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L-16-058

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
Supplemental Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805 (CAC Nos. MF3301 and MF3302)

By letter dated December 23, 2013 (Accession No. ML14002A086), as supplemented by letters dated February 14, 2014; April 27, 2015; May 27, 2015; June 26, 2015; November 6, 2015; and December 21, 2015 (Accession Nos. ML14051A499, ML15118A484, ML15147A372, ML15177A110, ML15313A306, and ML15356A136, respectively), FirstEnergy Nuclear Operating Company (FENOC) submitted a license amendment request to change the Beaver Valley Power Station, Unit Nos. 1 and 2, fire protection program to one based on the National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition.

In previous responses to Nuclear Regulatory Commission (NRC) questions during the review process, FENOC indicated that revisions to specific items in the license amendment request would be provided in future submittals. The enclosure to this letter replaces, in its entirety, Attachment L - NFPA 805 Chapter 3 Requirements for Approval, which was submitted in the December 23, 2013 letter.

The information provided by this submittal does not invalidate the significant hazards consideration analysis provided in the December 23, 2013 letter.

There are no regulatory commitments included in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager - Fleet Licensing, at (330) 315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 24, 2016.

Sincerely,

Marty L. Richey

Enclosure: Attachment L – NFPA 805 Chapter 3 Requirements for Approval

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Enclosure
L-16-058

Attachment L – NFPA 805 Chapter 3 Requirements for Approval

(52 pages follow)

L. NFPA 805 Chapter 3 Requirements for Approval (10 CFR 50.48(c)(2)(vii))

51 Pages Attached

Approval Request 1

NFPA 805 Section 3.3.5.1 states:

"Wiring above suspended ceilings shall be kept to a minimum. Where installed, electrical wiring shall be listed for plenum use, routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers."

The BVPS-1 and BVPS-2 locations listed below contain wiring above suspended ceilings that does not comply with NFPA 805 Section 3.3.5.1. FENOC requests NRC approval for the wiring above suspended ceilings in the subject locations as an acceptable variance from the requirements of NFPA 805 Chapter 3. For the purpose of this request, the electrical terms wiring, cable(s), and cord(s) are used synonymously.

This request is applicable for the following locations:

Unit 1 Primary Auxiliary Building Elevation 768'-7" (1-PA-1A)
- Containment Access Building (C.A.B.)
- Measuring & Test Equipment (M&TE) Issue Room

Unit 1 Service Building (1-SB-GEN)
- Elevation 735'-6"
  - Hot Chemistry Lab
  - Various Offices
- Elevation 752'-6"
  - Work Execution Center (WEC)
  - Outage Central
  - Various Offices

Unit 1 Turbine Building Elevation 735'-6" (1-TB-1)
- Chemistry Office
- Cold Chemistry Lab
- Various Offices

Unit 1 Warehouse Elevation 735'-6" (1-WH-1)
- "Fix It Now" Offices
- I&C Calibration Room
- I&C Shop
- Various Offices

Unit 2 Condensate Polishing Building Elevation 774'-6" (2-CP-1)
- Chemistry Lab
- Chemistry Office
- Various Offices

Unit 2 Turbine Building Elevation 774'-6" (2-TB-1)

- Office

Unit 2 Waste Handling Building (2-WH-1)
- Elevation 774'-6"
  - Health Physics
  - Various Offices
- Elevation 786'-6"
  - Health Physics
  - Various Offices

Unit 2 Primary Auxiliary Building Elevation 773'-6" (2-PA-5)
- Containment Access Building (C.A.B.)

Unit 1 & Unit 2 Control Room at elevation 735'-6" (3-CR-1)

Unit 2 Computer Room at elevation 735'-6" (2-CB-4)

Basis for Request:

It has been confirmed from selected plant walkdowns and above-ceiling surveys that there are minimal amounts of cables located above suspended ceilings that may not be in compliance with NFPA 805 Section 3.3.5.1. This request is based on the assumption that some exposed cables above suspended ceilings are not listed for plenum use or routed in armored cable, routed in metallic conduit, or routed in cable trays with solid metal top and bottom covers. These are referred to as "unqualified" cables in this request. The types of cables identified above suspended ceilings mainly consist of low voltage cables such as communication, lighting, and network type cables. However, in a few compartments there were also power, control, and instrumentation cables identified. Although power cables at BVPS are IEEE-383 qualified (or equivalent), it is undetermined whether the other cable types meet IEEE-383 or other qualification standards; therefore, these cables are assumed to be "unqualified" in terms of combustibility.

The term "compartment" is used to refer to the number- letter designations above (e.g. 3-CR-1) consistent with the detailed fire modeling that has been performed. The term "location" is used to describe the room or area within the compartment that contains the wiring above the suspended ceilings.

With the exception of the Control Room (3-CR-1), Unit 1 Turbine Building (1-TB-1) and Unit 2 Turbine Building (2-TB-1), the compartments in the scope of this request either contain no risk-significant PRA components or they are not risk-significant because the effect of "unqualified" cables is bounded by the assumption of whole room damage in the Fire PRA, including all Safe Shutdown (SSD)/Fire PRA targets (components and cables). Detailed fire modeling was therefore unnecessary in these compartments.

