actuated system. Proposed marked-up pages of the License Condition are provided in Attachment 4. Note that re-typed pages to reflect changes to this License Condition will be provided at a later date.

2.0 FIRE PROTECTION PROGRAM CHANGE

This fire protection program change will modify the CSA CO_2 fire suppression system from automatic actuation to manual only actuation. The changes involve realignment of a normally open valve to the closed position and associated electrical wiring changes. The CO_2 system will be used at the discretion of the fire brigade captain or operators to suppress complex fires such as hard to reach cable tray fires or fires requiring large quantities of hose stream water to extinguish.

Upon implementation of the planned modifications, a recently installed incipient fire detection (IFD) system will be credited as an early warning fire detection system for the CSA through the addition of administrative controls in the MP3 Technical Requirements Manual (TRM). The IFD system provides control room indication in addition to and independent of the originally licensed ionization and photoelectric smoke detectors. Upon implementation of the modifications, training is planned for operations and fire brigade personnel associated with the incorporation of IFD into the TRM. Training for operations staff includes understanding the IFD system alarm response in comparison with conventional smoke detection alarm and knowledge of CSA manual only actuation

[1] NUREG 1031, Supplement 2, "Safety Evaluation Report related to the operation of Millstone Nuclear Power Station, Unit No. 3," dated September 1985.

CO_2 system. Training and drills for fire fighting personnel currently include use of fire fighting strategies, IFD technology, and equipment specific to the various CSA fire scenarios. Training for fire fighting personnel related to the conversion of the CSA CO_2 system to a manual only actuation system is planned upon implementation of the required modifications. With the exception of a key lock on the manual valve, the CSA CO_2 system once converted from the automatic configuration will operate the same as other manual CO_2 suppression systems throughout the site.

Based on past experience (1999), a CO_2 discharge in the CSA has the potential to increase CO_2 levels in areas adjacent to the CSA. In addition to the CSA CO_2 system conversion, DNC is implementing additional modifications to ensure that the use of the CO_2 system in the CSA will not impact operator ability to perform safe shutdown actions in the event of a CO_2 discharge in the CSA. These modifications include eliminating the portion of the control building purge system that serves the CSA, installing CO_2 and O_2 monitoring equipment, and installing a breathing air station in alternate shutdown areas. The MP3 Updated Final Safety Analysis Report including the Fire Protection Evaluation Report will be updated to reflect these modifications.

3.0 BACKGROUND

The MP3 fire protection system, generally described in MP3 Updated Final Safety Analysis Report (UFSAR), Section 9.5.1, consists of numerous subsystems, procedures, and programs including fire detection, control of combustibles, fire barriers (walls, seals, etc.) and fire suppression (water, halon and CO_2). The license amendment is specific to the cable spreading area (CSA) Chemetron CO_2 fire suppression system. However since the Chemetron CO_2 system is interconnected with the Simplex detection system the modification impacts both systems.

3.1 Cable Spreading Area (CSA) CO_2 System Description

CO_2 gas is provided for fire suppression from a tank located in the yard area of the plant. It is piped to twelve areas of the plant for the purpose of fire suppression. This piping system includes three master selector valves near the CO_2 tank, initial and extended selector valves that serve individual areas, and lockout ball valves located at the Chemetron control panels. The CO_2 suppression systems at MP3 meet the guidelines of BTP CMEB 9.5-1, Section C.6.e., "Carbon Dioxide Suppression Systems," as documented in the Fire Protection Evaluation Report (FPER), Appendix B, "RESPONSE C.6.e," and in FPER, Section 4.1.2.2. The CSA CO_2 system is not safety-related, not required to shut down the reactor or mitigate the consequences of UFSAR Chapter 15 postulated accidents, and not required to maintain the reactor in a safe shutdown condition. The CO_2 system meets Fire Protection Quality Assurance (FPQA) standards as described in FPER Section 3.4 and FPER Appendix B, "RESPONSE C.4.a. through C.4.j."

Per the original design, the CSA low pressure CO_2 total flooding system is designed to maintain 50% CO_2 concentration for greater than 20 minutes. The system was approved for use during original plant licensing as discussed earlier. For a CSA discharge to occur, alarm signals from both of the applicable cross-zones of ionization / photoelectric detection in a given area are required. In the original design, with both cross-zones of detection in alarm, CO_2 discharge would occur after a 60-second time delay. Manual key stations are available that provide the ability to manually initiate a CO_2 discharge. The methods available to inhibit CSA CO_2 discharge include electrically inhibiting the master pilot valves located at the CO_2 tank, placing the key switch at the manual stations in "Abort", electrically inhibiting the input from the detection alarm signals via a key lock in the Chemetron panel, and closing of the ball valve located at the Chemetron panel. It should be noted that even if any of the electrical methods of inhibiting discharge described above are active, it is still possible to initiate CO2 discharge by means of a hand lever located at the pilot valve panel adjacent to the Chemetron panel and at each master pilot valve panel. Isolation of CO_2 by means of the mechanical valve at the CO_2 tank or the ball valve local to the Chemetron panel will prevent a CO_2 discharge.

The existing Chemetron panel provides indication of numerous conditions including, but not limited to alarm input from the Simplex cross-zone detection, trouble signals identifying ball valve off-normal alignment, initiation of a manual discharge and various trouble conditions (i.e., ground faults, shorts, open circuits, low voltage, etc.).

3.2 CSA Description

The fire area that contains the CSA involves the entire 24 ft - 6 in. elevation of the control building, gross volume of approximately 245,605 cubic feet. The room measurements are approximately 116 feet by 100 feet with a ceiling height of approximately 21 feet. All area boundaries are 3-hour fire-rated fire barriers, with the exception of outside walls, which are not fire-rated. The boundaries consist of reinforced concrete walls, ceiling and floor. The north boundary is exposed to the outside. The east boundary is adjacent to the service building. The south wall is adjacent to the turbine building. A portion of the west wall is adjacent to the technical support center and the remainder is an outside wall. The CSA floor is adjacent to the east and west switchgear rooms below. The CSA ceiling is adjacent to the control room, instrument rack room, and computer room above. Photographs of the CSA were previously provided in DNC letter dated May 7, 2002, Attachment 4.[2] Additional physical features are as follows:

- The CSA has two doors at ground elevation for access and egress (northwest and northeast corners).

[2] DNC letter, "Millstone Nuclear Power Station, Unit No. 3 Update to Information Regarding Change to the Fire Protection Program," dated May 7, 2002.

- A ground level courtyard area is located directly outside of the CSA.
- The CSA is a large open area with no subdivision walls.
- There are no radiological hazards in this area or adjacent areas (i.e. not a radiological control area).
- There are no floor drains installed in the CSA.
- The CSA is not a normally occupied space.

The CSA contains cables from redundant trains of safety related systems. Alternate shutdown capabilities are provided for a fire in the CSA using the fire transfer switch panel (east switchgear room) and the auxiliary shutdown panel (west switchgear room) which are located in separate fire areas. The fire hazards analysis for the CSA (fire area CB-8) is discussed in the Fire Protection Evaluation Report, Section 5 (analysis 34). Additional details regarding the combustibles in the CSA are as follows:

- The primary in-situ combustible in the CSA is cable that meets requirements of IEEE-383 or is jacketed with flame retardant material and fillers.[3] The combustible loading is approximately 220,000 Btu/ft^2 which DNC characterizes as moderately severe.
- The exposed cables are low voltage [120 volts alternating current (vac) or 125 volts direct current or less] control and instrument cables. The higher voltage cables that pass through the CSA are 4160 vac and 480 vac cable encased in metal conduit or concrete ductbanks.
- Redundant class 1E cables, conduit and trays are separated by a minimum of three feet vertically and one foot horizontally with alternative arrangements and deviations documented.
- All cables are provided with circuit fault protection devices (power supplies are coordinated) to remove any overcurrent or faulted condition.

Aside from cabling, the CSA also contains two electrical isolation panels fed with wiring in metal conduits from cable trays. The nearest cable trays are located approximately three feet horizontally from the isolation panels. Heavy gauge metal junction boxes are also located at the ceiling, floor, walls, and on columns within the CSA. The junction boxes and electrical isolation panels have steel construction with no or minimal openings. Additionally, there are two switch enclosure panels used as junction boxes in the CSA, a fire zone panel, and two IFD control panels. The switch enclosures contain insignificant combustibles and the other panels contain low voltage wiring and equipment and are substantially encased in metal enclosures.

The following fire fighting equipment is installed in the CSA or nearby areas. Portable suppression capability is described in the FPER, Section 4.1.3. The following equipment has been added recently to enhance manual fire fighting.

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(3) ANSI/IEEE STD 383-1974, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations," dated April 30, 1975.

- dry booster, continuous flow hose reels of sufficient numbers and locations within the CSA such that all trays can be reached (5 reels total, 100 feet of hose each)
- a 2-½" dry fire department connection through the north wall with 1-½" gated wyes inside the CSA to allow an expedient method of providing water to the CSA dry booster hose reels (alleviates the need to traverse outside hose through CSA doorways)
- one hose bin with 200 feet of hose near wall to connect to gated wye connection
- four new 2-½ gallon watermist extinguishers; two (one 50-pound, one 100-pound) wheeled CO_2 extinguishers. (Wheeled dry chemical extinguishers may be substituted for the wheeled CO_2 extinguishers.)
- one fire brigade locker inside the CSA with various equipment including a new thermal imaging camera dedicated for use in the CSA. The new camera is also supplemented by a second existing thermal imaging camera used site wide by the fire brigade
- portable ladders staged inside the CSA and dedicated for fire brigade use
- portable fan that is hydraulically (water turbine) powered is staged inside the CSA
- new water removal vacuum staged inside the CSA

This above equipment supplements the existing fire fighting equipment that was found acceptable during original plant licensing:

- portable fire extinguishers within the CSA consisting of four 20-pound CO_2 extinguishers
- exterior wheeled dry chemical extinguisher is also available just east of the diesel generator building
- electric fans, available in a nearby staging area
- two, interior, 100-foot, dry hose stations with electrically safe nozzles in the CSA
- two, interior, 100-foot, dry hose stations in areas nearby the CSA, capable for use in fighting a CSA fire
- exterior hydrant and hose house located west of the diesel generator building
- fire brigade locker in the service building

The water vacuum used by the site fire brigade has a 17-gallon capacity, however it is equipped with an automatic discharge pump which allows water removal without interruption. A hose attaches to the pump discharge and is routed directly to the outside courtyard for water removal as needed.

3.3 Ionization and Photoelectric Smoke Detection System Description

Cross-zoned ionization and photoelectric area-wide spot-type smoke detectors are installed in the CSA. All fire alarms, detection and trouble signals from the detectors are monitored by the Simplex main fire protection console located in the control room. The main fire protection console is powered by a reliable electrical supply and has an independent standby battery supply. This cross-zoned detection system was approved and determined to be acceptable in accordance with BTP CMEB 9.5-1, Section C.6.a, during original plant licensing in Supplement 1 to the NRC SER.[4] The CSA Simplex zone panel and main fire protection console provide extensive alarm and trouble condition indication including alarm and trouble signals from the cross-zone detection, trouble signals identifying ball valve off-normal alignment, initiation of a manual discharge, flow of CO_2 in the piping system (via pressure switches) and general panel trouble in the Chemetron panel. The fire detection and alarm systems are described in the Fire Protection Evaluation Report, Section 4.1.4.

3.4 Incipient Fire Detection System Description

The original ionization and photoelectric smoke detection system in the CSA has been augmented by a recently installed incipient fire detection (IFD) system. The IFD system is currently used to ensure early fire brigade response to a potential CSA fire.

In IFD operation, an air sample is delivered to a detector by means of a centrifugal blower connected to zone sampling line(s). A portion of this air is first diverted into a humidifier and humidified to approximately 100% relative humidity, and is then directed to a cloud chamber where it is subjected to a rapid vacuum expansion. The effect of the vacuum is to cool the air sample and cause water droplets to condense onto a particle that may be present in the air sample. It is known that particles smaller than the wavelength of visible light occur spontaneously as material is overheated, and in numbers far above those present in a normal ambient environment. As a result, thermally generated particles cause many droplets to form into a cloud, which is then detected by the measuring system of the cloud chamber. The end result is a continuous signal, which corresponds to the particle concentration and is displayed on the particle level bar graph.

In the CSA, the IFD system consists of two detection panels, each having four zones (two upper and two lower CSA quadrants) of coverage. Each zone consists of four air sampling heads connected by small diameter tubing which joins to form one tube run from the heads down to the zone (filter) manifold and into the detection panel. Each multiple detector head tube run is considered to be one zone. Through the use of solenoid valves, each IFD detection panel internal blower draws and samples air from

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[4] NUREG 1031, Supplement 1, "Safety Evaluation Report related to the operation of Millstone Nuclear Power Station, Unit No. 3," dated March 1985.

each zone, alternating zones approximately every 15 seconds. Data readings at each panel indicate the order in which zones are alarmed. A sign depicting the fire zone locations is located near the IFD detection panels, providing fire brigade members the ability to quickly identify which zones (quadrants) alarmed first and where to concentrate their response.

3.5 On-Site Fire Brigade Staffing and Training Description

The fire brigade at Millstone Power Station is described in Section 3.3 of the FPER. The fire brigade has a minimum of 5 members per shift and is supported by an additional operations fire team advisor knowledgeable in plant safety related system operations. The fire brigade is located on site within the protected area. Fire brigade training is conducted in accordance with administrative procedures and the training meets or exceeds the guidance provided in BTP CMEB 9.5-1, Section C.3.

Fire drills are conducted as specified in the Millstone Fire Protection Program Manual in accordance with BTP guidelines. Since the installation of the IFD system, several drills have been conducted for CSA fire scenarios based on receiving an IFD alarm. In this drill scenario the fire brigade searches for hot spots in the CSA cable trays using a thermal imaging camera prior to initiating (simulating) fire suppression using newly installed and existing fire fighting equipment described above. Based on fire drill data gathered for 2001 through 2002 for drills conducted at the Millstone units, a member of the fire brigade is expected to arrive at the scene of a fire in approximately 4 minutes from the drill announcement. Approximately 9 minutes after drill announcement, the first brigade member in full turnout gear is expected to arrive. Application of the first suppression agent is expected to occur between 9 to 15 minutes after drill announcement. These times are considered conservative because they include time required for drill instructors to provide participants with drill details.

Since original plant licensing, Millstone Power Station has built a separate fire training facility, located within the owner controlled area, where the brigade members train on various fire fighting techniques. The training facility includes full-scale mockups of Millstone specific plant areas. Recently, an elevated cable tray mockup was built to support realistic training for deep-seated cable tray fire scenarios. Training includes use of a thermal imaging camera to locate hot spots in cable trays.

3.6 Fire Fighting Strategy for the CSA

The Millstone Station Fire Fighting Strategies provide instructions to the fire brigade relative to safety related equipment in the area, special hazards and precautions, fire suppression equipment availability, assembly area(s), response strategy, spill or leak potential and ventilation strategies. The fire fighting strategies for MP3 are controlled in accordance with the Millstone Fire Protection Program Manual and meet the guidance in BTP CMEB 9.5-1, Section C.2.o. Based on CO_2 system lockout after the inadvertent discharge event in 1999, the site fire brigade has trained on CSA fire fighting strategies that:

- include manual fire fighting equipment and techniques,
- emphasize the importance of using the minimum amount of hose stream water necessary,
- direct rapid removal of water, and
- state the need for the switchgear rooms below to be investigated for damage.

The CSA fire fighting strategy also reflects the IFD system installation, expected response to IFD system alarms, and new manual fire fighting equipment such as the thermal imaging camera and extinguishers. Using the fire fighting strategies the fire brigade is trained to exercise good judgment in assessing the size and complexity of the fire, and to implement the appropriate suppression method (hose stream water, water mist extinguisher, etc.) when responding to a CSA fire alarm.

Manual ventilation methods for the CSA are also discussed in the fire fighting strategy. Smoke and CO_2 removal is directed by the fire brigade captain and consists of setting up portable smoke ejectors to create a ventilation path from the CSA to outside areas. The fire brigade regularly trains to these strategies and periodic drills are conducted in the CSA that include setting up the portable smoke ejectors. Manual smoke removal has been evaluated to be an acceptable means of purging the CSA and does not adversely impact the ability to safely shut down the plant in the event of a fire. The details of the smoke removal methods for the CSA are as follows:

- Regular station power to the portable electric fans will be used if available. Vital power is available in the nearby emergency diesel generator building. Power for portable fans would not be utilized until approximately one hour into the event. At that time, mutual aid fire trucks with electrical generators from surrounding towns would be on site, staged and available to provide power and assistance. Additionally, site fire protection has portable electrical generators available on site.

- The hydraulic (water turbine) smoke ejector has an inlet and outlet hose connection. The outlet hose would be attached and run out of the CSA, discharging in the outdoor courtyard. Water operating the hydraulic fan is not anticipated to be discharged into the CSA at any time.

3.7 Administrative Controls and Procedures

The fire protection program has administrative controls for the storage or use of transient combustibles in the plant. A fire protection permit is required for storage of transient combustibles in the CSA. Within the past year, the CSA has been designated as a Combustible Free Zone, which helps to ensure enhanced sensitivity and proper controls are in place in the event transient combustibles are brought into the CSA.

Also, fire protection procedures require prior documented concurrence from the fire protection program engineer or site fire marshal before transient combustibles or ignition source permits (welding, grinding) are allowed in the CSA. Proper use of administrative controls is monitored on a routine basis by fire prevention walkdowns controlled by the site fire marshal. These administrative controls meet the guidelines specified in BTP CMEB 9.5-1, Section C.2.

An operating procedure is in place to direct operator response to fire alarms in the plant. These procedures include instructions related to determining which fire zone is in alarm using the control room main fire protection console and local fire zone panels, sending operators to investigate alarms, actions to take relative to false alarms and malfunctions, and entry into emergency operating procedure for fire. A separate operating procedure provides instructions for operation of the CO_2 fire suppression system and includes use of the local Chemetron panels and pull stations to manually initiate or abort a CO_2 discharge, directions for specific plant areas related to system lockout for maintenance purposes, and actions to take during and following system actuation. The emergency operating procedure (EOP) for fighting fires at MP3 contains specific instructions in response to a CO_2 discharge including page system announcements, fire brigade and security actions for boundary controls of affected areas, fire brigade actions for control room atmosphere monitoring, and use of SCBA. When it has been determined that control room evacuation is required due to a control room fire, or when a fire has been confirmed in the cable spreading area, a separate EOP is provided. This EOP contains instructions for actions to take prior to evacuation including notifications and primary and secondary plant system operations.