There were some non-risk significant compartments identified that contain other types of cables above suspended ceilings in addition to the low voltage communication, lighting, and network type cables. These compartments include the following:

Unit 1 Warehouse (1-WH-1)

- Other cables types identified:
  - Power and control cable trays routed above some internal offices and shops

Unit 1 Service Building General Areas (1-SB-GEN)

- Other cable types identified:
  - Temporary low-voltage (i.e., 120 VAC) power receptacle extension cord in an office area
  - Power cable (120 VAC) for projectors in office areas

Unit 2 Condensate Polishing Building (2-CP-1)

- Other cable types identified:
  - Temporary low-voltage (i.e. 120 VAC) power receptacle extension cord in the chemistry lab

Unit 2 Waste Handling Building (2-WH-1)

- Other cable types identified:
  - Power cable (120 VAC) for a projector in an office area

1-WH-1, 1-SB-GEN, 2-CP-1, and 2-WH-1 are not risk-significant compartments and were conservatively modeled by assuming whole room damage. Thus, the presence of these potentially "unqualified" power type cables in addition to the communication, lighting, and network type cables will not preclude the capability to achieve the nuclear safety performance criteria of NFPA 805 Section 1.5. Note that the other cable types identified above may also be present in other non-risk significant office type areas within BVPS. However, they would also be bounded by assuming whole room damage and the presence of the cables would not preclude the capability to achieve the nuclear safety performance criteria.

Detailed Fire Modeling was completed in compartments 3-CR-1, 1-TB-1, and 2-TB-1. In 1-TB-1 and 2-TB-1 the cables above suspended ceilings are located in office type areas and are not in the vicinity of SSD/Fire PRA targets (components and cables), and as such, there is reasonable assurance that a fire involving the unqualified cables above suspended ceilings in these compartments would not damage or otherwise adversely affect SSD/Fire PRA targets. Based on this information, the only risk-significant compartment with potentially unqualified cables in the vicinity of SSD/Fire PRA targets of those listed as part of this request is the control room.

Within the control room, there are also other cable types above the suspended ceiling in addition to the low voltage communications, lighting, and network type cables. From visual inspection of locations above the control room suspended ceiling, many conduits were identified that include both control and instrumentation cables that may not be IEEE-383 (or equivalent) qualified. Although not confirmed, some conduits above the suspended ceiling may also contain power cables, which would be IEEE-383 (or equivalent) qualified. Visual inspections revealed that the majority of lighting

cables are armored or located within conduit. In general, power, instrumentation, and control cables located above the control room suspended ceiling are routed in conduit, with the exception of short sections of cable that may be exposed at the end of the conduit.

The presence of potentially "unqualified" cables above suspended ceilings will not preclude the capability to achieve the nuclear safety performance criteria of NFPA 805 Section 1.5. Defense-in-depth is also achieved in accordance with NFPA 805 Section 1.2, thus meeting the intent of NFPA 805 Section 3.3.5.1. The technical basis for the request is as follows:

Limited Ignition Sources:

Based on walkdowns and above-ceiling surveys in the subject plant areas, fixed ignition sources located in the space above the suspended ceilings are limited to small hazards such as communication, lighting, and network cables. These types of cables were determined to be low voltage, which are not prone to heat-generating overload faults and are not required to achieve the nuclear safety performance criteria.

Per Fire Probabilistic Risk Assessment (PRA) Frequently Asked Question (FAQ) 13-0005 (Accession Number ML13319B181), experience has shown that in the unlikely event of a self-ignited cable tray fire, the fire is not expected to spread beyond the cable tray of fire origin. Based on this and the guidance provided in Appendix R, "Cable Fires," to NUREG/CR-6850, self-ignited fixed cable fires were screened as non-challenging ignition sources in the fire modeling reports. The EPRI fire events database shows that self-ignitable tray fires have only led to localized failures in a small number of cables within a single raceway. No event has led to sustained open flaming fires, or damage to cables beyond the initially impacted raceway. Therefore, the presence of a limited number of potentially unqualified low voltage type cables above suspended ceilings in the identified compartments does not introduce any additional challenging ignition sources.

Table S-3 of the LAR includes implementation item BV1-2823, which will revise plant administrative procedures to ensure that all future cable installations above suspended ceilings comply with the requirements of NFPA 805 Section 3.3.5.1.

Detection and Suppression:

The fire protection systems and features serving each of the compartments that are included in this request are summarized below.

3-CR-1 (control room): This compartment is continuously occupied by operators, from which fire brigade response can be immediately initiated. Portable fire extinguishers are provided in this compartment and hose racks are provided in adjacent stairwells. Automatic detection is provided above and below the suspended ceilings.

1-PA-1A:

- Detection: Early warning ionization smoke detectors with partial area coverage and audible alarms sounding locally and in the control room.
- Suppression: A deluge system is installed over the Main Exhaust Filter Banks and a partial area wet pipe suppression system is installed over the western

portion of the fire compartment. There are portable fire extinguishers and hose racks positioned in the area.

1-SB-GEN:

- Detection: None.
- Suppression: An automatic suppression system is installed at the ceiling of the PCA Shop. There are portable fire extinguishers and hose racks located in the area.

1-TB-1:

- Detection: None.
- Suppression: An automatic CO2 suppression system is installed to suppress fires in the turbine bearings and generator area, which is actuated by heat detectors in the same location. There are portable fire extinguishers and fire hose racks located in the area.

1-WH-1:

- Detection: None.
- Suppression: An automatic suppression system is installed in the area. There are portable fire extinguishers and hose racks located in the area.