3.8 Reason for License Amendment

Currently, the CSA CO_2 system is disabled and locked out to preclude discharge and is not available for use. A continuous fire watch is in effect in accordance with the MP3 Technical Requirements Manual. These actions became necessary due to the potential for CO_2 to migrate to several vital areas such as the control room, the auxiliary shutdown panel in the west switchgear room and the fire transfer switch panel in the east switchgear room. Carbon dioxide transport was first recognized as a problem during an inadvertent CO_2 discharge event on January 15, 1999.[5] Boundary repairs were undertaken to arrest CO_2 migration with limited success. DNC determined that conversion of the CO_2 suppression system to a manually actuated system was necessary in order to maintain personnel safety. DNC committed to provide a

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[5] Northeast Nuclear Energy Company, Millstone Unit No. 3, LER 99-002-00, "Inadvertent Carbon Dioxide Fire Suppression System Actuation in the Cable Spreading Room," dated February 16, 1999. Supplement LER 99-002-01, dated June 27, 2001.

functional fixed fire suppression system prior to startup from the Spring 2004 refueling outage.[6]

On April 17, 2003, DNC submitted its request for approval of a deviation change for conversion of the automatic CO_2 system to a manual only actuation system.[7] In a facsimile dated August 7, 2003, the NRC transmitted a draft of a request for additional information (RAI) on DNC's proposed change.[8] During this time period and at the request of the NRC, DNC agreed to provide a license amendment request. This submittal, therefore, supercedes DNC's April 17, 2003 request. DNC's response to the RAI was provided in DNC letter dated January 23, 2004.[9] DNC's response to the RAI has also been incorporated into this submittal. The DNC response to RAI Question 1 related to Regulatory Guide 1.78 has been updated and included separately as Attachment 2 for incorporation into this license amendment.

4.0 TECHNICAL ANALYSIS

4.1 Details of the Planned Changes

4.1.1 **Fire Detection**

During original plant licensing, the ionization and photoelectric smoke detection system was the only detection system serving the CSA. With the addition of the recently installed IFD system, the current fire detection methodology for the CSA consists of the original ionization and photoelectric smoke detection system in conjunction with the IFD system. The justification for the planned conversion of the CO_2 suppression system to manual only actuation is based in part on the increased defense-in-depth for fire detection that is provided by the new IFD system.

The IFD system is UL listed and FM (Factory Mutual) approved, complies with the requirements of NFPA 72D and meets the guidelines for fire detection in BTP CMEB 9.5-1, Section C.6.a. The IFD system provides system trouble and fire alarm signals in the control room and at the local panels (IFD and Simplex zone panel). A 24-hour battery backup is provided.

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(6) DNC letter, "Millstone Nuclear Power Station, Unit No. 3, Update to Information Regarding Change to the Fire Protection Program," dated July 3, 2002.

(7) DNC letter, "Millstone Power Station Unit No. 3, Proposed Revision to the Previously Approved Deviation From Branch Technical Position (BTP) CMEB 9.5-1, Section C.7.c," dated April 17, 2003.

(8) V. Nerses (NRC) Facsimile to R. Joshi, "Draft Request for Additional Information (RAI) to be discussed in an Upcoming Conference Call (TAC No. MB8731)," August 7, 2003.

(9) DNC letter, "Millstone Power Station Unit 3, Response to Request for Additional Information Regarding a Change to the Fire Protection Program (TAC No. MB8731)," dated January 23, 2004.

The IFD system is compatible with the electromagnetic environment in the CSA. There have been no spurious IFD system alarms due to either welding or grinding outside the CSA or from monthly emergency diesels runs during the first 11 months of use. The CSA atmosphere is isolated from adjacent environments and no supply or exhaust air ventilates the CSA, therefore the potential for spurious alarms is low.

No changes to the original ionization and photoelectric smoke detection system are planned. In the manual-only actuation configuration, manual opening of the ball valve located at the Chemetron panel initiates the CO_2 discharge provided two cross-zones of detection (ionization / photoelectric) in a given area are in alarm. However, if the original smoke detection system is out of service or not operable, the lack of the permissive alarm signal from the smoke detection system will not prevent actuation of the CO_2 system. The CO_2 system can be actuated at a local key station. This aspect is the same as the original system design. No alarm signals from the IFD system are required as a permissive for a CO_2 discharge into the CSA.

As stated earlier, the fire fighting strategies, fire brigade training, and drills have been updated to reflect IFD system response, specifically, use of the IFD panel zone indications and thermal imaging camera to determine hot spots. Similar to CSA smoke alarms, control room response to IFD alarms are currently controlled by approved procedures and just-in-time training for operators has been conducted. However, additional procedure changes and operator training are planned for appropriate operator response to IFD fire alarms. This training is intended to focus on the compensatory actions required for an out of service IFD system, and to reinforce the fact that valid IFD alarms may not yield visible smoke or flames upon operator investigation of the alarm.

Currently, compensatory measures are initiated when the ionization and photoelectric detectors are out of service. The MP3 Technical Requirements Manual (TRM) controls these compensatory actions. Compensatory actions for the IFD system and IFD system surveillances have been approved for incorporation into the TRM and will be implemented as part of the planned modification.

4.1.2 **Fire Suppression – CO_2 System**

Physical Modification to CO_2 System. The planned changes modify the CSA CO_2 fire suppression system from automatic to manual only actuation. Under the automatic configuration of the CO_2 system, the ball valve local to the Chemetron panel for the CSA is aligned in the open position and initiation of CO_2 discharge is automatic (subject to pneumatic timers), upon receipt of an alarm condition from both cross-zones of detection (ionization / photoelectric) for the area. In manual only actuation configuration, the ball valve is re-aligned, such that it will be CLOSED under the system's normal configuration. After system circuit modifications, when the ball valve is placed in an off-normal position (i.e., NOT FULL CLOSED) a trouble signal will be generated. Indication of this trouble condition will be the same as for the automatic CO_2

system configuration (Chemetron panel and Simplex zone panel, Simplex main fire protection console and associated color graphics unit in the control room). Identification of the differences in operating mode and indication for the CSA is to be accomplished by means of new descriptive labels at the Chemetron panel and manual station, new description on the point information screens associated with the color graphics unit (software database changes), training of operators and fire brigade personnel and revisions to the applicable operating and surveillance procedures. Initiation of the CO_2 system in the manual configuration will continue to require the alarm condition, similar to the automatic configuration. Manual actuation of the ball valve will be necessary to begin the discharge. Because the system will be normally locked out through the ball valve, a control room annunciator window (5-6 on main board 1B) is no longer required and has been removed.

Upon implementation of planned modifications, the temporary lockout on the ball valve will be replaced with a key lock that is controlled by the control room operators. In response to NRC staff questions regarding human factors engineering for use of the ball valve, a step stool has been located below the Chemetron panel.

Testing Requirements. Per the requirement of BTP CMEB 9.5-1, the CSA CO_2 system complies with NFPA 12, "Carbon Dioxide Extinguishing Systems." NFPA 12, in turn, requires a system qualification test to verify operability of a new system. The original qualification test demonstrated that a 30 percent CO_2 concentration can be attained within 2 minutes of discharge, and a 50 percent concentration can be achieved within 7 minutes and sustained for the duration of the required discharge. During a February 2001 discharge test, the NFPA concentration build-up rates were met for the CSA elevations monitored and were maintained even though the discharge was terminated early. Nevertheless, an engineering evaluation was performed to determine if a new system qualification test should be performed. The evaluation concluded that no test was required since the CSA design features have not been changed since original plant licensing in such a way that would adversely alter CO_2 concentrations achieved following a discharge. The following considerations were included in this evaluation:

- There is no ventilation system serving the CSA other than the control building purge system (CBPS). The CBPS supply and exhaust dampers that enter the CSA have been isolated and blocked off. This change prevents pressurization of the control building purge system and potential CO_2 leakage through purge system dampers into areas outside the CSA during a CSA CO_2 discharge event. This change is considered to be an improvement to the CO_2 boundary.
- The CO_2 relief path remains unaltered. The CSA shares a common relief path with the east and west switchgear rooms. Backdraft dampers that prevent CO_2 leakage from the CSA into the switchgear rooms have been replaced by manual bubble tight dampers that are normally closed. This change was made in an effort to eliminate any potential CO_2 leakage via the relief ducting back into the

switchgear rooms given a CO_2 discharge in the CSA, and it represents an improvement to the CO_2 boundary.

- The CO_2 delivery system remains unchanged except for changing the initiation of the system from automatic to manual. This change does not affect the amount or rate of CO_2 discharged into the CSA. The modification from automatic to manual initiation is discussed in our April 17, 2003 letter, Attachment 1, Section B.IV.

- The CSA CO_2 over-pressurization vent path design has been reviewed and found to be acceptable.

- Based on data obtained during the February 2001 discharge test, it was determined that the initial pneumatic discharge timer timed out approximately 30 seconds longer than required by the original qualification test criteria. The timer has been recalibrated and a periodic surveillance is planned for this timer as well as other initial pneumatic discharge timers. This surveillance requirement provides added assurance that discharge timers will consistently perform as originally specified. A periodic preventive maintenance work activity is also planned to rebuild all selector and master selector valves for the CSA CO_2 system to ensure proper functioning. These improvements assure the system will perform as designed, consistent with the requirements for initial qualification testing. These improvements would not affect expected CO_2 concentrations and therefore do not require new qualification testing.

- Leakage observed during the inadvertent discharge event in 1999 was not of a magnitude that would cause the CO_2 concentrations inside the CSA to drop below the original design criteria. The failure of the west CSA door during the February 2001 test was attributed in part to latching issues. In addition, the unexpected extended initial discharge period may have caused an over-pressurization condition in the room contributing to door failure as well. The door in question did not exhibit any damage during initial startup or the inadvertent CO_2 discharge. The door, door hardware, electronic striker, closure arm, hinges, door sweep, auto door sweep and weather strip were all replaced after the planned discharge in 2001. In addition, several improvements or repairs to the CSA CO_2 boundary were made, or are planned, to control leakage to adjacent areas and were reviewed as part of this evaluation. Physical changes that have been made or are planned include repairing penetration seals, caulking ductwork, resealing doors, installing bubble tight dampers and blocking off the CSA purge system. It was concluded that the effect of any remaining leakage, following boundary repairs or modifications will have a negligible effect on CSA CO_2 concentrations and does not drive a requirement for a new qualification test.

A CO_2 puff test using air as a test medium is scheduled for the near future as part of the full restoration of the CO_2 system as a manual only actuation system. In this test, the CO_2 storage tank is isolated and the CO_2 header is slowly pressurized using compressed air through a test valve and then through the master CO_2 selector valve. A test signal is then used to simulate cross-zone detection and cause a discharge of air. As a precaution the CO_2 system is restored with the associated area ball lockout valve closed.

4.1.3 Fire Suppression – Manual

In the license amendment, the primary fire suppression methodology for the CSA is being changed from an automatic CO_2 system to manual suppression. New fire fighting equipment has been installed / staged in the CSA to complement the existing equipment available to account for this change in suppression methodology. The fire fighting strategies and fire brigade training have been updated to add the newer fire fighting equipment, manual ventilation strategy for CO_2 and smoke removal, and water usage / removal methods. Upon implementation of planned changes, updates to the fire fighting strategies, TRM, procedures, and training will reflect the availability and operation of the manual CO_2 fire suppression system as a backup method to manual fire suppression in the CSA.

4.1.4 Habitability

Although improvements to the CSA boundary have been performed to address CO_2 migration issues into adjacent areas, DNC has conservatively incorporated permanent breathing air stations in alternate shutdown areas. In addition, use of self-contained breathing apparatus (SCBA) is administratively controlled during a control room evacuation coincident with a CSA CO_2 discharge to address potential elevated levels of CO_2 in areas adjacent to the CSA. The following paragraphs discuss various modifications associated with CO_2 migration issues. Attachment 2 also discusses issues related to habitability in response to an NRC question.

<u>Permanent Breathing Air System Modification.</u> Permanent breathing air systems are being installed in the east and west switchgear rooms and plans for completing installation coincide with startup from the Spring 2004 refueling outage. Each system provides operators breathing air to supplement their SCBA bottle air while performing safe shutdown procedures in the east and west switchgear rooms (alternate shutdown panel) following a control room evacuation and CSA CO_2 discharge. Each system consists of manifold(s), regulator pressure gauge(s), air bottles, air-lines and low pressure alarm. The breathing air systems are self-contained, do not require electric power, and will be permanently mounted plant equipment when the modification is complete. Each system is being designed to provide operators sufficient breathing air to complete CSA fire suppression and ventilation activities. The breathing systems include tethers for easy movement within the safe shutdown areas. The combination of

SCBA tethered into the breathing air system is designed to provide approximately three hours of breathing air for each operator. Note also that the operators have approximately one hour of bottled air from the control room SCBA, which is checked on a routine basis.

Specifically, the west switchgear room breathing air system has been designed for four operators (four airlines) with a breathing rate of 2.5 cubic feet per minute for a duration of 3 hours each. The capacity is based on a fire scenario timeline which includes time for two CO_2 discharges and fire brigade investigation time between each discharge. The timeline is discussed later in this submittal. The east switchgear room has a capacity for two operators to perform shutdown actions for 3 hours each. During alternate plant shutdown, a maximum of four operators will be needed to perform shutdown actions. Operators proceed directly to the alternate shutdown panel in the west switchgear room. Operators are expected to perform some brief actions at the fire transfer switch panel in the east switchgear room. However operator action (circuit breaker manipulations) along aisle ways in the east switchgear room is also necessary and the breathing air station has been designed to accommodate those actions as well.

Based on actions required for the planned implementation for the breathing air system modification, a verification of equipment functionality and operation was performed by fire brigade personnel. This verification confirmed that the hose lines are of sufficient length to reach required stations in the east and west switchgear rooms and that the hose fittings and breathing equipment was operational.

<u>SCBA and Control Room Evacuation</u>. In the event a control room evacuation becomes necessary due to a fire in the CSA, the operators will need to proceed to areas adjacent to the CSA to perform an alternate plant shutdown. Due to the potential for CO_2 migration into the safe shutdown areas, the operators will be directed to don self-contained breathing apparatus (SCBA) while in the control room before proceeding to the shutdown areas if a CSA CO_2 discharge has occurred. Once operators are stationed at the alternate shutdown panel and control has been established (critical steps met), or stationed in the east switchgear room, they will hook up to the fixed bottled breathing air station described above. Fire brigade members will be available to survey the area for habitability and notify the operators if continued SCBA use is required. At Millstone, concentration levels of greater than 5,000 ppm CO_2 or less than 19.5 percent oxygen are restricted areas and require SCBA. If SCBA use is not required as determined by fire brigade surveys, operators may remove the SCBA and set it aside. It should be noted that fixed CO_2 and oxygen monitoring equipment is also available to the operators at these locations.

If a CSA CO_2 discharge has not occurred, and a control room evacuation is necessary due to a fire in the CSA, operators will be directed to carry the SCBA with them to the alternate shutdown areas. If a CSA CO_2 discharge should become necessary, the operators at the alternate shutdown areas will be directed to don the SCBA prior to CO_2

discharge. SCBA use will continue until the area is cleared for habitability by the fire brigade.

Prior to installation of the breathing air stations, and in an effort to determine acceptability of the proposed modification a verification of alternate shutdown actions wearing SCBA was performed. A mock evacuation of the control room after a simulated discharge of CSA CO_2 was accomplished with operators wearing SCBA. Critical timed design assumptions were met in this initial validation at the auxiliary shutdown panel in the west switchgear room. The use of SCBA, masks and voice amplifiers did not adversely affect access to isolation transfer switches or impede movement or visibility. Total elapsed time to don and checkout SCBA was approximately one minute and was completed in the control room prior to evacuation.

It should be noted that new voice amplifiers have been added to the control room SCBA to improve communications and to compensate for the potential extended duration of operating in SCBA.

Carbon Dioxide and Oxygen (O_2) Monitoring CO_2 and O_2 monitoring equipment are being installed in the control room, instrument rack room, service building west stairway, and east and west switchgear rooms. This modification is scheduled for completion prior to startup from the next refueling outage. The air monitoring/indicating components will be permanently mounted and powered by a non-safety-related source with battery backup. The monitoring equipment has both audible and visual (LED) alarms to warn personnel of restricted concentration levels. Using the CO_2 and O_2 monitors, operators have the ability to monitor concentration levels. The CO_2 and O_2 monitors are strategically placed so that personnel will be aware of air quality while controlling the plant or performing safe shutdown procedures in the control room, instrument rack room or east and west switchgear rooms, or while transiting the service building west stairway.

Control Building Purge System (CBPS). The CSA portion of the Control Building Purge System (CBPS) has been be blocked off and retired in-place.

The CSA was designed to be connected through ducting and fire dampers to the CBPS which utilizes a common duct system with one supply fan and one exhaust fan. In the event of a fire, the control room operators would align the CBPS to one of the six rooms that the CBPS serves. In the event of a large fire in the CSA, it is likely (expected) that the fire dampers would close and the CBPS would be unavailable for purging operations. As defined in the MP3 Fire Protection Evaluation Report during original plant licensing, portable smoke ejectors are provided to assist in removal of the products of combustion should the normal ventilation systems be unavailable because of damper closures or other failures. It should be noted that the CBPS, as originally designed, is powered from a non-Category 1E source and would therefore not be available in the event of a loss of off-site power.

During the inadvertent discharge event in 1999 and the discharge test in 2001, the shared ductwork of the CBPS and the control room emergency filtered recirculation system were determined to be a contributing factor in the migration of CO_2 from the CSA to the control room. With the CBPS running during a CO_2 discharge an increased differential pressure between the control room and the CSA is created. When the CBPS is not running, the differential pressure between the CSA and the control room following a CO_2 discharge is reduced. Therefore, DNC concluded that operating the CSA portion of the CBPS after a CO_2 discharge contributed to CO_2 migration into the control room.

The use of portable fans to purge the CSA provides an acceptable means for purging CO_2, smoke and products of combustion from the CSA and has been successfully demonstrated during CO_2 discharge testing. Removal of the purge system in the CSA was evaluated against License Condition 2.H. for fire protection and determined to be a change that does not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. The following justification is provided:

- The CBPS ductwork is a potential path for CO_2 leakage from a CSA CO_2 discharge into areas served by the CBPS. Blocking off supply and exhaust purge system ductwork will ensure no CO_2 will be transported through common ductwork into the control room pressurization boundary or the east or west switchgear rooms during a CSA CO_2 discharge. RG 1.78 requires protection of the control room from hazardous chemicals that may be inadvertently discharged. The CBPS was determined to enhance the CO_2 migration from the CSA to the control room and is discussed in detail in our letter dated March 21, 2001.[10]

- During original plant licensing, the CSA fire fighting strategy provided for manual venting of the CSA using portable venting methods as documented in the original FPER RESPONSE to BTP 9.5-1, section C.7.c. The common purge system was designed to assist in purging operations in the CSA and manual control was provided in the control room. The site fire brigade is routinely trained on the use of portable ventilation methods for purging the CSA.

- The use of portable fans for smoke or CO_2 removal provides an adequate and appropriate method of smoke removal from the CSA and has been successfully demonstrated. The CSA is easily accessible, portable fans are easily set up and there exists a relatively short smoke removal path to the outside. In addition, based on actual experience in purging operations in the CSA, the portable smoke ejectors were judged to be more efficient that the CBPS. Diverse

[10] Northeast Nuclear Energy Company, "Millstone Nuclear Power Station, Unit No. 3 Control Building Purge System," dated March 21, 2001.

methods (i.e., hydraulic powered fan and electric fans) are available for manual smoke removal. DNC has determined that manual purging methods using a system that is versatile enough to use various sources of power (hydraulic, normal plant power, fire brigade electrical generators) and that can also be used regardless of fire damper closures is a more efficient system than the CBPS for the CSA.

- The portable smoke ejectors are set up such that smoke and CO_2 are exhausted through the west stairwell directly to the outside courtyard. This forced ventilation pathway does not affect access or egress to other plant areas where safe shutdown actions may be required.

For the reasons discussed above, it was determined that this change does not adversely impact the ability to achieve and maintain safe shutdown in the event of a fire.

Water Removal From CSA. The license amendment will change the fire suppression philosophy such that a greater reliance is placed on manual fire fighting efforts, reserving CO_2 system actuation for complex fires. DNC does not consider it likely that fire fighting water will find a seam in the CSA floor and leak though to the east and west switchgear rooms below. As discussed earlier, the CSA fire fighting strategy used by the fire brigade currently directs the rapid removal of water after fire suppression, states the importance of using the minimum amount of hose stream water necessary, and directs investigation of the east and west switchgear rooms as a priority. Installation of the IFD system further increases the probability of detecting a fire early enough that water, required by fire suppression efforts, is further reduced.

Use of water for manual fire fighting in the CSA was part of the original fire protection program defense-in-depth for the CSA. As such, water removal requirements were part of the original plant design. Based on observed CSA CO_2 leakage to adjacent areas during the 1999 inadvertent discharge, DNC determined it prudent to address the potential for water leakage as part of the planned changes. Qualitatively, DNC has determined that the probability of gross leakage to the alternate plant shutdown area below the CSA is low for the reasons discussed in the following paragraphs.

BTP CMEB 9.5-1, *Section C.5.a.(14)*, requires floor drains for areas where use of hand hose lines may cause damage to safety related equipment. Use of manual suppression with portable fire extinguishers or hose lines in the CSA and the east and west switchgear rooms was evaluated during original plant licensing and found to be acceptable. The staff approved a deviation for a lack of floor drains in the CSA in NRC SER, Supplement 4, which states that the calculations were reviewed regarding the accumulation of water in areas that use CO_2 as the extinguishing agent. In the original MP3 SER the NRC approved a requested deviation for a lack of floor drains in the east and west switchgear rooms which discussed the accumulation of water from fire fighting efforts in the east and west switchgear room (two 60 gpm hose lines for over 100 minutes). It was determined that minor water accumulation (2 inches) in the switchgear rooms would not adversely affect safe shutdown based on the minimum three-inch clearance maintained between the floor and the switchgear / cabling.[11]

There are numerous electrical and mechanical penetrations into the CSA from above and below. These penetrations are sealed to a 3-hour fire rating and a hydrophoric rating of four inches of water. An engineering evaluation concluded that the resultant water discharge expected during manual fire fighting activities in the CSA is bounded by the control building flooding analysis. In addition, the penetration barriers and seals are qualified to ASTM E119 requirements and therefore are not adversely affected by the force of the water stream when hose lines are used.

Given that the IFD system provides detection in the incipient stage, fire fighting water use (if any) is expected to be minimal and most likely less than the amount postulated in the original engineering analysis. Misting or fog fire water streams, electrically safe nozzles and portable fire extinguishers are available for use in the CSA. The fire brigade is trained in the classroom and with hands-on fire fighting exercises regarding methods to minimize use of water and to spray water only where needed. CO_2 extinguishers are also available for fire extinguishment as well as the manual CO_2 system.

It is not expected that significant standing level of water will result as the east CSA door is at floor level. Water should flow through this door and be directed to the nearby outside courtyard. However, a water vacuum was purchased and is provided at the fire brigade storage locker located in the CSA to facilitate removal of fire suppression water from the floor. Rapid removal of standing water decreases the probability that water will find a floor seam or penetration seal and traverse to the switchgear rooms below

The following improvements have been made to the various penetrations in the CSA floor since original plant licensing:

- The cable blockouts between the CSA and the east and west switchgear areas have been improved by applying a 3" layer of Silguard 170 elastomer seal material.
- The boot seal joints were sealed with an adhesive sealant. The boot seals are located between the ductwork and the floor between the cable spreading area, the east and west switchgear and the control room.
- The spare conduit penetration caps were sealed with an adhesive sealant.

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11 Northeast Utilities letter, "Millstone Nuclear Power Station, Unit 3 NRC Chemical Engineering Branch (Fire Protection) Review Meeting, March 7, 1984," dated March 23, 1984. (B11090)

During a postulated unmitigated fire in the CSA that causes the control room to be abandoned, the operators will need to perform alternate shutdown activities in the switchgear rooms below the CSA. For the reasons discussed above, the risk of water leakage into the switchgear rooms below and likelihood of damaging safe shutdown equipment located there is considered very small. Therefore it has been concluded that manual fire fighting activities, as the primary source of suppression in the CSA, will not adversely impact the ability to safely shutdown the plant.

Operator Training for Habitability Modifications. An initial validation (walk-through) of the revised EOP for a CSA fire and subsequent control room evacuation was performed in January 2003. Two operators and two fire brigade members simulated a control room evacuation after a simulated CSA CO_2 discharge. Observers recorded critical times and general observations as follows:

- Communication with SCBA new voice amplifiers was clear.
- Visibility was very good and did not impede any steps.
- From the time of the simulated reactor trip, the total elapsed time to don and checkout SCBA staged in the control room was approximately one minute.
- Verifying the power operated relief valves (PORVs) were closed at the auxiliary shutdown panel in the west switchgear room was completed in 14 minutes and 16 seconds which was within the acceptable 15-minute time frame. It is important to note that prior to control room evacuation, EOP-directed action ensures the PORV block valves are closed.
- Establishing reactor head vent letdown was accomplished in 24 minutes and 46 seconds which was within the 30-minute acceptance criteria.

Since that time, the breathing air stations have been installed and planned EOP changes will require operators to hook into air lines after critical timed steps have been achieved.

Training for operators scheduled to be completed prior to implementation of the planned changes includes the following items:

- Determine the possible psychological effects that could occur to a Self Contained Breathing Apparatus user and how to respond to them.
- Discuss the safety precautions for using the Self Contained Breathing Apparatus.
- Discuss the limitations of the Scott 4.5 Self Contained Breathing Apparatus.
- Discuss the operation of the Voice Amplifier for the AV-2000 Facepiece.
- Determine the operating parameters for cylinder pressure, in-line air source(s), and air supply hose.
- Determine the need for an air cylinder replacement.
- Perform the pre-operational checks for the Self Contained Breathing Apparatus.

- Demonstrate donning the Scott 4.5 Self Contained Breathing Apparatus.
- Demonstrate donning the Scott 4.5 facepiece.
- Demonstrate inserting and removing the mask mounted regulator with the facepiece.
- Demonstrate breathing using the Scott 4.5 Self Contained Breathing Apparatus.
- Perform facepiece fit check, free of any detectable leakage.
- Demonstrate operating the Voice Amplifier on the Scott facepiece
- Operate the component parts on the Scott 4.5 Self Contained Breathing Apparatus.
- Demonstrate connecting the airline supply hose to the air source and to the Scott 4.5 with extended air supply hose.
- Demonstrate breathing with the unit while on the in-line air supply.
- Demonstrate emergency operation by transferring from an in-line air supply to main 4.5 cylinder.

Currently the operators train on many of the above-mentioned items since use of SCBA and precautions are part of the EOP for fire. The EOP for fire includes instructions for fire brigade to perform medical screening during bottle change out, ensuring adequate hydration after each SCBA bottle use, and rest breaks between SCBA bottle use. In addition, guidance is provided for a site safety department representative, an industrial hygienist, and a ventilation system engineer to be called in. The EOP for fire also includes steps for the fire brigade to sample the atmosphere every 15 minutes and provides the levels for donning SCBAs (<19.5% O_2 or >5,000 ppm CO_2).

4.2 Fire Scenarios

This section discusses the potential fire scenarios in the CSA based on the proposed amendment. Note that manual fire fighting is the primary suppression method in all cases with fire brigade response (commencement of manual fire fighting) expected within 15 minutes of an alarm. Typically fire brigade use of floor-based hose streams or hose streams applied from ladders staged in the CSA would be effective to fight difficult cable tray fires. However, the fire brigade may elect to use the manual CO_2 system based on fire complexity.

4.2.1 **Insitu Cable Fire - Self Ignition**

This scenario considers an insitu combustible fire involving cable insulation in a cable tray. Ignition of the cable is through self-heating via over-current or shorts. This is an unlikely scenario since the cables are provided with circuit fault protection devices. However, should such a fire scenario develop, the IFD system is expected to alarm very early into the cable heat-up phase. Fire fighting personnel are expected to respond to the CSA to initiate a search of the cause of the IFD alarm (for example, through use of the thermal imaging camera). If smoke is observed, fire fighters will locate the seat of the fire and initiate suppression activities as necessary, using available manual fire fighting equipment. Because the IFD system is designed to detect a fire prior to smoke development, it is expected that there will be sufficient time to contain fire spread (if any) to a very small area of cable tray. Even if a fire is allowed to continue to grow, fire propagation is expected to be very slow since the cables are IEEE-383 qualified or flame retardant. Smoke development is only expected under this scenario if ignition occurred after IFD alarm and the subsequent fire is allowed to grow. This is not expected to occur given the early response by fire fighters. Any smoke that is developed is expected to be mostly contained within the boundary of the CSA and can be manually removed using portable fans (smoke ejectors). If smoke migrates out of the CSA northwest and northeast doors, then control room operator access to the alternate shutdown east and west switchgear rooms remains available via the service building stairwell.

Therefore, an insitu, self-ignited cable fire is expected to be detected in the incipient stage which will allow prompt fire brigade response and action. Manual suppression activities would be expected to limit the fire effects to a small area of cable tray. The manual CO_2 system is available as backup to the manual suppression activities of the fire brigade.

4.2.2 **Insitu Cable Fire -Transient Ignition**

This scenario considers an insitu combustible fire involving cable insulation in cable tray. Ignition of the cable is by a transient source such as hotwork or an exposure fire involving a transient combustible. The hotwork ignition scenario is unlikely since there are administrative controls in place to cover exposed combustibles from the effects of hotwork and to place a firewatch. However, should such a fire scenario develop, the firewatch will notify the control room and utilize portable fire extinguishers. In the meantime, fire fighting personnel are expected to respond to the CSA to initiate manual fire fighting activities. Suppression activities are conservatively expected to take place approximately 15 minutes after notification of fire fighting personnel. The fire brigade would utilize manual fire fighting equipment from the CSA supplemented with equipment brought to the scene.

A sustained fire involving cable trays is expected to propagate very slowly given that the cables are IEEE-383 qualified or flame retardant. The CSA is constructed with reinforced concrete boundaries and has a relatively large gross volume of approximately 245,000 cubic feet. The large volume of the CSA is expected to dissipate a substantial amount of energy from a transient exposure fire and cable fire. Such a fire may also be deep-seated and expected to be contained within a small section of cable tray(s). A deep-seated fire may require longer duration manual suppression activities and the response of effective fire fighting personnel is critical. The fire fighters at Millstone are properly trained and equipped, and their manual suppression activities are expected to contain and extinguish the fire. The recent addition of fire fighting equipment described earlier in this submittal ensures diverse methods are available to fire fighting personnel to aid in fire extinguishment. Should it be determined to use the manual CO_2 system, pockets of smoldering cables could remain after CO_2 fire suppression and may require direct application of small diameter hose streams.

Smoke that is developed (if any) is expected to be contained for the most part within the boundary of the CSA. There is the possibility of some smoke migration to other areas of the control building. Significant smoke development may occur if the fire is unmitigated for some time period. If significant smoke develops, fire fighters can manually ventilate the CSA. Assuming the control building northwest stairwell is used as a smoke removal path, control room operator access to the alternate shutdown east and west switchgear rooms remains available via the service building stairwell.

Therefore, an insitu, transient-ignited cable fire is expected to be initially detected by the IFD and subsequently contained and extinguished by prompt manual suppression activities. The manual CO_2 system is available as backup to the manual suppression activities of the fire brigade.

4.2.3 Transient Combustible Fire

This scenario considers a transient combustible fire involving a Class A material or flammable liquid. Administrative controls will carefully restrict the amounts and types of combustibles brought into the CSA. The scenario where material is brought into the CSA and ignites and burns is considered to be bounded by the Insitu Cable Fire - Transient Ignition scenario discussed above. The conclusions for this scenario are similar to the Insitu Cable Fire -Transient Ignition scenario.

4.2.4 Unmitigated Fire

An unmitigated fire, although considered highly unlikely, is postulated to burn for some time period without any active fire suppression actions. The consequence of an unmitigated fire is potential loss of CSA equipment and cables. This scenario has already been considered in the fire safe shutdown analysis. Because the CSA contains redundant trains of safe shutdown equipment that is not separated, alternate safe shutdown has been provided in separate plant fire areas. Therefore, an unmitigated fire in the CSA will not prevent the safe shutdown of the plant.

4.2.5 Rapidly Developing Fire

A rapidly developing fire is one in which the combustion stage occurs almost simultaneously with ignition. This type of fire would require that a significant quantity of type A transient combustibles be available to ignite and rapidly burn. The fire protection defense-in-depth philosophy for the CSA assures that this type of fire has a low likelihood of occurrence; however, should such a fire occur, the fire will be detected and extinguished by the fire brigade prior to compromise of the intervening fire barriers.

This assurance is provided by the following:

- Transient combustibles and ignition sources are strictly controlled by administrative procedures in the CSA as previously discussed.

- If this type of fire were to occur, both the IFD system and the ionization and photoelectric smoke detection system would be available to provide alarms to alert the control room of a fire. The addition of the IFD system increases the reliability of the detection function in the event of a fire. The improvement in response time attributable to IFD will vary dependent upon the circumstances involved. It should be noted that the ionization and photoelectric smoke detection system is not being replaced or removed.

- Propagation of fire in the CSA is expected to be very slow based on the combustible loading of the room, flame retardant or IEEE-383 cable, and the spatial separation of the cable trays from ignition sources.

- The site fire brigade response to the CSA upon receiving an alarm from either the IFD or smoke detection system ensures fire damage would be limited. For this type of fire, the primary suppression method expected is manual fire fighting, using fire suppression activities commensurate with the type and size of fire encountered. The NRC allowed the use of CO_2 as an extinguishing agent in the CSA during original plant licensing, with the stipulation that there be good access for manual fire fighting with hose streams.[12] Since that time, DNC has supplemented the existing manual fire fighting equipment with new equipment and methods to improve the fire brigade's effectiveness in fire suppression activities.

  Should it become necessary to isolate the room and use CO_2 as an extinguishing agent, procedures are in place to ensure safe and effective CO_2 discharge. These diverse methods of suppression capability build the level of defense-in-depth for fire suppression in the CSA and ensure there is no significant fire damage to seals and barriers.

- Finally, the plant fire safe shutdown analysis demonstrates that loss of the CSA will not prevent the safe shutdown of the plant. Alternate shutdown capabilities are provided for a fire in the CSA using the fire transfer switch panel (east

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[12] NUREG 1031, Supplement 2, "Safety Evaluation Report related to the operation of Millstone Nuclear Power Station, Unit No. 3," dated September 1985.

switchgear room) and the auxiliary shutdown panel (west switchgear room) which are located in separate fire areas.

4.2.6 Fire Scenario Timeline with CO_2 Discharge

The following timeline was developed to determine the breathing air capacity required for the new permanently installed breathing air stations in the east and west switchgear rooms as discussed earlier. The timeline is based on known CO_2 discharge data, past experience gained during the inadvertent discharge event and good engineering judgment. Below, "T" indicates time in minutes.

T=0	First CO_2 discharge starts (23 minute duration)
T=23	Fire brigade begins investigation for effectiveness of CO_2 suppression (20 minute duration)
T=43	Second CO_2 discharge starts (23 minute duration)
T=66	Purging operations commence for CSA and adjacent areas (84 minute duration)
T=150	Areas purged of smoke and CO_2

4.3 Risk Insights

Although this submittal is not a risk-informed license amendment request, Attachment 3 contains a DNC analysis of the fire frequencies for the CSA for the conversion of the CO_2 system to manual only actuation.

4.4 Defense-In-Depth

To achieve and maintain a high level of confidence for the MP3 Fire Protection Program, it is organized and administered using the defense-in-depth concept. The defense-in-depth concept assures that if any level of fire protection fails, another level is available to provide the required defense. In accordance with the NRC guidelines of BTP CMEB 9.5-1, this defense-in-depth principle is aimed at achieving an adequate balance in:

A. Preventing fires from starting;

B. Detecting fires quickly, suppressing those fires that occur, putting them out quickly, and limiting their damage; and

C. Designing the plant safety systems so that if a fire should start in spite of the fire prevention program, and if it should burn for a considerable period of time in spite of fire suppression activities, it will not prevent the safe shutdown of the plant.