2-PA-5:

- Detection: Early warning ionization smoke detectors with audible alarms locally and in the control room. Heat detectors located inside the Charcoal Filter Banks.
- Suppression: There are portable fire extinguishers and hose racks located in the area. Also, there is a water spray system for the SLCRS Charcoal Filters.

2-CP-1:

- Detection: Automatic sprinkler flow alarms in Chemistry lab elevator walkway. Heat Detectors installed for Charcoal Filter.
- Suppression: An automatic suppression system is installed in the Chemistry lab and walkway near the elevator. There are portable fire extinguishers and hose racks located in the area.

2-TB-1:

- Detection: None.
- Suppression: An automatic CO2 suppression system is installed to suppress fires in the turbine bearings and generator area, which is actuated by heat detectors in the same location. There are portable fire extinguishers and fire hose racks located in the area.

2-WH-1:

- Detection: None.

- Suppression: An automatic wet pipe sprinkler system is installed in the area. There are portable fire extinguishers and fire hose racks located in the area.

2-CB-4:

- Detection: Early warning ionization smoke detectors with audible alarms are installed in the area. Additionally, smoke detectors are installed that provide alarm and actuation of the Halon system.
- Suppression: An automatic Halon system is installed in the area. Additionally, there are portable fire extinguishers located in the area and hose racks are available in the stairwells.

Propagation of Fire through Ventilation:

It has been determined that fire above or below a suspended ceiling would not likely result in propagation of fire via the ventilation system(s). As described above, with the exception of 3-CR-1, 1-TB-1, and 2-TB-1, these compartments are not risk-significant locations as they either do not contain risk-significant PRA equipment/cables or all the SSD/Fire PRA targets (components and cables) are assumed to be damaged by a fire in these locations and have minimal risk impact. All compartments that are adjacent to and potentially exposed by these locations were also reviewed as part of the Fire PRA Multi-Compartment Analyses. It was determined that in all cases, there is acceptably low risk to the nuclear safety performance criteria.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

Detailed Fire Modeling was completed in compartments 3-CR-1, 1-TB-1, and 2-TB-1. In 1-TB-1 and 2-TB-1 the cables above suspended ceilings are located in office type areas and are not in the vicinity of SSD/Fire PRA targets (components and cables), and as such, there is reasonable assurance that a fire involving the unqualified cables above suspended ceilings in these compartments would not damage or otherwise adversely affect SSD/Fire PRA targets. Based on this information, the only risk-significant compartment with potentially unqualified cables in the vicinity of SSD/Fire PRA targets of those listed as part of this request is the control room.

From visual inspection of the control room and review of the Fire PRA Database, it was determined that the vast majority of SSD/Fire PRA cables are routed up through the floor into the control room and are not routed above the suspended ceiling. Based on walkdowns and above-ceiling surveys in the control room, fixed ignition sources located in the space above the suspended ceiling are limited to small hazards such as communication, lighting, and network cables. These types of cables were determined to be low voltage, which are not prone to heat-generating overload faults and are not required to achieve the nuclear safety performance criteria. The SSD/Fire PRA cables and the majority of the power, control, and instrumentation cables located above the suspended ceiling were determined to be routed in metal raceways, with the exception of short sections of cable that may be exposed at the of the conduit. Additionally, the

control room suspended ceiling is not an entirely enclosed ceiling and the suspended ceiling tiles are of an open grid type (i.e., egg-crate design). Thus, if a fire were to occur above the suspended ceiling, it would be readily detected by operators who are located within the control room at all times.

Any NSCA-credited cables that are routed above a suspended ceiling are assumed to be fire-damaged in the NSCA as appropriate, and Variations from Deterministic Requirements (VFDRs) are evaluated as necessary. The fire risk evaluations that were performed determined that the VFDRs identified are acceptable based upon:

1. The measured change in CDF and LERF
2. Adequate defense in depth and maintaining safety margins

The cables above the suspended ceilings also have no adverse impact on the radiological release performance criteria. The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Attachment E), which is not affected by cables above the suspended ceilings that do not comply with the requirements specified in NFPA 805 Section 3.3.5.1.

Safety Margin and Defense-in-Depth:

Exposed, non-plenum-rated electrical wiring located above suspended ceilings is minimal and is well dispersed, such that it will not threaten components that are necessary for nuclear safety capability. Therefore, the safety margin inherent in the analysis for the event of a fire has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1: Hot work controls and the lack of significant fixed ignition sources in the locations above the suspended ceilings will limit the possibility of fires in these locations.

Echelon 2: Automatic detection and suppression systems serving the compartments have been listed above. Additionally, manual detection and fire brigade manual suppression capability will limit fire damage in these locations. Fire rated barriers between fire areas limit the spread of fire above the suspended ceilings.

Echelon 3: VFDRs were evaluated and found acceptable in accordance with NFPA 805, Section 4.2.4.2, "Performance based approach – fire risk evaluation with simplifying deterministic assumptions."

A reasonable balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

FENOC requests NRC approval for low voltage cables such as communication, lighting, and network type cables above suspended ceilings in the subject locations as an acceptable variance from the requirements of NFPA 805 Chapter 3. Based on the assessment above, the level of risk is acceptable because the configurations:

(A) Satisfy the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintain safety margins; and

(C) Maintain fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 2
NFPA 805 Section 3.3.12(1) states:

"The oil collection system for each reactor coolant pump shall be capable of collecting lubricating oil from all potential pressurized and non-pressurized leakage sites in each reactor coolant pump oil system."