The following paragraphs describe how the defense-in-depth principle is preserved with the change to the MP3 fire protection program.

4.4.1 Preventing fires from starting

A key element in CSA fire prevention is the type of combustible and the spatial arrangement of the cable trays in the area in relation to potential ignition sources. The CSA is a large open area and the principal in-situ combustible, cable, is IEEE-383 or is flame retardant. The criteria for the IEEE-383 flame test demonstrates that these cables do not propagate fire even if the outer covering and insulation have been destroyed in the area of the flame impingement. Per IEEE-383 standard, the cables that self-extinguish when the flame source is removed or burn out pass the test. The higher voltage cables that pass through the CSA are inside metal conduit or concrete ductbanks that provide passive protection and will limit flame spread. All cables are provided with circuit fault protection devices (power supplies are coordinated) to remove any overcurrent or faulted condition. This essentially eliminates the presence of in-situ ignition sources. Redundant class 1E cables, conduit and trays are separated by a minimum of three feet vertically and one foot horizontally with alternative arrangements and deviations documented.

Fire propagation from the electrical isolation panels or junction boxes in the CSA is very unlikely based on their construction and distance from nearby cable trays. A fire initiated inside one of the two switch enclosures in the CSA is also not expected to propagate to cable trays due to the insignificant combustibles inside the switch enclosure.

Use of the fire protection program administrative controls discussed earlier in this submittal builds the level of defense in depth for fire prevention.

4.4.2 Detecting fires quickly, suppressing those fires that occur, putting them out quickly, and limiting their damage

A critical factor in the protection of the CSA is the ability to quickly detect a fire in the room. The earlier a fire is detected, the higher the probability that damage will be limited. In the change to the fire protection program, the IFD system is relied on to ensure an early fire brigade response, thereby preventing or minimizing fire damage to the extent practical. An early response by the fire brigade to a pre-emergent fire detected by the IFD system is expected to prevent fires from reaching the combustion stage. The IFD system is designed to detect a fire very early in its incipient stage (pre-combustion) such that the relative fire size (if any) is much smaller at the time of intervention. The CSA IFD system rapidly detects sub-micron particles which are generated at the incipient stage of a fire. The incipient stage of a fire is the earliest stage of a fire when sub-micrometer pre-combustion particles are formed. Visible/smoldering smoke is produced in the second stage. The visible stage is followed by the flame stage and the final stage of a fire is the heat stage, at which point the combustion is expanding. The IFD system was designed and tested to meet NFPA standards.

The original ionization and photoelectric smoke detection system installed in the CSA provides an added level of detection. This smoke detection system is capable of detecting products of combustion. The smoke detection system was also designed and tested in accordance with NFPA standards.
Fire alarms, detection and trouble signals from the detectors (IFD and smoke) are monitored in the control room. Response to these alarms is controlled by approved procedures. Required response is to send an operator to investigate the nature of the alarm and take appropriate action. These actions include contacting the site fire brigade and entry into an emergency operating procedure for fire.

To build the level of defense needed to quickly suppress CSA fires and limit potential damage, current CSA fire fighting strategies rely on manual fire fighting capabilities of a site fire brigade as the primary method of fire suppression. The fire brigade is expected to initiate manual fire fighting activities and quickly control and suppress any fire encountered. Brigade response capabilities are ensured through hands-on training, drills, and appropriate fire fighting equipment. The strategy for the CSA, in conjunction with new and diverse fire fighting equipment, provides the fire brigade the best fire fighting response strategy for the area. Manual suppression activities would limit the damage from the most likely fires to a small area of cable tray. If a deep-seated fire could not be extinguished effectively with water, the CO_2 system would be used. Additionally, although unlikely, the brigade captain may decide in conjunction with the operations personnel that CO_2 should be used as the first means of suppression.

Physical features of the CSA that contribute toward effective manual fire suppression are the following:

- The CSA has two doors at ground elevation allowing easy access and egress (northwest and northeast corners).
- A ground level courtyard area is directly outside of the CSA and is well suited as a staging area for additional fire fighting equipment, trucks and personnel.
- The CSA has relatively large internal areas that are open and well suited for brigade members to maneuver hoses, ladders, and equipment during fire fighting activities.
- There are no radiological hazards in this area or adjacent areas that could impede fire fighting operations, fire fighting strategies or response (i.e. not a radiological control area).

Ample and diverse fire fighting equipment discussed below is on hand in the CSA to effectively deal with fires of various magnitudes. Supplemental assistance and equipment is also provided by local fire departments.

- Dry hose stations and continuous flow hose reels are provided in sufficient numbers and locations within the CSA such that all trays can be reached.
- A through-wall connection from the outside courtyard to the CSA facilitates use of fire water from outside fire hydrants without running hose through doorways to provide water to the CSA dry booster hose reels. Nearby valves control water to the dry hose stations.
- Portable fire extinguishers within the CSA are varying types and sizes and provide an adequate selection of manual suppression options for the fire brigade to use commensurate with fire type, size or complexity.
- A thermal imaging camera enhances the capability of the fire brigade to search for hot spots and potential fires.
- Hydraulically or electrically powered portable fans are available in the CSA to eject smoke from the area.
- The additional ladders staged in the CSA enhances the fire brigade's ability to access cable trays. Ladder training has been conducted to simulate conditions that fire brigade members might encounter in an actual fire response to an upper elevation tray fire.
- A water vacuum is available in the CSA to permit rapid removal of water from the CSA floor. Water removal is a priority after fire suppression in the CSA fire fighting strategies.

A general CSA fire scenario would progress as follows: Early IFD warning of a potential fire allows brigade members to locate and investigate the area of concern before a deep-seated fire develops. Coverage for the recently installed IFD system is broken down into upper and lower level zone quadrants (as hazards dictate). Each panel (two total) will monitor two upper and two lower quadrants. Data readings at each panel indicate the order in which zones are alarmed, giving fire brigade members a primary area to concentrate their search. The use of a thermal imaging camera to search cable trays for heat if no smoke is visible is available to fire brigade members also. Regardless, if a cable fire went undetected and developed quickly into a deep-seated fire, fire brigade members would perform an initial investigation of the area and provide feedback to the brigade captain and control room operators. Operations and fire brigade personnel, working together, would locate the fire, determine the extent, isolate electrical power as necessary, and start extinguishment.

Depending on type and location of fire, brigade personnel using the above hoses and extinguishers, as needed, would provide effective extinguishment. Instructions for fighting a fire in the CSA are contained in the fire fighting strategy which provides instructions to the fire brigade relative to potential hazards, safety related equipment in the area, special hazards and precautions, fire suppression equipment availability, assembly area(s), response strategy, spill or leak potential and ventilation strategies.

In addition to manual fire fighting, the manual only actuation CO_2 system would be available for use to suppress complex fires. This system was approved for use in an automatic mode during original plant licensing. The CSA CO_2 system is a low pressure CO_2 total flooding system designed to obtain 50% CO_2 concentration in the CSA for greater than 20 minutes. The system was designed and tested in accordance with NFPA standards.

4.4.3. **Designing the plant safety systems so that if a fire should start in spite of the fire prevention program, and if it should burn for a considerable period of time in spite of fire suppression activities, it will not prevent the safe shutdown of the plant.**

The plant fire safe shutdown analysis demonstrates that loss of the CSA will not prevent the safe shutdown of the plant. The CSA contains redundant trains of fire safe shutdown cables, in addition to other safety related cables. Alternate shutdown capabilities are provided for a fire in the CSA using the fire transfer switch panel (east switchgear room) and the auxiliary shutdown panel (west switchgear room) in separate fire areas, as well as additional manual actions which will be performed in areas outside of the control room and CSA. There are no required alternate shutdown cables routed inside the CSA.

4.5 Summary

The fire protection strategy for the CSA has been strengthened by the addition of an early warning IFD system that is designed to ensure an early fire brigade response to developing fires in the incipient stage. The original ionization and photoelectric smoke detection system will provide an added measure of fire detection, providing alarms when a fire reaches its combustion stage. Also, additional manual fire fighting equipment has been installed or staged to further assist the fire brigade in locating and extinguishing fires in the CSA. It has been determined that a vast majority of the fire scenarios in the CSA can be effectively extinguished with manual fire fighting activities including the use of water hose streams. Although DNC analysis shows that the likelihood of having to use the CO_2 suppression system in the CSA is considered low, the license amendment would continue to credit CO_2 usage for fire suppression.

Removing the automatic feature of the CO_2 system, does not adversely impact the effectiveness of the overall CO_2 system operating parameters (CO_2 design concentration and discharge time). During original plant licensing, the NRC agreed that the design of the CO_2 system for concentration, thermal shock, and other design parameters were within the guidelines of BTP CMEB 9.5-1. The planned changes do not affect these parameters. Also, during original licensing, the NRC approved use of a CO_2 system based in part on the physical design of the CSA. Supplement 2 to the NRC SER, states that the access and egress routes are well defined in the cable spreading room. Additionally the SER states that cable tray arrangement and separation in the cable spreading room has been provided to allow the fire brigade ample time to effectively control and extinguish any anticipated fires. The modifications associated with this license amendment do not change the physical dimensions or cable tray arrangements of the CSA. Based on the above discussion, the original bases for a CSA CO_2 suppression system is not affected. The ability of the CO_2 system, once actuated, to fight cable fires is not diminished by any changes being proposed by this modification.

The change to the fire protection program has been determined to maintain an adequate level of defense-in-depth for fire protection in the CSA. The new and existing fire protection features including fire-fighting equipment, administrative controls, trained on-site fire fighting personnel, and two fire detection systems adequately compensate for DNC's elimination of the automatic initiation feature of the CO2 system.

The license amendment would provide manual control over CO_2 discharge and therefore significantly decrease the likelihood of a potential inadvertent CO_2 discharge, which in turn will improve personnel safety at Millstone.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

The proposed amendment modifies the initiation method for the cable spreading area (CSA) carbon dioxide fire suppression system (CO_2 system). Under the original licensed configuration, the initiation of CO_2 discharge is automatic provided a smoke alarm condition for the area is present. In the manual mode, the same alarm condition is required to be present, however, the CO_2 discharge occurs only after manual manipulation of a CO_2 system valve. The proposed plant changes involve modification of the alignment position (closed versus open) of a CO_2 system valve and some associated circuit modifications. No modifications to the CO_2 delivery system, vent path, or discharge amount are planned. The modifications assume a greater reliance on manual fire fighting activities (e.g., water suppression) for which new fire fighting equipment has been installed and training conducted. The NRC staff required good access and equipment for manual fire fighting in the CSA as part of original plant licensing. The CO_2 system remains available for use to suppress complex fires as deemed necessary by a fire assessment performed by trained personnel.

Dominion Nuclear Connecticut, Inc. (DNC) has evaluated whether or not a Significant Hazards Consideration (SHC) is involved with the proposed changes by focusing on the three standards set forth in 10 CFR 50.92(c) as discussed below.

Criterion 1:

Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The CO_2 system is designed to limit the effects of fire damage to plant equipment and does not contribute to the prevention or initiation of a fire event. The CO_2 system is not safety-related and is not relied upon to safely shut down the reactor, mitigate radiological consequences of any accident, or maintain the reactor in a safe shutdown condition. Accordingly, the proposed amendment does not affect the inputs or assumptions for any accidents previously evaluated nor does it affect initiation of a fire event. Modifying the CO_2 initiation system to a manual mode reduces the possibility of a malfunction leading to an inadvertent CO_2 discharge. Because the automatic initiation feature of the CO_2 system would be eliminated by the proposed amendment, inadvertent operation would no longer need to be a postulated failure for the CO_2 system. The current analysis for a worst-case fire event allows for complete loss of the CSA which is protected by 3-hour fire-rated barriers. Alternate safe shutdown methods are available in the event that a fire consumes all equipment and cables in the room. The proposed amendment does not modify the fire suppression methodology in a way that would cause any greater damage than complete loss of the CSA. The incipient fire detection system offsets the delay time for manual CO_2 initiation by allowing an earlier response time by the fire brigade. Failure to take manual action is bounded by previous failure of the CO_2 system to operate. Based on this discussion, the proposed amendment does not increase the probability or consequence of an accident previously evaluated.

Criterion 2:

Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The CO_2 system is a mitigating system designed to limit the effects of fire damage to plant equipment and is not credited for safe shutdown of the plant. The proposed amendment does not involve any change that would impact designed CO_2 concentration levels and therefore does not affect the ability of the CO_2, once delivered, to act as fire extinguishing agent. The proposed amendment does not introduce failure modes, accident initiators, or malfunctions that would cause a new or different kind of accident or fire event. The potential for increased water usage due to the proposed change in fire fighting methodology for the CSA is within the capability and capacity of the existing site fire water system and potential water buildup on the CSA floor is bounded by the existing flooding analysis. Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Criterion 3

Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

The evaluated fire event assumes a fire coincident with a loss of power, with no additional plant accidents. As stated above, the current analysis for a worst-case fire event in the CSA allows for complete loss of all cables and equipment in the CSA resulting in loss of use of the control room. The proposed amendment changes the CO_2 system initiation method from automatic to manual and impacts the response time of applying CO_2 as a fire-extinguishing agent. This impact is not significant in that any potential increase in fire damage does not exceed complete loss of all the CSA cables and equipment. In addition, the incipient fire detection system offsets the delay time for manual CO_2 initiation by allowing an earlier response time by the fire brigade. The proposed amendment does not modify the CSA fire area 3-hour fire rated barriers. Therefore, based on the above, the proposed amendment does not involve a significant reduction in a margin of safety.

In summary, DNC concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

Facility Operating License No. NPF-49 Condition 2.H "Fire Protection" states the following:

> "Dominion Nuclear Connecticut, Inc. shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report for the facility and as approved in the SER (NUREG - 1031) issued July 1984 and Supplements Nos. 2, 4, and 5 issued September 1985, November 1985 and January 1986, respectively, subject to the following provision:
>
> The licensee may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

Title 10 of the Code of Federal Regulations (CFR) Section 50, Appendix A, General Design Criterion 3 (GDC 3) states in part:

> "Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Fire-fighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures systems, and components."

10 CFR 50.48(a)(1) requires that each operating nuclear plant must have a fire protection plan that satisfies GDC 3. Millstone Unit No. 3 was licensed after January 1, 1979, consequently NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Reactors, LWR Edition" was the basis document for the initial licensing basis review. Included in NUREG-0800 is Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection For Nuclear Power Plants." BTP CMEB 9.5-1 presented guidelines acceptable to the NRC Staff for implementing GDC 3 in the development of a fire protection program. Alternative approaches could be requested with suitable bases and justification.

BTP CMEB 9.5-1 Section C.7.c recommended an automatic water suppression system in the Cable Spreading Room (Fire Protection of Specific Plant Areas). During the initial licensing process, Millstone Unit 3 requested the NRC approve a deviation to this guidance to allow the use of an automatic gaseous suppression system (carbon dioxide - CO_2) in the Cable Spreading Room.

In a letter dated September 19, 1985,[13] the NRC issued Supplement No. 2 to the Millstone Nuclear Power Station, Unit No. 3 Safety Evaluation Report (SER). In section 9.5.1.6 of this report, the NRC documented its review of manual fire fighting provisions specified for the CSA and concluded that the CO_2 extinguishing system with good access for manual fire fighting with hose streams would provide an adequate level of protection for the cable spreading room and was, therefore, an acceptable deviation from staff guidelines.

DNC has performed a technical evaluation and concluded that a manually actuated CSA CO_2 system, improved manual fire fighting capability, and two fire detection systems is an acceptable alternative to an automatic CO_2 system. This change to the fire protection program is permitted by Facility Operating License No. NPF-49 Condition 2.H since it does not adversely affect safe shutdown of the plant in the event of a fire. In addition, DNC concludes that continued compliance with 10 CFR 50.48 and 10 CFR 50 Appendix A, GDC 3 will be maintained with this proposed amendment.

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[13] B. J. Youngblood letter to J. F. Opeka, "Issuance of Supplement No. 2 to NUREG-1031 - Millstone Nuclear Power Station, Unit No. 3," dated September 19, 1985.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

DNC has determined that the proposed amendment would change requirements with respect to use of a facility component located within the restricted area, as defined by 10 CFR 20, or would change an inspection or surveillance requirement. DNC has evaluated the proposed change and has determined that the change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released off site, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

ATTACHMENT 2

MILLSTONE POWER STATION, UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)
UPDATED RESPONSE TO QUESTION 1 FROM DNC LETTER TITLED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION DATED JAN 23, 2004

MILLSTONE POWER STATION, UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)
UPDATED RESPONSE TO QUESTION 1 FROM DNC LETTER TITLED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION DATED JAN 23, 2004

BACKGROUND:

During original plant licensing, Millstone Unit 3 (MP3) requested a deviation from the requirements of Branch Technical Position (BTP) CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," to allow an automatic carbon dioxide (CO_2) fire suppression system to be installed in the cable spreading area (CSA). The deviation was approved by the NRC in September 1985.[1] After a 1999 inadvertent CO_2 discharge and subsequent investigation and evaluation of CO_2 migration concerns, Dominion Nuclear Connecticut, Inc. (DNC) proposed a change to the fire suppression methodology in the CSA. On April 17, 2003, DNC submitted its request for approval of conversion of the automatic CO_2 system to a manual mode.[2] In a facsimile dated August 7, 2003,[3] the U.S. Nuclear Regulatory Commission (NRC) transmitted a draft of a request for additional information on DNC's proposed change. On December 17 and 30, 2003, teleconferences were held to discuss this information with the NRC. DNC's response to the RAI was provided in DNC letter dated January 23, 2004.[4] DNC's updated response to NRC QUESTION 1 is provided in the balance of this Attachment.

QUESTION 1:

10 CFR Part 50.48(a) requires each operating nuclear power plant to have a fire protection plan which meets Criterion (GDC) 3 of Appendix A to Part 50. In particular, GDC 3 states, "Fire-fighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components." The NRC has provided specific criteria, information, recommendations, and guidance acceptable to the staff that may be used to meet the requirements of 10 CFR 50.48 and GDC 3. This information is provided in NUREG 0800, Standard Review Plan, Section 9.5.1, Fire Protection Program and in Regulatory Guide (RG) 1.78 as it relates to habitable areas such as the control room

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(1) NUREG 1031, Supplement 2, "Safety Evaluation Report related to the operation of Millstone Nuclear Power Station, Unit No. 3," dated September 1985.