NFPA 805 Section 3.3.12(4) states:

"Leakage points on a reactor coolant pump motor to be protected shall include but not be limited to the lift pump and piping, overflow lines, oil cooler, oil fill and drain lines and plugs, flanged connections on oil lines, and the oil reservoirs, where such features exist on the reactor coolant pumps."

The underlying purpose of 10 CFR Part 50, Appendix R, Section III.O and NFPA 805, Section 3.3.12 is to ensure that failure of the Reactor Coolant Pump (RCP) lube oil system will not cause a fire during normal or design basis accident conditions and that there is reasonable assurance the system will withstand the Safe Shutdown Earthquake. The intention of the regulation is for licensees to accomplish this by extending the concept of defense-in-depth to fire protection in fire areas essential to nuclear safety performance criteria.

An approval is requested for BVPS-1 and BVPS-2 RCP oil collection systems (OCS) from the requirements of NFPA 805 Section 3.3.12(1) and 3.3.12(4), in that the RCP oil misting is not captured within the originally approved OCS 10 CFR Part 50 Appendix R review. The RCP, steam generator, and piping associated with each of the three reactor coolant loops are partitioned from one another at various levels by radial reinforced concrete walls positioned approximately 120 degrees from adjacent radial walls. Oil collection pans with spray shields and enclosures for the RCP lubricating oil system are provided. This design is intended to prevent the RCP lubricating oil system from becoming a potential source of fire. Appendix R, Item III.O of 10 CFR Part 50 requires that the RCP be equipped with an OCS to mitigate the fire hazard associated with the RCP lubricating system. BVPS-1 and BVPS-2 have installed stainless steel shrouds to encompass each of the following potential oil discharge points: upper bearing assembly, oil cooler assembly, lower bearing assembly, oil lift pump motor assembly, motor catch basin assembly, and oil retention ring.

These shrouds will catch oil leakage that may be sprayed from these points. The associated drain lines are large enough to accommodate the largest anticipated oil leakages. Each of the three RCPs has an oil collection tank that can accommodate the entire oil capacity of its associated RCP (320 gallons for BVPS-1 and 300 gallons for BVPS-2). In BVPS-1, the tank is located at the 692'-11" elevation and in BVPS-2, the tank is located at the 718'-6" elevation in their respective Containment Buildings. A flame arrestor/vent assembly continuously vents each oil collection tank to containment. The RCP OCS is seismically supported and has been designed to accommodate the differential movement of the reactor coolant loops. The RCP OCS was designed and

reviewed in accordance with 10 CFR Part 50, Appendix R, Section III.O for BVPS-1 and Section C.7.a of BTP CMEB 9.5.1 for BVPS-2 to collect leakage from pressurized and non-pressurized leakage sites in the RCP OCS. The RCP OCS design and installation was approved for BVPS-1 in NRC SER, dated June 6, 1979, and approved for BVPS-2 in NUREG-1057, dated October 1985. The NRC approval did not discuss the collection of oil mist.

Basis for Request:

RCP motors are large and will consume oil during the course of normal operation. Large motors tend to lose some oil due to heat through the seals, and the oil potentially will become atomized in the ventilation system. The previously approved RCP OCS's are designed and sized to collect and contain oil from potential pressurized and non-pressurized leakage areas in a seismic event resulting in failure of the lubrication system. The OCS design cannot wholly contain the atomized oil mist, as its design is not completely sealed in order to permit adequate air cooling for safe motor operation. A design change to a completely sealed motor of this size would be a significant modification that would contribute little to reducing fire risk.

The oil mist resulting from normal operation can accumulate on surfaces in the vicinity of the RCP and motor and will not adversely impact the ability of a plant to achieve safe and stable conditions even if ignition occurs. The quantity of oil that may be found in areas of the Containment Building due to the RCP oil vapor mist is very small and does not contribute significantly to fire loading nor create potential fire propagation between fire compartments.

In addition, Generic Letter 86-10, "Response to Industry Questions," dated April 24, 1986, Question 6.2 (presented below) discussed oil dripping. The response concluded that there was no concern with oil consumption (which is an oil misting phenomena) but the primary concern was with an oil fire started from a pressurized leakage point and/or spilled leakage.

Question 6.2 states:

It would appear that a literal reading of Section III.O regarding the oil collection system for the reactor coolant pump could be met by a combination of seismically designed splash shields and a sump with sufficient capacity to contain the entire lube oil system inventory. If the reactor coolant pump is seismically designed and the nearby piping hot surfaces are protected by seismically designed splash shields such that any spilled lube oil would contact only cold surfaces, does this design concept conform to the requirements of the rule?

The response states:

If the reactor coolant pump, including the oil system, is seismically designed and the nearby hot surfaces of piping are protected by seismically designed splash shields such

that any spilled lube oil would contact only cold surfaces, and it could be demonstrated by engineering analysis that sump and splash shields would be capable of preventing a fire during normal and design basis accident conditions, the safety objective of Section III.O would be achieved. Such a design concept would have to be evaluated under the exemption process. The justification for the exemption should provide reasonable assurance that oil from all potential pressurized and unpressurized leakage points would be safely collected and drained to the sump. The sump should be shown capable of safely containing all of the anticipated oil leakage. The analysis should verify that there are no electric sources of ignition.

Historically, there have been no fires attributed to oil misting based on normal operation in the industry. Fires have occurred due to oil leakage from equipment failure such as cracked welds on piping or inadequate collection pan design. Beaver Valley does not have a history of significant oil loss from the RCPs as a result of oil misting or oil leakage that is not contained by the properly designed and installed OCS.

- The OCS as designed complies with 10 CFR 50, Appendix R, Section III.O and was approved to collect leakage from pressurized and non-pressurized leakage sites in the RCP oil system.
- Oil misting from normal operation is not leakage; it is normal motor oil consumption.
- Oil misting from normal operation does not significantly reduce the oil inventory.
- Oil misting does not account for an appreciable heat release rate or accumulation near potential ignition sources or non-insulated reactor coolant piping.
- The RCPs use synthetic oil having a high flash point in excess of 400 degrees Fahrenheit. This temperature is well above the expected design surface temperature (150 degrees Fahrenheit) of any of the mirror insulation and other small components that the vaporized oil might contact.
- The RCP piping is covered with metal mirror insulation which will not absorb/accumulate oil mist in quantities that will create a fire ignition source.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The nuclear safety performance criteria are met because redundant reactor coolant pumps (RCPs) are available as necessary and the RCPs are not required to achieve or maintain post-fire safe shutdown.

The radiological release performance criteria are met because (1) the entire Containment Building during power operations is an environmentally sealed radiological area, (2) the potential for oil mist from the RCPs does not change the radiological release evaluation performed for each fire zone where potentially contaminated water and smoke is contained and monitored, (3) the oil mist does not add additional radiological materials to the area or challenge systems boundaries that contain such materials, and (4) fire brigade control of water runoff and smoke is not hindered

because of the existence of the misting.

Safety Margin and Defense-in-Depth:

Oil mist resulting from normal operation will not adversely impact the ability of a plant to achieve and maintain post-fire safe shutdown, even if ignition occurs. There are redundant RCPs to achieve and maintain safe and stable conditions, if required; therefore, the safety margin inherent in the analysis for the event of a fire has been preserved. The potential for oil mist from the RCPs does not directly result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is maintained by the oil collection system and by the reactor coolant pump design, and is not adversely affected by this configuration. The introduction of small amounts of oil misting does not adversely affect Echelons 2 and 3. The oil misting does not result in compromising fire detection, automatic or manual fire suppression functions, or post-fire safe shutdown capability.

A balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for the potential of oil misting from the present configuration of Beaver Valley's RCPs OCS due to normal consumption and not captured by the OCS that is designed for pressurized and non-pressurized leakage and spillage. As discussed above, oil misting does not create an ignition source within the Containment Building requiring modification to the previously approved OCS that fully complies with 10 CFR 50, Appendix R, Section III.O. No fires have occurred in the BVPS-1 and BVPS-2 Containments as a result of RCP oil misting during the accumulated years of RCP operation.

BVPS has determined that the performance-based approach satisfies the following criteria:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 3
NFPA 805 Section 3.5.11 states:

"Means shall be provided to isolate portions of the yard fire main loop for maintenance or repair without simultaneously shutting off the supply to both fixed fire suppression systems and fire hose stations provided for manual backup. Sprinkler systems and manual hose station standpipes shall be connected to the plant fire protection water main so that a single active failure or a crack to the water supply piping to these systems can be isolated so as not to impair both the primary and backup fire suppression systems."

The underlying purpose of NFPA 805, Section 3.5.11 is to ensure that there is available water supply for suppression (automatically or manually) after isolation for maintenance, or during a repair of the fire protection supply piping. A Duquesne Light letter dated October 27, 1976, stated in the response for BTP Position IV C.2.a:

The fire protection underground yard loop has been installed using NFPA 24 as a guide and found satisfactory by the NELPIA inspector.... Approved post indicator valves (PIVs) are installed to provide isolation capability of the underground loop.... BVPS 1 is in compliance with this position.

Maintenance or repair activities can be performed by isolating a portion of the loop.

In addition, BTP Position IV C.3.a states in part:

Each automatic sprinkler and manual hose station should have an independent connection to the plant underground water main.

The BVPS-1 response states:

The manual hose rack system for the fuel building and auxiliary building have separate independent connections to the yard underground main. The hose rack systems for the service building, warehouse areas, auxiliary bay, and turbine building can be fed from two different yard underground sources. The sprinkler system headers in the turbine building and new warehouse can be fed from two different yard underground connections. The sprinkler system header in the old warehouse has only one connection to the underground yard main, however, all areas serviced by this header have backup water hose racks from another yard connection or backup protection from outside hydrants.

Amendment No.18 to the BVPS-1 facility Operating License No. DPR-66 dated June 6, 1979, Section 4.3.1.3 "Fire Water Piping System" states:

Post Indicator type valves are strategically located along the fire loop which provides sectionalized control and isolation of portions of the fire main loop....The arrangement

of the sectionalizing valves insure that a single break in the system will not deprive water supply to both primary and secondary protection systems in the fire zone.

The intention of the regulation is for licensees to accomplish the above by extending the concept of defense-in-depth to fire protection in fire areas essential to nuclear safety.

Basis for Request:

BVPS-1 meets the current license condition by providing sectionalizing valves to isolate individual buildings and zones. This BVPS-1 request addresses the issue that depending on the location of isolation or repair, such as locations in the Auxiliary Building and Safeguards Area, a single active failure or a crack in the interior fire protection water supply piping may not be isolable without impairing both the primary fixed suppression and the backup manual fire hose stations because both are supplied by the same internal water supply header. However, portions of the system can be isolated with the available sectionalizing valves in combination with other compensatory measures to restore suppression capabilities to the area or zone, with the use of staged temporary fire hoses or through bypassing the isolated portion of piping with fire hoses.