(2) DNC letter, "Millstone Power Station Unit No. 3, Proposed Revision to the Previously Approved Deviation From Branch Technical Position (BTP) CMEB 9.5-1, Section C.7.c," dated April 17, 2003.

(3) V. Nerses (NRC) Facsimile to R. Joshi, "Draft Request for Additional Information (RAI) to be discussed in an Upcoming Conference Call (TAC No. MB8731)," August 7, 2003.

(4) DNC letter, "Millstone Power Station Unit 3, Response to Request for Additional Information Regarding a Change to the Fire Protection Program (TAC No. MB8731)," dated January 23, 2004.

and to the use of specific fire extinguishing agents.

Please describe how the planned configuration meets the regulatory requirements. The licensee may address this by describing how the proposed change conforms to RG 1.78 as it relates to habitable areas such as the control room and at the local control stations in the east and west switchgear rooms or describe specifically how any alternatives will meet the requirements.

RESPONSE TO QUESTION 1:

Regulatory Guide (RG) 1.78 requires the control room be appropriately protected from hazardous chemicals that may be discharged as a result of equipment failures or other events. DNC has determined that the potential exists for CO_2 migration from the CSA into the control room (above) and the east and west switchgear rooms (below), during a CO_2 discharge in the CSA. The CO_2 leakage could potentially result in unacceptable concentration levels in the spaces adjacent to the CSA over an extended period of time after a discharge. To restore CO_2 as a fixed fire suppression system in the CSA while maintaining compliance with our license condition, several plant design changes are being implemented. These changes, discussed in the body of the license amendment request, ensure habitability of the control room and alternate plant shutdown locations (east and west switchgear rooms) throughout the anticipated duration of a postulated fire event. Specifically, the requirements of RG 1.78 (1974) are met as follows:

<u>General toxicity limit from RG 1.78, Table C-1.</u> Toxicity limit for CO_2 is 1.0% by volume (approximately 10,000 ppm). Consideration of the toxicity limit is included in procedure directed actions. While in the control room, operators are directed to don self-contained breathing apparatus if CO_2 concentration is above 5,000 ppm for a predetermined time or when oxygen levels drop below 19.5%. Installation of CO_2 and oxygen (O_2) monitoring equipment assists operators in determining these levels.

<u>Regulatory Position C.1. Major depots or storage tanks of CO_2 should be considered in evaluation of control room habitability during a postulated hazardous chemical release.</u> Engineering analysis was performed to determine the effects on control room habitability for a CO_2 tank rupture and CO_2 relief and purge paths. Recent results from the inadvertent CO_2 discharge event and subsequent testing have indicated that the purge path contributed to CO_2 migration and modification to the purge system was necessary. The CSA portion of the control building purge system was blocked off.

In addition, due to the location of outside air intake into the east switchgear room, which has a separate ventilation system, an analysis was performed to evaluate habitability of this room following CSA CO_2 relief. It was determined that procedure instructions to isolate the east switchgear room supply fan prior to a CSA CO_2 discharge will be required as part of the restoration of the CO_2 suppression system to operational status.

Regulatory Position C.2. Evaluate frequent rail, road and water shipments of CO_2 past the site for impact on control room habitability. Based on past studies, CO_2 shipments by rail, road or water are not of concern. The on-site MP3 CO_2 storage tank of approximately 45 tons has been analyzed for control room habitability and bounds any potential impacts of CO_2 shipments in transit past the site.

Regulatory Position C.3. CO_2 stored on site should be accompanied by instrumentation that will detect its escape, set off an alarm, and provide a readout in the control room. In accordance with the original design, the control room receives an alarm on CO_2 tank low level should inadvertent discharge of the CO_2 storage tank occur during normal plant operation. In the event of a control room evacuation to the alternate shutdown location, (east and west switchgear rooms) new air monitors permanently installed in these rooms have audio and visual alarms and reset capability to alert operators to potential rising CO_2 levels. In addition, portable CO_2 monitors are available for local surveys.

Regulatory Position C.4. CO_2 toxicity limits should be taken from appropriate authoritative sources. Source and basis for toxicity limits for the CO_2 system are addressed in approved calculations. These sources include:

- Genium Publishing Corporation, Material Safety Data Sheets Collection: Sheet No. 54 – Carbon Dioxide, Revision B, September 1992. Genium Publishing Corporation, Schenectady, New York.

- 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, Cincinnati Ohio.

Regulatory Positions C.5.a. and C.5.b. Consider maximum concentration and maximum concentration-duration accidents described in RG 1.78 in control room habitability evaluation. Effects of a full CO_2 storage tank rupture were analyzed in approved calculations and both accidents described in RG 1.78 are covered. The largest safety relief valve for the CO_2 system is on the stationary outdoor storage tank. The results of these calculations are not impacted by the planned CSA CO_2 system configuration. However, should a tank rupture or relief occur when operators are performing shutdown activities from the alternate location, self-contained breathing apparatus, a breathing air system, and air monitors are available.

Regulatory Position C.6. Atmospheric dilution factors. Analytical methods used in calculations for control room habitability and east switchgear room were taken from RG 1.78 and NUREG-0570 and dilution factors were included.

Regulatory Postion C.7. Closing air ducts, detection of CO_2, and air flows should be considered in evaluation of control room habitability. The control room ventilation and the east and west switchgear rooms can be isolated by shutting off room intake fans and closing ventilation dampers as needed. CO_2 and O_2 alarm and monitoring equipment is located in the control room, instrument rack room, east and west switchgear rooms, and in the service building, northwest stairway (control room evacuation path). Portable monitors are available also. Currently the CO_2 storage tank rupture and effects on control room intake are analyzed. The path to the switchgear room intakes is more torturous and longer than the path to the control room. The limiting event for switchgear room habitability is understood to be the evacuation of the control room to the alternate shutdown location, accompanied by a CSA CO_2 discharge.

Regulatory Position C.8. Rate of air infiltration. It has been determined that potentially unacceptable levels of CO_2 may infiltrate the switchgear rooms and the control room during a CSA discharge event. For this reason, supplemental breathing air systems are being installed in the east and west switchgear rooms. Sufficient breathing capacity is provided to account for the completion of two full CO_2 discharges without cylinder change-out. The air breathing system is designed so air cylinders may be replaced as the system is being used. Each system consists of manifold(s), regulator pressure gauge, air bottles, airlines, and low-pressure alarm and meets NFPA breathing air requirements. The breathing air systems are self-contained and do not require electric power.

In the control room, seven self-contained breathing apparatus (SCBA) are currently pre-staged, each with a spare 60-minute air cylinder. The associated SCBA masks have been outfitted with new voice amplifiers for stronger person-to-person communications. Power supplies can be changed out during use and spares are available. Each SCBA staged in the control room will also be outfitted with a quick-connect airline fitting to allow connection to the new breathing air system in the east and west switchgear rooms. All equipment is periodically checked and maintained to ensure continued functionality.

It is important to note, as discussed in response to Regulatory Position C.11., these areas are capable of being purged of CO_2 using various methods.

The following measures assist in reducing potential leakage from the CSA into adjacent areas:

- Additional sealing of the spare electrical metal floor penetrations in the west portion of the instrument rack room and CSA has been performed to improve the leak-tightness of fire protection seals further preventing potential CO_2 migration from the CSA boundary.

- Penetrations in the boundaries of the CSA are fire rated assemblies (penetration seals and fire dampers) that are captured in the penetration inspection program. Some ductwork passes through the CSA to the control room and these ventilation duct penetrations are also periodically inspected.

- The CSA fire doors, their hardware and seals are inspected visually and functionally to insure that they operate properly every 18 months. In addition, the doors are inspected periodically per approved procedures to assure they are not damaged or degraded and that they latch securely.

<u>Regulatory Position C.9. Makeup air for room pressurization and pressure differential.</u> The control room emergency ventilation system operating in recirculation mode and a control room pressurization system can be manually initiated. To support operation of the control room emergency ventilation system, the MP3 Technical Specifications surveillance requirement ensures control room positive pressure of greater than or equal to 1/8-inch water gauge relative to adjacent areas on a periodic basis. The switchgear room ventilation system was not designed to provide a positive pressure relative to surrounding areas.

<u>Regulatory Position C.10. Allow for 10 cubic feet per minute of unfiltered air into control room.</u> Refer to response to Regulatory Position C.8. Note that the switchgear rooms were not designed to limit or filter intake air during a radiological event.

<u>Regulatory Position C.11. Removal capability of chemical by filtration or other means.</u> The fire brigade has portable exhaust fans for purging CO_2 from the CSA and the switchgear rooms and is trained on their use. In addition, the control building purge system (CBPS) is capable of purging CO_2 from the control room and the switchgear rooms. Portable fans are also available for purging operations in these rooms.

<u>Regulatory Position C.12. Chemical Release from container (storage tank) or pipe concurrent with design accident (LOCA, flood, tornado or earthquake).</u> The potential CO_2 migration into the control room or east and west switchgear room is bounded by the CO_2 storage tank rupture analysis.

<u>Regulatory Position C.13. If accident indicates that chemical toxicity limits might be exceeded, SCBA should be provided. For long duration event, sufficient air for six hours should be provided.</u> Seven SCBAs each with one-hour air cylinders and one replacement cylinder are pre-staged in the control room. In addition, breathing air systems have been provided that supply 3 hours of breathing air for 4 operators in the west switchgear room and 3 hours of breathing air for 2 operators in the east switchgear room. A maximum of four operators are needed to perform alternate shutdown activities in these two areas. Three hours of breathing air available per operator is considered to be sufficient breathing air for a worst-case fire scenario in which purging of CSA and adjacent areas to acceptable CO_2 levels is completed

approximately 2.5 hours after initial CO_2 discharge. The breathing air system design allows bottle change-out during use and spare air bottles are located on site.

Regulatory Position C.14. Detection instrumentation and air supply equipment should meet the single-failure criterion. The west switchgear room (auxiliary shutdown panel) will have two permanent air detectors/monitors/alarms and the east switchgear room will have one. The permanent monitors have back up power. The fire brigade has portable air monitors for use during an event. There are a total of 61 SCBA, 60-minute packs on-site with 60 spare full air cylinders. During a significant fire event, mutual aid is called immediately which brings more fire fighters, SCBA, spare cylinders, and a cascade fill station. New switchgear room breathing air systems are self-contained mechanical systems, requiring no electric power. Air cylinders can be changed out during system operation and spare bottles will be available on site.

Regulatory Position C.15. Emergency procedures should be written to address the event, including use of detection instrumentation. Changes to the emergency operating procedures are planned to address CO_2 discharge in the CSA. Prior to manually initiating a CSA CO_2 discharge, procedure directed actions including announcements and evacuations are performed associated with the potential hazards. Instructions are provided for evacuation of the control room and SCBA use while traveling to switchgear rooms to perform shutdown. Permanent CO_2 and O_2 detectors, monitors, and alarms will be located in the control room, instrument rack room, east and west switchgear rooms, and service building northwest stairway. In the control room, operators are directed to don SCBA if CO_2 levels are above 5,000 ppm for a predetermined time or when O_2 levels drop below 19.5%. Changes to the emergency operating procedure are planned to direct use of SCBA during various fire scenario events that are coincident with a CSA CO_2 discharge. Procedures are also provided to isolate the control room (no evacuation). Procedures for inspection and inventory of SCBA are also in place.

ATTACHMENT 3

MILLSTONE POWER STATION, UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)
FIRE FREQUENCY ANALYSIS FOR MILLSTONE UNIT 3 CABLE SPREADING AREA

Approved 11/17/03 Effective 11/21/03

CALCULATION TITLE PAGE

Total Number of Pages: 37

Fire Frequency Analysis for Millstone Unit 3 Cable Spreading Area

TITLE

PRA04YQA-04080S3	0
CALCULATION No.	**Revision No.**
N/A	N/A
VENDOR CALCULATION No.	**Revision No.**

N/A
VENDOR NAME

NUCLEAR INDICATOR:	50.59 Evaluation or Screen Attached	Calc. Supports DCR/MMOD/EE?	Calc. Supports Other Process?
☐CAT1 ☐RWQA ☐SBOQA ☐FPQA ☐ATWSQA ☒NON-QA	☐YES ☒NO	☐YES ☒NO	☐YES ☒NO
		↓ N/A Ref. No.	↓ N/A Reference

INCORPORATES:

CCN NO:	AGAINST REV.
N/A	N/A

Executive Summary

The change from an automatically actuated CO2 system to a manually actuated system in the CSA does not result in a significant increase in fire frequency. This conclusion is based on the following:

- *The CSA is a relatively large room.*
- *There are very few fixed ignition sources in the CSA.*
- *Based on the results listed in Table 15, hot-work activities are the largest contributor to fire risk in the CSA. This assessment is significant because the automatic CO2 system would have been locked out during hotwork activities.*
- *The fire size, reflected in the frequency analysis as the severity factor, dominates the fire frequency in some scenarios.*
- *A new fire protection strategy for the CSA has been developed in support of the changed of the CO_2 system from automatic to manual actuation.*

Approvals (Print & Sign Name)		
Preparer: F.J. Joglar Mangeno //signature on file//		Date:
Interdiscipline Reviewer: J. T. Mangeno //signature on file//	Discipline: Fire Protection	Date:
Interdiscipline Reviewer : D. Fredericks //signature on file//	Discipline: Licensing	Date:
Independent Reviewer: F. O. Cietek //signature on file//		Date:
Engineering Approver: D. M. Bucheit //signature on file//		Date:

Installation Verification

☐ Calculation represents the installed configuration and approved licensing condition (Calculation of Record)

☒ N/A does not affect plant configuration (e.g., study, hypothetical analysis, etc.)

Preparer/Designer Engineer: (Print and Sign) Francisco Joglar Date:

Approved 11/17/03 Effective 11/21/03

PassPort DATABASE INPUTs

Calculation Number: PRA04YQA-04080S3 Revision: 0

Vendor Calculation Number/Other: N/A Revision: N/A

CCN # N/A Calc. Voided: ☐ Yes ☒ No

Superseded By: N/A Supersedes Calc: N/A

Discipline (Up to 10) W

Unit (M1, M2, M3)	Project Reference (EWA, DCR or MMOD)	Component Id	Computer Code	Rev. No./ Level No.
N/A	N/A	N/A	N/A	N/A

PMMS CODES*					
Structure	System	Component	Reference Calculation	Rev. No.	CCN
N/A	N/A	N/A	PRA02NQA-03107S2	0	N/A
N/A	N/A	N/A	PRA99YQA-02863S2	0	N/A
N/A	N/A	N/A	PRA02NQA-03131S2	0	N/A

*The codes required must be alpha codes designed for structure, system and component.

NOTE: Avoid multiple item references on a line, e.g., LT 1210 A-D requires four separate lines.

Reference Drawing	Sheet	Rev. No.
N/A	N/A	N/A

Comments:

N/A

Referenced By Calculation	Impact Y	Impact N	AR Reference/Calc Change Ref.
N/A	N/A	N/A	N/A

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1. Purpose

The objective of this calculation file is to determine the frequencies of fires generating target damage in the Millstone Unit 3 (MP3) Cable Spreading Area after the CO_2 fire suppression system is changed from automatic actuation to manual only actuation. Targets are defined as orange and purple safety related cables.

2. Summary

The change from an automatically actuated CO2 system to a manually actuated system in the CSA does not result in a significant increase in fire frequency. This conclusion is based on the following:

The CSA is a relatively large room.

There are very few fixed ignition sources in the CSA.

Based on the results listed in Table 15, hot-work activities are the largest contributor to fire risk in the CSA. This assessment is significant because the automatic CO2 system would have been locked out during hotwork activities.

The fire size, reflected in the frequency analysis as the severity factor, dominates the fire frequency in some scenarios.

A new fire protection strategy for the CSA has been developed in support of the CO_2 system change from automatic to manual actuation.

3. References

1. J. M. Chavez. "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Control Cabinets - Parts 1 & 2." Albuquerque, NM: Sandia National Laboratories. SAND86-0336. Washington, D.C.: Government Printing Office, April 1987. NUREG/CR-4527.

2. Appendix F – Fire Protection Significance Determination Process (SDP). October 14, 2003. Working draft Revision 2.3a.

3. EPRI TR-1002981, "Fire Modeling Guide for Nuclear Power Plant Applications," August 2001.

4. EPRI TR-105928, "Fire PRA Implementation Guide," December 1995.

5. Fire Dynamics Tools (FDT): Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program. NUREG-1805, Draft Report for Comments.

6. Automatic and Manual Suppression Reliability Data for Nuclear Power Plant Fire Risk Analyses, NSAC-179L.

7. Fire Protection Evaluation Report, MNPS Unit 3

8. Unit 3 Fire Fighting Strategies

4. Assumptions

Assumptions are included within the body of the calculation.

5. Method of Calculation

The fire frequency analysis in the CSA follows the following sequence of activities:

- Identification of ignition sources: Activities for completing this step include plant walk-downs, and fire modeling analysis for determining the damage zone for ignition sources in the room.
- Description of selected fire scenarios in the CSA: The purpose of this activity is to determine which fire scenarios in the CSA are contributors to the fire risk profile of the room.
- Fire modeling in support of the fire risk analysis: This purpose of this activity is to determine the consequences of each fire scenario in terms of equipment damage and time to damage.
- Fire detection and suppression analysis: The purpose of this activity is to determine the probability of no suppression in each contributing fire scenario.
- Fire frequency analysis: The purpose of this activity is to determine the fire frequency of the CSA based on the selected fire scenarios.

6. Body of Calculation

The cable spreading area (CSA) is located at elevation 24'-6" in the control building below the main control room. It has a floor area of 11,284 ft^2 and a ceiling height of 21 ft [7].

Passive fire protection: The CSA can be accessed through 2 single fire doors located at the northeast and northwest walls respectively. CSA walls, ceiling and floor adjacent to other rooms or buildings are made of three-hour fire-rated concrete.

Fire detection: The CSA is equipped with two fire detection systems: 1) a cross-zoned smoke detection system (ionization and photo-electric), and 2) an early warning incipient fire detection system. Both systems have separate alarms and separate indications to the control room.