As an example, a single active failure or piping crack in the interior building fire protection header in the Auxiliary Building can eliminate water supply for both the standpipe system as well as the fixed fire suppression systems to the Component Cooling Pumps area and the Waste Storage areas.

Therefore, depending on the section of piping being isolated for maintenance or repair, there are locations in BVPS-1 where the arrangement of valves on the outdoor fire mains in combination with the valves on the interior building does not meet the specific requirement of NFPA 805 Section 3.5.11, such that a single active failure or piping crack can be isolated without shutting off the supply to both primary and backup fire suppression in a particular zone or area.

The BVPS-1 Fire Protection water supply headers are located inside buildings, and these headers supply both fixed fire suppression systems and the standpipes supplying the manual hose stations. Many of the internal headers are supplied by two connections to the yard loop.

Where maintenance and/or repair actions for BVPS-1 may be required, the closing of some sectional valves to isolate the piping section may also isolate both suppression systems and backup manual hose stations serving the area. In these situations, compensatory measures would be enacted as required by site procedures.

Additional fire hose and fittings are available, per site procedures to provide temporary fire protection water supply by bypassing the isolated section of piping with water from the non-isolated section of piping to serve the affected area or alternatively, to develop a sufficient hose length supplying the area from an available source of fire water. The

additional hoses are located at various and diverse locations around the site, such as in hydrant hose houses and at hose stations outside the fire area.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The current configuration of the lack of sectional isolation valves between the sprinkler system and hose station connections does not adversely affect nuclear safety.

Compensatory measures, such as equivalent capacity backup fire hose protection to restore suppression capabilities, and establishment of fire surveillance within the related area, ensure that there is no adverse impact on the ability to detect and suppress fires. Addition of sectionalizing valves to separate the hose stations from the sprinkler systems in an area would not significantly improve the radiological release performance criteria or the nuclear safety performance criteria.

The radiological release performance criteria is met because (1) the potential for the fire brigade to suppress a fire is not diminished in radiological areas should a failure in the supply piping occur because of the available additional fire hose to either bypass the isolated sections of piping or reach the isolated areas directly, and (2) the fire brigade control of water runoff and smoke is not hindered because of a potential isolation to a section of the fire protection water supply piping.

Safety Margin and Defense-in-Depth:

The isolation of a section of the fire protection supply piping will not adversely impact the ability of a plant to achieve and maintain post-fire safe shutdown in the event of a fire. Plant personnel are familiar with periodic isolation of sections of piping to perform routine maintenance. Prior to this activity, the site evaluates the areas that are unprotected and creates appropriate compensatory measures, such as the readiness of additional fire hose to reach the affected areas, additional fire prevention controls, and fire surveillances. There are many ready sources for additional fire hoses that are available to retrieve the needed temporary fire hoses as discussed above. Fire protection piping inside the power block buildings, except for the Intake Structure, is not required to achieve and maintain safe and stable conditions. Therefore, the safety margin inherent in the post-fire safe shutdown analysis for the event of a fire has been preserved and the safe and stable capability has not been reduced.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by this configuration. Echelons 2 and 3 are met in performance evaluations through appropriate compensatory measures, such as the readiness of additional fire hose to reach the affected areas, and fire surveillances. The fire brigade is trained to respond to and extinguish fires with the tools provided to them, which include the standpipe and hose system. The lack of sectional isolation valves does not result in compromising fire suppression functions or post-fire safe shutdown capability.

A balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for the present configuration of the fire protection water supply piping to BVPS-1. There are piping arrangements that do have adequate isolation capabilities because of the many sectionalizing valves. However, in various locations, isolation has the potential to remove from service both the fixed fire suppression systems and the fire hose stations providing the manual backup in an area during a period of maintenance or repair. As discussed above, BVPS-1 has the capability to provide additional fire hose(s) from other available locations to facilitate a bypass around the isolated section of piping or to directly reach any unprotected area. The NRC previously reviewed and approved the BVPS-1 sectional arrangement of the automatic suppression systems and the fire hose stations as is evident in the Amendment No.18 to the BVPS-1 facility Operating License No. DPR-66 dated June 6, 1979, Section 4.3.13. Therefore, the intent of NFPA 805 Section 3.5.11 is met since, BVPS-1 can supplement fire suppression water capabilities by using temporary fire hose(s) in the place of installed piping.

BVPS has determined that the performance-based approach satisfies the following criteria:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 4
NFPA 805 Section 3.5.14 states:

"All fire protection water supply and fire suppression system control valves shall be under a periodic inspection program and shall be supervised by one of the following methods. 3.5.14(a): Electrical supervision with audible and visual signals in the main control room or other suitable constantly attended location. 3.5.14(b): Locking valves in their normal position. Keys shall be made available only to authorized personnel. 3.5.14(c): Sealing valves in their normal positions. This option shall be utilized only where valves are located within fenced areas or under the direct control of the owner/operator."

BVPS-1 Amendment 18 SER, dated June 1979 states:

The license will implement supervision of the post indicator sectionalizing valves to assure they are in the open position by means of electrical switches and alarms or chains, locks or tamper proof seals with administrative procedures conforming to NFPA 26. The arrangement of the sectionalizing valves insure that a single break in the system will not deprive water supply to both primary and secondary protection systems in the fire zone.