Fixed fire suppression: The CSA was originally equipped with an automatic CO_2 suppression system. An alarm signal from two cross-zones of smoke detection was required to initiate the timer. In the automatic configuration, the CO_2 was released after a 60 second delay. In the manual only actuation configuration, actuation of a ball valve will also be required to initiate the CO_2 discharge. Manual actuation of the CO_2 suppression system also requires the following actions: 1) ensure the area is clear of personnel (surrounding areas may also become uninhabitable), 2) coordinate discharge with Operations (discharge requires Shift Manager authorization).

Manual fire suppression: Manual fire fighting equipment is located throughout the CSA. The equipment includes portable fire extinguishers (CO_2, water mist, and large capacity wheeled CO_2), dry hose reels, dry hose lines connected to normally closed valves in the turbine building and service building, and a thermal imaging camera located inside a fire brigade locker in the CSA. A fire watch is assigned to the CSA during hotwork activities. This fire watch is trained to suppress fires with portable fire extinguishers.

6.1 Fire Ignition Frequencies for the CSA

The fire frequency analysis in the CSA described in this document consists of the following general tasks:

1. Identification of fixed and transient ignition sources in the CSA: In this initial step, room drawings were reviewed and walk-downs were conducted to determine which ignition sources should be included in the frequency analysis.

2. Selection and description of fire scenarios in the CSA: Based on the identified ignition sources, fire scenarios were selected to represent the fire risk profile of the room.

3. Fire modeling studies: Fire modeling of the selected fire scenarios was conducted to determine the extent of fire damage for each fire scenario.

4. Calculation of severity factors: A severity factor was assigned to each selected fire scenario. The severity factor is the probability that a heat release rate of at least the size required for generating target damage occurs.

5. Fire detection and suppression analysis: Detection and suppression analysis was conducted separately from fire modeling activities due to the limited capabilities of

analytical tools to simulate suppression. The fire frequency analysis credits detection and suppression in the form of a probability of no suppression for each scenario.

6. Determination of fire ignition frequencies for each selected fire scenario: Determination of fire ignition frequencies considers the generic frequencies, location of the fire, severity factors, and probabilities of no suppression.

6.1.1 Ignition Source Identification

There are very few fixed ignition sources in the room. The ignition sources can be summarized as:

Two electrical isolation panels located near the center of the room. The only cables in close proximity to the isolation panels are those cables that are directly connected to the isolation panels, which are routed in conduits.

A number of heavy gauge metal junction boxes are mounted at the ceiling, floor, walls and on columns. In addition, there are two switch enclosure panels used as junction boxes, a fire zone panel, and two incipient fire detection (IFD) panels.

The majority of the combustible load in the room consists of IEEE-383 qualified cables routed in cable trays and conduits throughout the room.

6.1.2 Selection and Description of Fire Scenarios

Two general types of fire scenarios are usually postulated as part of a fire risk assessment: fixed ignition source and transient fire scenarios.

Fixed ignition sources in the CSA could contribute to the fire risk profile if they are associated with safety-related cables or equipment or, if ignited, fire generated conditions affect safety-related equipment in the room. These two conditions are analyzed in detail for the two isolation panels in the CSA.

The two isolation panels in the CSA are safety-related, one associated with the purple train, and the other with the orange train. The panels isolate safety related circuits from non-safety related circuits. If any of the panel ignites, it may impact the operation related to the respective safety related train. However, no cable associated with these panels is part of any accident mitigating sequence credited in the fire PRA Therefore, from a plant operability perspective, a fire starting in any of these two isolation panels does not disable any accident mitigating equipment.

A fire zone of influence (ZOI) for fires in either of these two isolation panels was calculated using fire modeling tools to determine if damage could occur to safety-related cables in the room. These isolation panels are vertical cabinets with closed doors. For screening purposes, a conservative heat release rate of 725 kW is assumed. This fire intensity is the average of the two benchboard cabinet experiments reported in NUREG/CR 4527 [1]. This is a conservative estimate because the isolation panels are completely closed. In contrast, the two benchboard cabinet fires reported in [1] had 3 X 6 ft^2 ventilation grills. The resulting ZOI for a single isolation panel, assuming damage criteria for IEEE-383 qualified cable is described in Table 1. (Note that damage temperature for IEEE-383 cable is approximately 625 ^oF, with a critical heat flux of approximately 11 kW/m^2 [2].) The calculations supporting Table 1 are documented in Attachment A.

Table 1: ZOI for CSA isolation panel

Region	ZOI	Model in Five-Rev1 Library [3]
Flames (ft)	8.7	Heskestad's flame height correlation
Plume (ft)	10.0	Heskestad's plume temperature correlation
Ceiling Jet (ft)	0.3	Alpert's ceiling jet correlation
Flame Radiation (ft)	4.8	Point source radiation model
Smoke Layer (^oF)	200	MQH Room temperature correlation

Any equipment within the distances listed in Table 1 is expected to be damaged by fire. For each isolation panel, room walkdowns confirmed that only those cables connected directly to the isolation panels are within the calculated distances in Table 1. Furthermore, the generated room temperature 20 minutes after ignition is approximately 200 ^oF, which is not sufficient for damaging or igniting IEEE-383 cables. Therefore, fires these two isolation panels do not damage additional equipment and no fire scenario related to the isolation panels is required to be postulated.

In addition to the isolation panels, a number of heavy gauge metal junction boxes and fire protection panels in the CSA. The junction boxes have no or minimal openings and the amount of combustibles inside the junction boxes is significantly less than the isolation panels. Therefore, no fire scenario related to junction boxes is postulated. In terms of fire protection panels, a conservative heat release rate of 20 kW was assigned to them resulting in a calculated ZOI of 1.5 ft for each panel. Room walkdowns confirmed that there is only a cable tray stack 12" above a 2' x 2' panel, but the trays are not safety related.

The two switch enclosures that are currently being used as junction boxes were treated in a similar manner to junction boxes. Safety-related cables are outside the ZOI for the switch enclosures as well.

Finally, it is assumed that the probability of self-ignited cable fire is very small for IEEE-383 cable. Therefore, no self-ignited cable scenario is required to be postulated.

After screening all fixed ignition sources in the room, only transient fire scenarios remain to be postulated in the CSA.

There are three types of transient fires that can be postulated: 1) general transients, 2) transients caused by hotwork, and 3) cable fires caused by hotwork. Each fire scenario is postulated considering each of these possible transient fire initiators. As a first step, the different locations where orange (Train A) and purple (Train B) trains came together, or "pinch-points", were identified in raceway and conduit drawings. Pinch-points consisted for the most part of:

- cable trays of opposite trains crossing each other
- cable trays of opposite trains running parallel to one another within a short distance
- conduits of opposite trains crossing each other or located within a short distance
- conduits and cable trays of opposite trains crossing each other
- conduits and cable trays of opposite trains running parallel on top of one another

Once the "pinch-points" were clearly labeled on plant drawings, a walk-down was conducted to identifying specific features of each pinch-point relevant to the description of fire scenarios. A total of seven fire scenarios were identified. The target for all scenarios is damage to two trains, each containing cables from orange and purple trains.

Scenario CSA1 - A floor-based transient fire below two cable trays of opposite trains running parallel to one another within a short distance. The horizontal separation between the trays is 3'. Both trays are 13' above the floor. There are no intermediate combustibles between the fire and the target trays.

Scenario CSA2 - A stack of 9 cable trays is located 3'6" above the floor. The last tray (tray 9) is 16' above the floor. Trays 1, 7 and 8 have orange train cables. A purple train conduit is located above the stack at elevation 17'. The scenario consists of a transient or welding fire affecting cables from the two opposite trains.

Scenario CSA3 - A 4'6" high stack of 4 cable trays is located at floor level. The top tray has orange train cables. A tray with purple train cables crosses perpendicular to the stack 6' above the floor. The scenario consists of a welding or transient fire affecting cables from the two opposite trains.

Scenario CSA4 - A cable tray with purple train cables is 6' high. A stack of two trays crosses perpendicular to the purple train tray at 8.5' above the floor. The top tray in that two-tray stack has orange train cables. The scenario consists of a welding or transient fire affecting cables from the two opposite trains.

Scenario CSA5 - A floor based transient fire below vertical trays of containing cables of opposite trains 4' apart horizontally. The trays are 6' above the floor and run vertically up to the ceiling.

Scenario CSA6 - A cable tray with purple train cables runs horizontally 7'6" above the floor. A stack of 6 trays runs perpendicularly above this tray. The top tray in the stack has orange train cables. This top tray is 14' above the floor. The scenario consists of a transient or welding fire affecting cables from the two opposite trains.

Scenario CSA7 - Two parallel conduits run vertically along a column inside the room. The two conduits are from opposite trains and are 10 inches apart horizontally. The scenario consists of a floor-based fire near the column affecting the two conduits.

6.1.3 Fire Modeling

The type of fire scenarios selected in the CSA is appropriate for fire analysis using hand calculations since it was previously determined in the discussion about fixed ignition sources that hot gas layer effects are not a factor. (See smoke layer temperature in Table 1.) All the scenarios consist of cable trays adjacent to or above a fire. In these situations, a flame height, a plume temperature, or a flame radiation analysis is used for determining if cable trays can be damaged by fire, and if so, when.

For targets located within a cable tray stack, the empirical model for fire propagation among cable trays in FIVE-Rev1 [3] was used for determining time to target damage. For individual trays subjected to fire conditions, time to target damage was calculated assuming a t^2 heat release rate profile that grows to the peak fire intensity in 600 seconds (slow growth). This growth rate was selected because it is highly unlikely that combustibles with faster growing profiles, such as flammable liquids, would be brought into the CSA. The CSA has been classified as a combustible free zone, which requires special permits from the fire brigade before combustibles are brought into the room. Furthermore, there is no equipment in the room requiring lubrication. The fire modeling calculations for the selected scenarios are as follows:

Scenario CSA1:

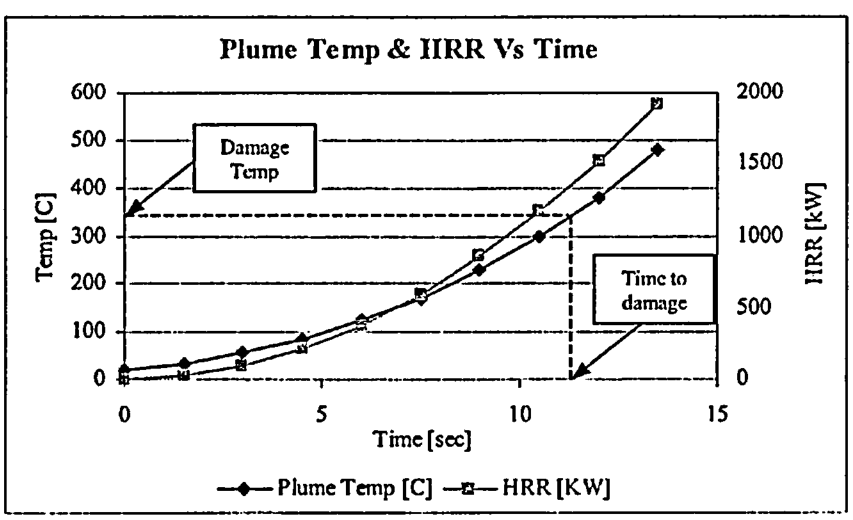
The heat release rate required to generate 625 °F (330°C) at 13' above the base of the fire was calculated to be approximately 1.3 MW using Heskestad's fire plume temperature correlation as described in Table 2. It is assumed that the plume will affect the two cable trays of interest. The time to target damage is assumed to be the time it takes for the heat release rate profile to generate a plume temperature of 625 °F (330°C). The estimated time to damage is approximately 11 min. as illustrated in Figure 1.

Table 2: Five-Rev1 analysis for plume temperature (CSA1)

EPRI's Five-Rev1 Analysis

Date:	3/12/2004
Analyst:	Francisco Joglar
Inputs	
Ambient temperature [°C]	20
Fire location factor	1
HRR [kW]	1300
Fire elevation [m]	0
Target Elevation [m]	3.96
Radiation Fraction	0.40
Fire Diameter [m]	0.6
Results	
Plume Temp [°C]	**328 (625 °F)**

Figure 1: Plume temperature and heat release rate vs. time curve (CSA1).



Scenario CSA2:

A fire was postulated to start on the floor either as a general transient or a transient caused by hotwork. Based on Heskestad's flame height correlation, a 150 kW fire would generate flames reaching the lowest tray. A 115 kW fire however could produce plume temperatures of 625 °F at the lowest tray. Table 3 summarizes input values and result for the plume temperature analysis.

Table 3: Five-Rev1 analysis for plume temperature (CSA2)

EPRI's Five-Rev1 Analysis
Heskestad's Plume Temperature Correlation

Date: 3/12/2004
Analyst: Francisco Joglar

Inputs	
Ambient temperature [°C]	20
Fire location factor	1
HRR [kW]	115
Fire elevation [m]	0
Target Elevation [m]	1.066
Radiation Fraction	0.40
Fire Diameter [m]	0.6
Results	
Plume Temp [°C]	357 (675 °F)

Fire propagation to the sixth cable tray would take approximately 15 minutes, which is obtained from adding 5 minutes (ignition of first tray), 4 minutes (ignition of second tray), and 3, 2, and 1 minutes for the remaining trays, 3, 4, and 5, respectively. This calculation follows the approach described in EPRI's Fire PRA Implementation Guide (TR-105928) [4] for fire propagation between cable trays. Propagation above the sixth tray is assumed to occur immediately. Time to target damage is considered to be 15 min.

Scenario CSA3:

Since the cable tray stack starts on the floor, any sustained transient fire was assumed to ignite the first tray and propagate upwards to affect the trays from the opposite train. The propagation and target damage was estimated to be about 15 minutes based on the model for fire propagation described in the analysis for Scenario CSA2. Since the target is at floor level, fires with relatively low fire intensities near the trays can cause ignition. A nominal heat release rate value of 50 kW is assumed for the ignition source.

Scenario CSA4:

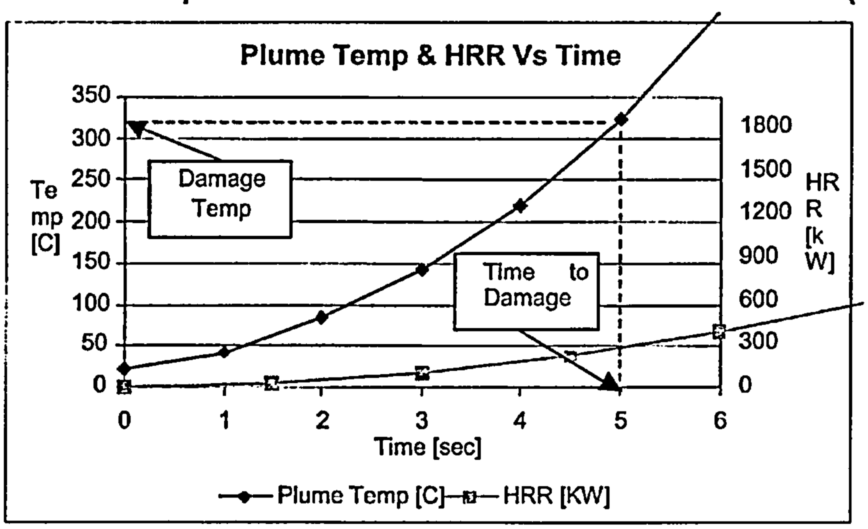
A heat release rate of 270 kW is necessary for generating plume temperatures of 625 °F (330°C) 6' above the floor, where the purple train cable tray is located. The time to reach this temperature is 5 minutes based on the analysis presented in Figure 2. Table 4 summarizes plume temperature results.

Table 4: Five-Rev1 analysis for plume temperature (CSA4)

EPRI's Five-Rev1 Analysis
Heskestad's Plume Temperature Correlation

Date:	3/12/2004
Analyst:	Francisco Joglar
Inputs	
Ambient temperature [C]	20
Fire location factor	1
HRR [kW]	270
Fire elevation [m]	0
Target Elevation [m]	1.82
Radiation Fraction	0.40
Fire Diameter [m]	0.6
Results	
Plume Temp [C]	332 (630 °F)

Figure 2: Plume temperature and heat release rate vs. time curve (CSA4)



Ignition of the orange train cables, located in the second tray in the stack above the purple train tray is conservatively assumed to be 5 min. Therefore, time to target damage for this scenario is 10 min.

Scenario CSA5:

Results for the ignition of the first tray in Scenario CSA4 summarized in Table 4, are fully applicable for ignition of the two vertical trays in Scenario CSA5. Time to target damage is 5 min given a 270 kW fire.

Scenario CSA6:

A heat release rate of 425 kW is necessary for generating plume temperatures of 625 °F (330°C) 7.5' above the floor, where the purple train cable tray is located. The time to reach this temperature is 6 minutes based on the analysis presented in Figure 3. Table 5 summarizes plume temperature results.

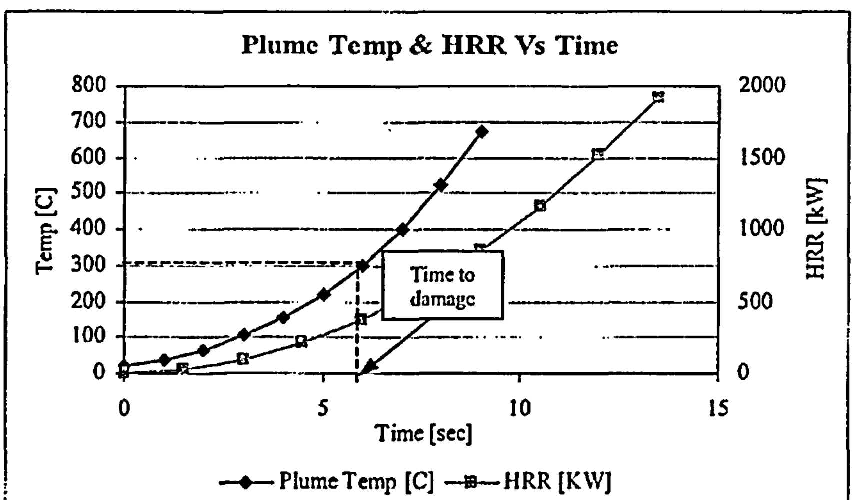
Table 5: Five-Rev1 analysis for plume temperature (CSA6)

EPRI's Five-Rev1 Analysis
Heskestad's Plume Temperature Correlation

Date:	3/12/2004
Analyst:	Francisco Joglar

Inputs	
Ambient temperature [C]	20
Fire location factor	1
HRR [kW]	425
Fire elevation [m]	0
Target Elevation [m]	2.3
Radiation Fraction	0.40
Fire Diameter [m]	0.6
Results	
Plume Temp [C]	332 (630 °F)

Figure 3: Plume temperature and heat release rate vs. time curve (CSA6)



Given ignition of the first tray in the stack in 6 minutes, the six-tray stack is assumed ignited in 21 min, following the EPRI guide for fire propagation among cable trays described earlier (5 min for ignition of the first tray, 4 min for ignition of second tray, etc). Specifically, 6 min for ignition of the lowest purple train cables, and 15 minutes for propagation within the six-tray stack until reaching the orange train cables.

Scenario CSA7:

The two parallel conduits will be affected mostly by flame radiation since the conduits run down vertically along a column almost to floor level. Almost any sustained fire close enough to the conduits will be capable of damaging them. For the purpose of this scenario, a 30 kW fire is assumed 1' from the column. This fire will generate a heat flux that can damage the conduits as summarized in Table 6. The estimated time to damage is 4.6 min is documented in Table 7.

Table 6: Five-Rev1 analysis for flame radiation (CSA7)

EPRI's Five-Rev1 Analysis
Point Source Flame Radiation Model

Date: 3/15/2004
Analyst: Francisco Joglar

Inputs	
Fire heat release rate [kW]	30
Radiation fraction	0.40
Distance from flames [m]	0.3
Results	
Heat flux [kW/m^2]	10.62

Table 7: Five-Rev1 analysis for target temperature (CSA7)

EPRI's Five-Rev1 Analysis
Target Temperature Analysis

Date: 3/15/2004
Analyst: Francisco Joglar

Inputs

Ambient temperature [C]	20
Incident heat flux [kW/m2]	11
Time [sec]	275
Thermal conductivity [kW/mK]	0.000235
Density [kg/m3]	1375
Specific heat [kW/kgK]	1.39

Results

Target Temp [C] 327 (620^0 F)

Summary of Results

Table 8 summarizes fire-modeling results in the CSA for each of the fire scenarios. These values are used for calculating severity factors and probability of no suppression.

Table 8: Summary of fire modeling results for CSA

Scenario	Critical HRR [kW]	Time to Dam [min]
CSA1	1300	11
CSA2	115	15
CSA3	50	15
CSA4	270	10
CSA5	270	5
CSA6	425	21
CSA7	30	4.6

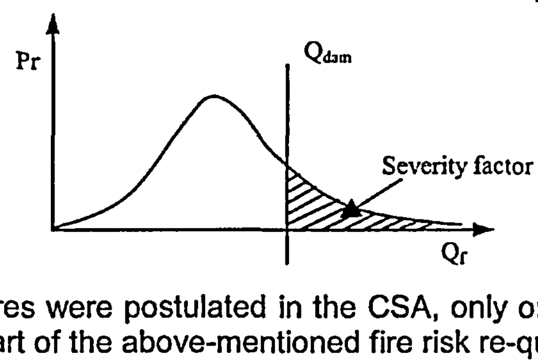
6.1.4 Severity Factors

The severity factor is defined as the probability of a fire reaching any heat release rate that generates target damage. This is a new definition that differs from the one used in EPRI's Fire PRA Implementation Guide (TR-105928 [4]). This new definition and approach for calculating severity factors is under development in an ongoing EPRI-NRC/RES fire risk re-quantification project. Millstone Unit 3 is a pilot plant in this project.

EPRI's TR-105928 [4] severity factors were not calculated based on the characteristics of each fire scenario. Instead, a predetermined value was assigned to any scenario occurring in a specific plant location having a specific ignition source (for example, switchgear room/electrical cabinet). In this context, the severity factor was defined as the conditional probability of fire reaching the heat release rate that generated damage. Since this probability was always the same for every fire scenario, the methodology did not capture the fact that all fire scenarios are different. That is, fire sizes of varying magnitude will have different probabilities of occurrence and can also generate damage.

With the above discussion serving as a short introduction, severity factors are calculated by finding the area under the probability density function (PDF) curve for the heat release rate (HRR), and to the right of the heat release rate that generates damage. This area is the probability of occurrence of a fire with at least the intensity required for target damage. Mathematically this is expressed as $\Pr(\dot{Q}_f > \dot{Q}_{dam})$, where Q_f is the random variable for fire intensity and Q_{dam} is the heat release rate required for damage. Figure 2 provides a conceptual representation of this method.

Figure 4: Conceptual representation of the use of a probability density function for heat release rate to determine severity factors



Since only transient fires were postulated in the CSA, only one PDF is necessary for calculating severity factors. As part of the above-mentioned fire risk re-quantification project, an expert panel assigned a gamma distribution with parameters with ά = 1.86 and ß = 53.7 to transient fires. The severity factor for each fire scenario is listed in Table 9.

Table 9: Severity factors for fire scenarios in CSA

Scenario	Critical HRR [kW]	Severity Factor
CSA1	1300	5.2E-10
CSA2	115	3.3E-01
CSA3	50	7.2E-01
CSA4	270	3.2E-02
CSA5	270	3.2E-02
CSA6	425	2.5E-03
CSA7	30	8.7E-01

6.1.5 Fire Detection and Suppression Analysis

The fire detection and suppression features in the CSA are credited in the fire frequency analysis in the form of a probability of no suppression. Two probabilities of no suppression are calculated for each postulated fire scenario for the purpose of evaluating the risk impact of changing the CO_2 system from automatic initiation to manual only initiation. Probabilities of no suppression are calculated based on the different times to target damage listed in section 6.1.3. for each fire scenario.

The detection-suppression analysis includes the following fire protection features in the CSA:

- Fire detection: Cross-zone fire detection system, and incipient fire detection system.
- Fixed fire suppression: Automatic or manual CO_2 fire suppression system.
- Manual fire suppression: Fire brigade and hotwork fire watch.

<u>Automatic CO_2 System Configuration</u>

Signals from the two cross-zones of detection are necessary for activating the CO_2 suppression system. Once activated, in the automatic configuration, after a 60 second delay, CO_2 discharge occurs. At this point, the CSA needs to be closed so that the suppression agent is effective. A soak time of 20 minutes is required before the room can be opened again. Once the room is opened, the fire brigade can proceed with additional manual suppression activities as needed.

Time results for each scenario assuming an automatic CO_2 system is summarized in Table 10. Time to CO_2 discharge was compared to target damage times. This comparison indicates that targets should be protected from fire damage. The suppression agent is expected to control the fire well before localized target damage occurs. The smoke detection response time was calculated using the correlation for estimating smoke detector response time described in NUREG 1805 [5], Draft Report for Comments. The time to CO_2 discharge is calculated by adding the delay time of 1 minute to the smoke detection response time.

The time to manual suppression by the fire brigade was determined by adding 20 minutes to the time of CO_2 discharge. The CO_2 suppression system, at a minimum, is expected to control or prevent fire growth. Therefore, the suppression agent will have the effect of increasing the available time for target damage. If the fire is not completely suppressed, the fire brigade can extinguish the remaining fire with available equipment. This would occur after the room has been closed for at least 20 minutes to allow suppression with CO_2. Manual fire fighting activities immediately after the room is open again will most likely require the use of portable breathing equipment. The time available for the fire brigade to extinguish any remaining fire is assumed to be half the time to target damage listed in Table 8 due to the suppression effects of the CO_2.

The probability of no suppression for each scenario is calculated multiplying the unreliability of the automatic CO_2 system times the probability of failure of the fire brigade. The unreliability of the CO_2 system is assumed to be 0.04 (NSAC 179L [6]). The probability of fire brigade failure is calculated from the cumulative distribution for transient fire durations documented in EPRI's Fire PRA Implementation Guide as follows:

- For general transient fire scenarios, the cumulative distribution curve for transient fire durations was evaluated as the time to target damage.

- For transient and cable fires caused by hotwork, the automatic CO_2 system would have been disabled and assumed to be operated manually. Therefore, suppression activities included prompt suppression by the fire watch, the fire brigade, and possibly by the manual actuation of the CO_2 system. The cumulative distribution curve for welding fires in EPRI's fire PRA Implementation Guide [4] is used for determining the probability of failed prompt suppression by the fire watch. For the purpose of this study, prompt suppression is defined as the ability of the fire watch to suppress a fire with portable fire extinguishers in less than 5 minutes. The probability of failure of fire brigade to suppress hotwork fires after failed attempts by the fire watch are calculated using the cumulative distribution curve for general transients, since at this point, the means of ignition are irrelevant. Furthermore, the hotwork curve in EPRI's Fire PRA Implementation Guide [4] appears to group primarily shorter duration fires together. No credit is given to the manual CO_2 system initiation or manual fire fighting for preventing room-wide damage.

Table 11 summarizes the probabilities of no suppression assuming an automatic CO_2 system in the CSA.

Table 10: Summary of detection and suppression time results assuming automatic CO2 system.

(Smoke detector response was calculated using a the model for estimating smoke detector response time described in NUREG 1805, Draft Report for Comments.)

Smoke Detection Analysis
Smoke Detector Response Correlation

Date: 3/16/2004
Analyst: Francisco Joglar

Inputs

Radiative fraction	0.3	
Room height [m]	6.4	
Fire elevation [m]	0	
Horizontal radial distance [m]	3.8	72 smoke detectors in 11284 ft^2 of floor area

Scenario	Input HRR [kW]	Cross Zoned Smoke Det T_{det} [sec]	Time to suppression [min] assuming auto CO_2: Auto CO_2	Time to suppression [min] assuming auto CO_2: Brigade	Time to damage [min]
CSA1	1300	7	1.1	20.1	11
CSA2	115	14	1.2	20.2	15
CSA3	50	18	1.3	20.3	15
CSA4	270	10	1.2	20.2	10
CSA5	270	10	1.2	20.2	5
CSA6	425	9	1.2	20.2	21
CSA7	30	21	1.3	20.3	4.6

Table 11: Summary of probability of no suppression results assuming automatic CO_2

Scenario	Time to damage [min]	Unreliability of Automatic CO2	Failure of manual Supp for Transients	Failure of manual Supp for Hotwork: Fire Watch	Failure of manual Supp for Hotwork: Fire Brigade	Pr(No Supp) Transient	Pr(No Supp) Hotwork
CSA1	11	0.04	0.7	0.12	0.6	2.8E-02	7.2E-02
CSA2	15	0.04	0.55	0.12	0.45	2.2E-02	5.4E-02
CSA3	15	0.04	0.55	0.12	0.45	2.2E-02	5.4E-02
CSA4	10	0.04	0.7	0.12	0.6	2.8E-02	7.2E-02
CSA5	5	0.04	0.9	0.12	1	3.6E-02	1.2E-01
CSA6	21	0.04	0.45	0.12	0.22	1.8E-02	2.6E-02
CSA7	4.6	0.04	0.9	0.12	1	3.6E-02	1.2E-01

Manual CO_2 System Configuration

In the case of a manual CO_2 system, a recon team will enter the CSA after a detection signal. At this point, preparation for manual fire suppression will begin and the possibility of use of the CO_2 will be assessed. If necessary, a member of the fire brigade will actuate the system after authorization from the Shift Manager is obtained. If it is determined that the CO_2 system is not necessary, manual fire suppression will proceed using hose streams or portable fire extinguishers. At some point during manual fire fighting activities, the fire brigade captain may determine that use of the CO_2 system is necessary. The event tree in Figure 5 captures these activities.

Figure 5: Event Tree for Suppression Activities in CSA Assuming Manual CO_2

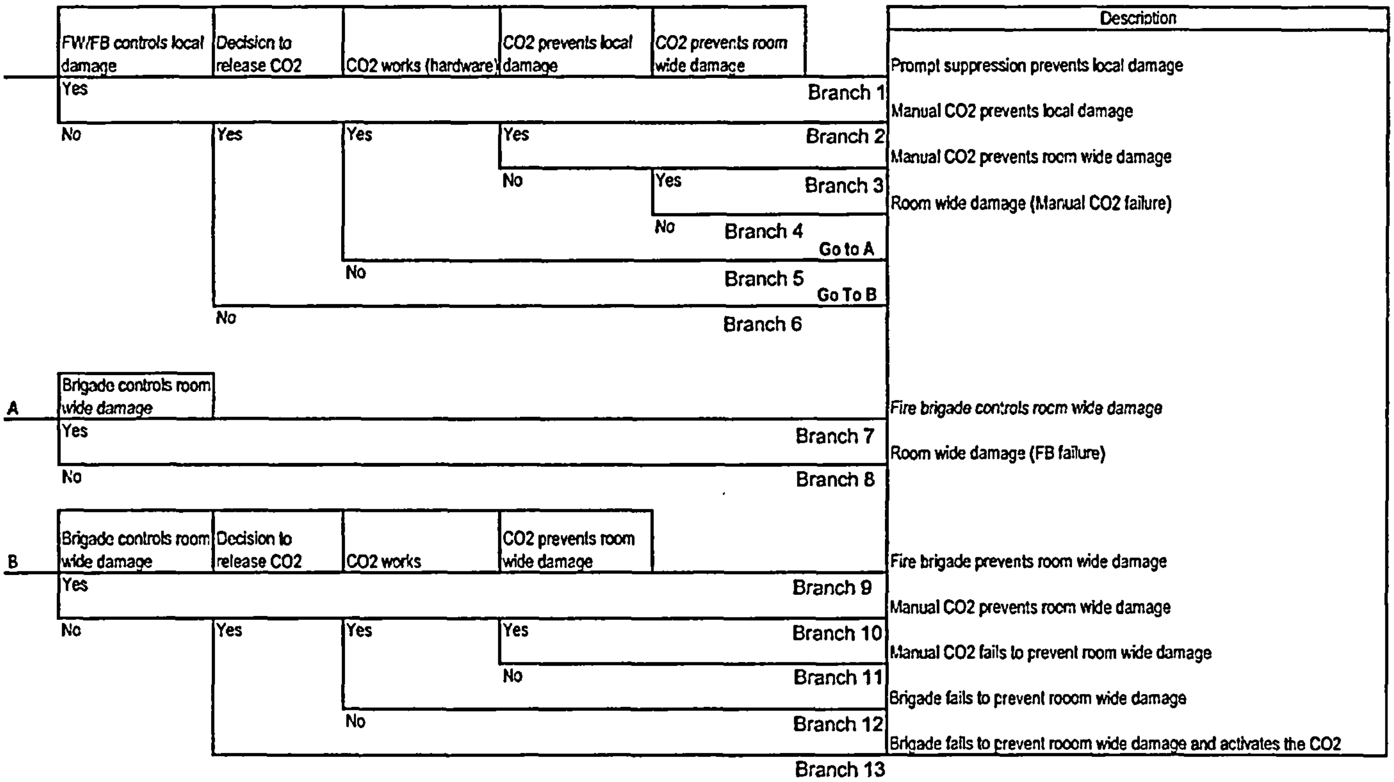


Figure 5 suggests that there are essentially three paths available for successful suppression of the fire:

1. Fire brigade only
2. Manual actuation of the CO_2 only
3. A combination of fire brigade and the manual actuation of the CO_2 system.

Based on fire brigade assessment, the fire brigade captain may decide to fight the fire manually or may decide to use the CO_2 system as conditions warrant.

Fire modeling calculations predicted relatively short target damage times. Therefore, the case of not actuating the manual CO_2 system before target damage is a realistic scenario. For that reason, two classifications for target damage have been included in the event tree: local damage, and room-wide damage. Local damage refers to the target set described in each fire scenario. The damage times for this target set are listed in Table 10. Room-wide damage refers to damage to additional targets in the room. The time for room-wide damage is assumed to be the time that the smoke layer reaches 330°C (625 °F), which is the damage temperature for IEEE-383 qualified cable. Given the relatively large size of the CSA, a fire in the order of 6MW burning for 45 minutes would generate such a smoke layer according to the MQH room temperature correlation in Five-REV1 (Table 12). The fire brigade will need to extinguish the fire or actuate the manual CO_2 system before 45 min after ignition in order to prevent room-wide damage.

Table 12: Five-Rev1 Analysis for Room Temperature

EPRI's Five-Rev1 Analysis
MQH Temperature Correlation

Date	3/25/2004
Analyst:	Francisco Joglar

Inputs		
Ambient temperature [C]	20	
Duration [sec]	2700	
Opening area [m^2]	2	
Height of opening [m]	2	
Room length [m]	33	
Room width [m]	33	
Room height [m]	6.4	
Thermal conductivity [kW/mK]	0.0014	
Density [kg/m3]	2000	
Specific heat [kJ/kg]	0.88	
Wall thickness [m]	0.3	
HRR [kW]	6000	
Results		
Room Temp [C]	361.5	683 (^oF)

Event tree nodes illustrated in Figure 5 are described as follows:

1. Fire watch/Fire brigade (FW/FB) controls local damage: This event refers to prompt actions by the fire brigade (or fire watch in the case of hotwork scenarios) to suppress local damage. Values are calculated using the cumulative distribution curves for fire duration in EPRI's Fire PRA Implementation Guide [4]. In the case of hotwork scenarios, prompt suppression by the fire watch is obtained multiplying the value resulting from the welding curve in 5 minutes by the value resulting from the transient curve in (t_{dam}-5 min), which is the remaining time after prompt suppression attempts. Notice that in the case of hotwork scenarios CSA5 and CSA7, no credit is given to the fire brigade since time to local target damage is approximately 5 min. In the case of transient fires, prompt suppression probabilities are calculated evaluating the cumulative distribution curve for transient combustibles in the time to target damage.

2. Decision to release CO_2: This event occurs twice in the event tree. In the first branch, it refers to the fire brigade deciding to release CO_2 based on their initial assessment of fire

conditions. The decision to release the gas is assumed to be highly unlikely at this time and a probability of failure of 1 has been assigned. In branch B however, this event refers to the fire brigade releasing the gas after fighting the fire for some time. Based on human reliability analysis (HRA), a value of 1.0E-2 is assigned to the probability of failure to actuate the manual CO_2 system. This value assumes that the brigade is fully aware of the fire conditions in the room and has decided that use of CO_2 is the best option.