Yard hydrants with isolation curb box valves are installed along the yard loop at intervals of approximately 250 feet.

BVPS-2 SER NUREG-1057, dated October 1985 states:

Yard hydrants are provided at intervals of less than 250 feet along the protection water supply loop. The lateral to each yard hydrant is provided with a key-operated isolation valve to facilitate hydrant maintenance and repairs without shutting down any part of the fire water supply system....

Approved post-indicator sectional control valves are provided to isolate portions of the underground main for maintenance or repair without shutting off the supply to primary and backup fire suppression systems that serve areas containing or exposing safety-related systems.

By letter dated May 23, 1984, the applicant committed to supervise all valves in the fire protection water supply system, in accordance with NFPA 26.

On the basis of its evaluation and the above commitment, the staff concludes the fire protection water supply meets Section C.6.b of BTP CMEB 9.5-1 and is, therefore, acceptable.

Both versions of the BTP, for pre- and post-1979 operating plants, require electrical or administrative control over the fire protection water supply valves. The documents also refer to NFPA 26. In 1988, NFPA 26 was withdrawn and is no longer an active fire

protection code (Provision of valve supervision was incorporated into individual codes governing a variety of suppression systems). An earlier version, NFPA 26-1976 is a Recommend Practice rather than a Standard. NFPA 26 Chapter 6, "Methods of Supervision" includes Subsection 6-1: "The various methods of supervision, in addition to systematic weekly (or monthly in the case of locked valves) inspection by a competent plant employee, are as follows: central station, proprietary or remote station alarm service; local alarm service which will cause the sounding of an audible signal at a constantly attended point; locking valves open; sealing of valves; and notification systems." NFPA 26 subsection 6-2 states in part: "If valves are locked, distribution of keys should be restricted to only those directly responsible for the fire protection system...."

Basis for Request:

The control valves in the supply lines to the individual fire hydrants are underground valves and are not supervised as required by NFPA 805 Section 3.5.14. These valves do not have an extended permanently attached method of changing the valve's position. This type of valve was selected because the location of the underground piping in the yard precludes the installation of a post indicator valve above the surface level which would interfere with vehicle traffic, equipment movement, and have the potential for damage. The valves were referred to as curb box type valves in the BVPS-1 SER and as key-operated valves in the BVPS-2 SER. Plant procedures refer to them only as curb box valves. The term "key" comes from the description of the long T-handle portable valve operating tool.

This section of NFPA 805 requires the valves to be electrically supervised, locked, or sealed. The underground control valves supplying each outdoor fire hydrant are provided with a curb box for access, and require the use of a long handle T-wrench to reposition the valve. These valves are noted, inspected and tested in accordance with site procedures to periodically confirm that they are in the required open position.

- The underground valves and/or curb boxes are not designed to accept monitoring switches, locks and chains, or sealing devices.
- The valves are not subject to inadvertent closure or tampering because they require the use of a special T-wrench for operation. Each valve controls the water supply to only one outdoor fire hydrant.
- The valves are located underground and without the special long handle valve wrench for operation, the valves cannot be inadvertently operated or misaligned accidently.
- The valves are included in a periodic inspection program.

Even though the valves are not equipped to monitor tampering or repositioning, their inaccessibility and the physical requirement to obtain and use the special T-wrench prevents them from being subject to tampering. In addition, the valves are included in the Beaver Valley inspection program.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The non-supervision of curb valves for the underground yard fire main loop does not adversely affect nuclear safety or radiological release performance criteria. Administrative control has been implemented for periodic surveillance of the curb box valves. The inaccessibility of the curb box valves, the required usage of a special T-wrench, and periodic surveillance by trained and authorized personnel ensures that the nuclear safety and radiological release performance goals, performance objectives, and performance criteria are not affected.

Safety Margin and Defense-in-Depth:

The non-supervised curb valves for the underground fire main loop require a special wrench for operation, and they are operated by authorized personnel only. Therefore, the safety margin inherent in the analysis for the event of a fire has been preserved. Based on these justifications, this condition does not adversely affect the system pressure or flow and therefore does not impact fire protection defense-in-depth. The non-supervision of curb valves does not directly result in compromising fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by this configuration. Echelons 2 and 3 are met since the curb box valves do not adversely affect the system pressure or flow nor compromise fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

A balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for unsupervised fire hydrant curb box valves as required by NFPA 805 Section 3.5.14 based on the following:

The underground valves and/or curb boxes are not designed to accept monitoring switches, locks and chains, or sealing devices. The valves are not subject to inadvertent

closure or tampering because they require the use of a special T-wrench to be operated, and each valve controls the water supply to only one outdoor fire hydrant. The valves are located underground and require a particular long handle valve wrench for operation. The valves cannot be inadvertently operated or misaligned accidently. The valves are included in a periodic inspection program. The long handle tools (used to manipulate the valve position) are not maintained on the valve.

Therefore, even though the valves are not equipped to monitor tampering or repositioning, their inaccessibility and the physical requirement to obtain the special T-wrench prevents them from being subject to tampering. The valves are also included in the Beaver Valley inspection program.