3. CO_2 hardware works: This is the unreliability of the CO_2 system. NSAC 179L [6] recommends a value of 0.04.

4. CO_2 prevents local damage: Given that the hardware works, this event refers to an operator actuating the system in time to prevent local damage. This is a probability of a human action at the time of local damage. A value of 1.0 has been assigned to the probability of failure since local damage occurs at a relatively short period of time.

5. CO_2 prevents room-wide damage: Given the failure of preventing local damage, this event refers to an operator actuating the system in time to prevent room-wide damage. This is a probability of a human action at the time of room-wide damage. Notice that this event is also present in branch B of the event tree. In this case, the system is operated after the brigade has fought the fire for some time. The time assumed for the HRA calculation is 30 min. A value of 1.0E-3 has been assigned as the probability of failure to actuate the system in the available time.

6. Fire brigade controls room-wide damage: Given the failure of prompt suppression protecting local damage, this event refers to the fire brigade extinguishing the fire in 45 minutes or less. The cumulative distribution curve for transient fire duration in EPRI's Fire PRA Implementation Guide [4] is used to obtain this value.

Table 13 lists the probabilities of manual suppression failure used in the event tree.

Table 13: Probabilities of no suppression assuming brigade suppresses the postulated fire and no manual CO_2 is used (Prompt suppression)

Scenario	Time to damage [min]	Failure of Manual Supp for Transients	Failure of Manual Supp for Hotwork		Pr(No Supp)	Pr(No Supp)
			Fire Watch	Fire Brigade	Transients	Hotwork
CSA1	11	0.4	0.12	0.6	4.0E-01	7.2E-02
CSA2	15	0.2	0.12	0.45	2.0E-01	5.4E-02
CSA3	15	0.2	0.12	0.45	2.0E-01	5.4E-02
CSA4	10	0.45	0.12	0.6	4.5E-01	7.2E-02
CSA5	5	0.7	0.12	1	7.0E-01	1.2E-01
CSA6	21	0.18	0.12	0.22	1.8E-01	2.6E-02
CSA7	4.6	0.7	0.12	1	7.0E-01	1.2E-01

6.1.6 Scenario Frequency Determination

Fire scenario frequencies for transient fires are calculated using the following equation:

$\lambda_s = \lambda_g \cdot W_{is} \cdot W_g \cdot SF \cdot P_{ns}$, where

λ_g is the generic ignition frequency associated with a particular ignition source and is obtained from EPRI's TR-105928 [4]),

W_{is} is the ignition source-weighting factor. This factor is calculated as $1/N_c$ for hotwork fire scenarios where $N_c = 100$ is the total number of compartments in the plant. For general transient scenarios W_{is} is $(9/13)\cdot(1/N_c)$ to account for extension cords, overheating and heater fires.

W_g is the geometry-weighting factor. This factor is also referred to as the floor area ratio. It is conservatively assumed to be 0.15. Specifically, each transient fire occurring in a fixed 15% of the floor area will result in the consequences listed in each scenario.

SF is the severity factor

P_{ns} is the probability of no suppression.

Since all the postulated fire scenarios consist of transient fires, three different frequencies are calculated as follows:

1. Scenario frequency for general transients
2. Scenario frequency for transient fires caused by hotwork
3. Scenario frequency for cable fires caused by hotwork

Table 14 lists the frequencies of severe transient fires without the probabilities of no suppression. These are the initiating event frequencies for the event tree analysis, in which the probabilities of no suppression are accounted for. Note that the frequencies of the two hotwork scenarios are added together.

Table 14: Frequency of Severe Transient Fires.

These are the initiating event frequencies for suppression event trees.

Scenario	Description	λ_g	W_{fs}	W_g	SF	λ_{severe}
1a	Transient	1.3E-03	6.9E-03	1.5E-01	5.2E-10	7.0E-16
1b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	5.2E-10	2.8E-14
1c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	5.2E-10	
2a	Transient	1.3E-03	6.9E-03	1.5E-01	3.3E-01	4.5E-07
2b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	3.3E-01	1.8E-05
2c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	3.3E-01	
3a	Transient	1.3E-03	6.9E-03	1.5E-01	7.2E-01	9.7E-07
3b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	7.2E-01	3.9E-05
3c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	7.2E-01	
4a	Transient	1.3E-03	6.9E-03	1.5E-01	3.2E-02	4.3E-08
4b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	3.2E-02	1.7E-06
4c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	3.2E-02	
5a	Transient	1.3E-03	6.9E-03	1.5E-01	3.2E-02	4.3E-08
5b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	3.2E-02	1.7E-06
5c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	3.2E-02	
6a	Transient	1.3E-03	6.9E-03	1.5E-01	2.5E-03	3.4E-09
6b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	2.5E-03	1.4E-07
6c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	2.5E-03	
7a	Transient	1.3E-03	6.9E-03	1.5E-01	8.7E-01	1.2E-06
7b	Transient caused by HW	3.1E-02	1.0E-02	1.5E-01	8.7E-01	4.7E-05
7c	Cable fire caused by HW	5.1E-03	1.0E-02	1.5E-01	8.7E-01	

The fire scenario frequencies, which are calculated by multiplying the frequency of severe transient fires by the probability of no suppression, are listed in Table 15 for the cases of automatic and manual CO_2 actuation. In the case of manual actuations, the frequencies from the event tree in the 3rd, 7th, 9th, and 10th branch are added together. These are the branches where the manual system fails to protect the target set described in each scenario.

Table 15: Fire Scenario Frequencies

			Automatic CO_2 System		Manual CO_2 System	
Scenario	Description	λ_{severe}	Pr(No supp)	$\lambda_{scenario}$	Pr(No supp)	$\lambda_{scenario}$
1a	Transient	7.0E-16	2.8E-02	~0	Event tree	~0
1b	Transient caused by HW	2.8E-14	7.2E-02	~0	Event tree	~0
1c	Cable fire caused by HW					
2a	Transient	4.5E-07	2.2E-02	9.8E-09	Event tree	8.9E-08
2b	Transient caused by HW	1.8E-05	5.4E-02	9.6E-07	Event tree	9.6E-07
2c	Cable fire caused by HW					
3a	Transient	9.7E-07	2.2E-02	2.1E-08	Event tree	1.9E-07
3b	Transient caused by HW	3.9E-05	5.4E-02	2.1E-06	Event tree	2.1E-06
3c	Cable fire caused by HW					
4a	Transient	4.3E-08	2.8E-02	1.2E-09	Event tree	1.9E-08
4b	Transient caused by HW	1.7E-06	7.2E-02	1.2E-07	Event tree	1.2E-07
4c	Cable fire caused by HW					
5a	Transient	4.3E-08	3.6E-02	1.6E-09	Event tree	3.0E-08
5b	Transient caused by HW	1.7E-06	1.2E-01	2.1E-07	Event tree	2.1E-07
5c	Cable fire caused by HW					
6a	Transient	3.4E-09	1.8E-02	6.1E-11	Event tree	6.1E-10
6b	Transient caused by HW	1.4E-07	2.6E-02	3.6E-09	Event tree	3.6E-09
6c	Cable fire caused by HW					
7a	Transient	1.2E-06	3.6E-02	4.2E-08	Event tree	8.2E-07
7b	Transient caused by HW	4.7E-05	1.2E-01	5.7E-06	Event tree	5.7E-06
7c	Cable fire caused by HW					

6.2 Conclusions

The change from an automatically actuated CO2 system to a manually actuated system in the CSA does not result in a significant increase in the frequency of damaging fires. This conclusion is based on the following:

The CSA is a relatively large room.

Consequently, a large fire burning for an extended time period would have to occur before targets not directly within the fire plume can be damaged. This room configuration decreases the advantage of an automatically actuated fixed suppression system over one that is manually actuated.

There are very few fixed ignition sources in the CSA.

Specifically, only two electrical isolation panels and a number of junction boxes. These sources are not credited in the PRA in any accident mitigating sequence and are located far enough from any safety-related cable tray. Their contribution to fire risk is minimal. In terms of cables, the CSA has IEEE-383 qualified cable, significantly reducing the contribution of self-ignited cable fires to the risk profile of the room.

Based on the fire frequency results listed in Table 15, hot-work activities are the largest contributor to fire risk in the CSA.

Given this conclusion and the fact that the automatic CO_2 system would have been de-activated during hot-work operations in the CSA, the change from an automatic to manual CO_2 system would have a minimal impact on fire risk to the room.

The fire size, reflected in the risk analysis as the severity factor, dominates the fire frequency in some scenarios.

A relatively small fire would be capable of generating target damage in most scenarios. This results in a larger severity factor, which consequently increases the fire frequency. This is a conservative estimate because the CSA is equipped with a detection system capable of detecting fires in their incipient stage. Fire in this incipient stage can be characterized as smoldering or very small flaming fires (i.e., welding slags) not capable of damaging targets a short distance away. The duration of this stage is highly uncertain ranging from minutes to hours. Therefore, fires are expected to be detected before reaching relatively larger intensities in their growing or self-sustained stages, which are the ones postulated in fire modeling analyses.

A new fire protection strategy for the CSA has been developed in support of the change of the CO_2 system from automatic to manual actuation. [8]

A fire protection program that supports the change from an automatic to manual system has been developed. The program includes fixed and manual fire protection features including an incipient fire detection system and manual fire suppression equipment inside the room. The change from an automatic to a manual CO_2 system in the CSA does not have an impact on the fire hazards in the room. There will be no change in the amount of combustibles in the room after the change is made. In terms of safe shutdown, there is also no change in the ability to safely shut down the reactor and no new threat is introduced to the safe shutdown cables (e.g., degrading a protection system such as electrical raceway fire barrier system (ERFBS)). That is, the current configuration of safety related equipment would remain identical.

7. Design Review

Not applicable for this calculation.

8. Attachments

Attachment A: Zone of Influence for Isolation Panels in the CSA

Attachment A: Zone of Influence for Isolation Panels in the CSA

This Attachment summarizes the zone of influence (ZOI) calculations for the isolation panels in the CSA. The fire ZOI is defined as the region where a given target is expected to be damaged by fire-generated conditions. In general, the ZOI consists of five distinct fire-generated hazardous regions: flame, flame irradiation region, fire plume, ceiling jet, and the hot gas layer. The critical values (usually distances) that define the zone of influence are calculated using fire models listed in Appendix D of EPRI's Fire Modeling Guide [3], which summarizes the hand calculations automated in FIVE-Rev1. Specifically:

1. Target in Flame: A target should be considered inside a flame if a portion of it is located directly above the base of the fire and its distance from the base of the fire is less than the flame height. The flame height is calculated using Heskestad's flame height correlation.

2. Target in the Flame Irradiation Region: A fraction of the heat released by the fire is irradiated from the flame to its surroundings. The intensity of this heat flux decreases as the radial distance from the fire increases. The critical distance, defined as the distance from the center of the flame where the target would receive greater than its critical heat flux, is calculated using the point source fire irradiation model.

3. Target in the Fire Plume: Two distances are used to determine whether or not a target would be damaged when exposed to plume temperature: the target elevation above the fire, and the plume radius. The critical distance at which a target will be immersed in gas temperatures with a magnitude at least equal to its damage temperature is calculated using the Heskestad correlation for plume temperature.

4. Target in the Ceiling Jet: A horizontal radial distance from the centerline of the fire plume is used to determine if a target in the ceiling jet will be in contact with gases with temperatures at least equal to its damage temperature. This critical distance is calculated using Alpert's ceiling jet temperature correlation.

5. Target in the Hot Gas Layer: The heat release rate required to generate a hot gas layer with a temperature similar to the damage criteria of a target is estimated using the MQH correlation. This correlation requires the specification of the room geometry and natural ventilation. For totally enclosed rooms, it is recommended to assume 0.5" high leakage paths below the openings.

Figure A-1 provides a pictorial representation of the zone of influence. In addition, Tables A-1 to A-5 list the inputs and outputs of each fire modeling calculation.

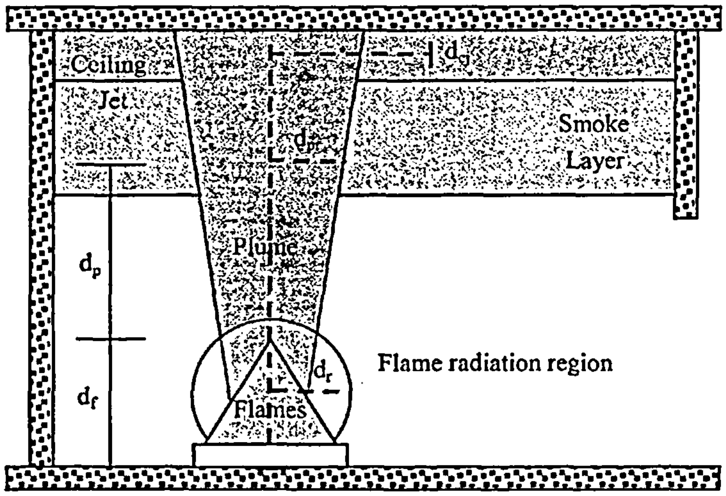


Figure 1: Fire zone of influence. d_p: critical distance for targets in the plume, d_{pr}: radius of the plume at the critical distance, d_f: flame height, d_{cj}: critical distance for targets in the ceiling jet, d_r: critical distance for targets subjected to flame radiation.

Table A-1: Calculation of the critical distance for target damage inside the flames

EPRI's Five-Rev1 Analysis
Heskdestad's Flame Height Correlation

Date	4/7/2004	
Analyst:	Francisco Joglar	
Inputs		
Fire diameter [m]	0.6	
HRR [kW]	725	
Results		
Flame height [m]	**2.7**	8.7 (ft)

Table A -2: Calculation of the critical distance for target damage inside the fire plume

EPRI's Five-Rev1 Analysis
Heskestad's Plume Temperature Correlation

Date	4/7/2004	
Analyst:	Francisco Joglar	
Inputs		
Ambient temperature [C]	20	
Fire location factor	1	
HRR [kW]	725	
Fire elevation [m]	0	
Target Elevation [m]	3.048	(10 ft)
Radiation Fraction	0.40	
Fire Diameter [m]	0.6	
Results		
Plume Temp [C]	**320**	(609 °F)

Table A -3: Calculation of the critical distance for target damage inside the ceiling jet

EPRI's Five-Rev1 Analysis
Alpert's Ceiling Jet Correlation

Date	4/7/2004	
Analyst:	Francisco Joglar	
Inputs		
Ambient temperature [C]	20	
Fire location factor	1	
HRR [kW]	725	
Fire elevation [m]	0	
Room height [m]	6.4	
Horizontal radial distance [m]	0.09144	
Results		
Ceiling Jet Temp [C]	**336**	637

Table A-4: Calculation of the critical distance for targets subjected to flame radiation

EPRI's Five-Rev1 Analysis
Point Source Flame Radiation Model

Date 4/7/2004
Analyst: Francisco Joglar

Inputs	
Fire heat release rate [kW]	725
Radiation fraction	0.40
Distance from flames [m]	1.46
Results	
Heat flux [kW/m2]	**11**

Table A-5: Smoke layer temperature generated by a 725 kW fire burning for 20 min inside the CSA.

EPRI's Five-Rev1 Analysis
MQH Temperature Correlation

Date 3/12/2004
Analyst: Francisco Joglar

Inputs		
Ambient temperature [C]	20	
Duration [sec]	1200	
Opening area [m2]	2	
Height of opening [m]	2	
Room length [m]	33	
Room width [m]	33	
Room height [m]	6.4	
Thermal conductivity [kW/mK]	0.0014	
Density [kg/m3]	2000	
Specific heat [kJ/kg]	0.88	
Wall thickness [m]	0.3	
HRR [kW]	725	
Results		
Room Temp [C]	94	201 (^{o}F)

The results of this zone of influence calculations are summarized in Table 1 in the body of the calculation file.

ATTACHMENT 4

MILLSTONE POWER STATION, UNIT 3
LICENSE AMENDMENT REQUEST REGARDING A CHANGE TO THE FIRE PROTECTION PROGRAM (TAC NO. MB8731)
MARKED UP PAGES

D. Exemptions from certain requirements of Appendix J 10 CFR Part 50 (Section 6.2.6; SSER 4) and from a portion of the requirements of General Design Criterion 4 (Section 3.9.3.1, SSER 4) of Appendix A to 10 CFR Part 50 have previously been granted. See Safety Evaluation Report Supplement 4, November 1985. With these exemptions the facility will operate, to the extent authorized herein, in conformity with the application, as amended, the provisions of the Act, and the rules and regulations of the Commission.

E. Dominion Nuclear Connecticut, Inc. shall fully implement and maintain in effect all provisions of the Commission-approved physical security, guard training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The plans, which may contain Safeguards Information protected under 10 CFR 73.21, are entitled: "Millstone Power Station Physical Security Plan," with revisions submitted through March 29, 1988; "Millstone Power Station Suitability, Training and Qualification Plan," with revision submitted through July 21, 1986; and "Millstone Power Station Safeguards Contingency Plan," with revisions submitted through October 30, 1985. Changes made in accordance with 10 CFR 73.55 shall be implemented in accordance with the schedule set forth therein.

F. Except as otherwise provided in the Technical Specifications or Environmental Protection Plan, Dominion Nuclear Connecticut, Inc. shall report any violations of the requirements contained in Section 2.C of this license in the following manner: initial notification shall be made within 24 hours to the NRC Operations Center via the Emergency Notification System with written followup within thirty days in accordance with the procedures described in 10 CFR 50.73(b), (c) and (e).

G. The licensees shall have and maintain financial protection of such type and in such amounts as the Commission shall require in accordance with Section 170 of the Atomic Energy Act of 1954, as amended, to cover public liability claims.

remove parenthetical expression due to redundancy

H. Fire Protection ~~(Section 9.5.1, SER, SSER 2, SSER4, SSER5)~~

Dominion Nuclear Connecticut, Inc. shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report for the facility and as approved in the SER (NUREG-1031) issued July 1984 and Supplements Nos. 2, 4, and 5 issued September 1985, November 1985 and January 1986, respectively, subject to the following provision: s

The cable spreading area carbon dioxide fire suppression system will be a manually actuated system as described in SER dated (Insert new date).

The licensee may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

I. This license is effective as of the date of issuance and shall expire at Midnight on November 25, 2025.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by H.R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Attachments/Appendices:
1. Appendix A - Technical Specifications (NUREG-1176)
2. Appendix B - Environmental Protection Plan
3. Appendix C - Additional Conditions

Date of Issuance: January 31, 1986