BVPS has determined that the performance-based approach satisfies the following criteria:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 5

NFPA 805 Section 3.11.3 states:

"Fire Barrier Penetrations. Penetrations in fire barriers shall be provided with listed fire-rated door assemblies or listed rated fire dampers having a fire resistance rating consistent with the designated fire resistance rating of the barrier as determined by the performance requirements established by Chapter 4. (See 3.11.3.4 [sic] for penetration seals for through penetration fire stops.) Passive fire protection devices such as doors and dampers shall conform with the following NFPA standards, as applicable:

(1) NFPA 80, Standard for Fire Doors and Fire Windows
(2) NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
(3) NFPA 101, Life Safety Code

Exception: Where fire area boundaries are not wall-to-wall, floor-to-ceiling boundaries with all penetrations sealed to the fire rating required of the boundaries, a performance-based analysis shall be required to assess the adequacy of fire barrier forming the fire boundary to determine if the barrier will withstand the fire effects of the hazards in the area. Openings in fire barriers shall be permitted to be protected by other means as acceptable to the AHJ."

FENOC is requesting approval for the use of two 1.5-hour fire dampers in series with 1-hour fire wrap as adequate measures to maintain the fire rating of duct penetrations through barriers. Fire damper assemblies that are located close to but outside the fire barrier are installed with two 1.5-hour fire dampers in series instead of a single 3-hour fire damper. Although the fire damper assemblies were purchased as UL-labeled units, the manufacturer removed the UL label from the assemblies due to the untested configuration. The ductwork from the fire barrier to the damper assembly could not be wrapped with a 3-hour rated material due to weight limitations on the structural supports. Additional structural support would not significantly increase the level of fire safety.

The areas with two 1.5-hour fire dampers in series and 1-hour fire wrapped within the power block areas of BVPS-2 are listed below in Table 1:

Table 1

Fire Compartment	Description
2-ASP	Alternate Shutdown Panel Room
2-CB-1	Instrument and Relay Room and Cable Spreading Room
2-CB-5	Control Building Fan Room
2-CB-6	West Communication Room
2-CP-1	Condensate Polishing Building

Table 1	
Fire Compartment	**Description**
2-CV-1	West Cable Vault & Rod Control Area
2-CV-2	East Cable Vault & Rod Control Area
2-CV-3	Cable Vault & Rod Control Area
2-CV-4	South Cable Vault & Rod Control Area
2-CV-5	North Cable Vault & Rod Control Area
2-CV-6	Cable Vault & Rod Control Relay Room
2-FB-1	Fuel Handling & Decontamination Building
2-SB-1	Service Building Emergency Switchgear - Train A
2-SB-2	Service Building Emergency Switchgear - Train B
2-SB-6	Service Building Battery Room 2-1
2-SB-7	Service Building Battery Room 2-3
2-SB-8	Service Building Battery Room 2-2
2-SB-9	Service Building Battery Room 2-4
2-SG-1N	North Safeguards Area
2-WH-1	Waste Handling Building

Basis for Request:

Some fire damper assemblies were required to be installed within completed HVAC systems where some of the assemblies are located close to but outside the fire barrier. The guidance states that the ductwork from the fire barrier to and including the damper assembly should be enclosed with a fire-rated barrier material equivalent to the fire barrier. However, due to the weight limitations of the structural supports, the ductwork is wrapped with a 1-hour rated material instead. Although the fire damper assemblies were purchased as UL-labeled units, the manufacturer removed the UL label from the assemblies due to the untested configuration.

Certain configurations of ductwork of steel construction penetrating a fire barrier without a fire damper have been tested and shown to remain intact during exposure to a 1-hour fire duration on the ASTM E-119 time-temperature curve. Underwriters Laboratory (UL) tested HVAC duct which was 0.022" thick galvanized sheet steel, with an air-drop opening in the ductwork on the unexposed side of the barrier located 10' from the barrier. The UL results show that maximum temperatures on the unexposed side adjacent to the barrier were 499°F on uninsulated steel duct and 176°F on insulated steel duct. Maximum temperatures on the unexposed side, 9' from the barrier, were

175°F on uninsulated steel duct and 178°F on insulated steel duct. The testing demonstrates that the steel ducts without fire dampers are adequate and will not propagate a 1-hour fire through the barrier. In addition, the typical melting point for steel is between 2500-2800°F, which is greater than the ASTM E-119 furnace temperature of 1700°F during a 1-hour test, 1850°F during a 2-hour test, and 1925°F during a 3-hour test; therefore, the steel duct work will remain intact for longer durations. Seismic ductwork installed at BVPS is of a minimum thickness of 20 gauge (> 0.0359") which is thicker than the tested ductwork. Therefore, the robust construction of the steel ductwork provides a barrier to prevent the propagation of fire through the ductwork. The installation of the 1-hour-fire-rated wrap on the ductwork provides additional defense-in-depth (DID).

The NRC was made aware of the fire damper in series configuration where one fire damper is installed within the plane of the fire barrier and the second fire damper is installed outside the plane of the fire barrier. This is described in NRC SSER - NUREG-1057, Supplement 3, dated November 1986, Section 9.5.1.4, "General Plant Guidelines:"

> *In the SER, the staff stated that 3-hour fire-rated damper assemblies are provided in all ventilation ducts that penetrate 3-hour fire-rated barriers and that the damper assemblies are Underwriters Laboratories, Inc. (UL) labeled. By letter dated March 27, 1985, the applicant informed the staff that the 1 1/2-hour-rated fire damper assemblies are installed in series in each duct penetrating a 3-hour fire-rated barrier. Moreover, because the applicant redefined the fire area boundaries, some damper assemblies had to be installed within completed heating, ventilation, and air conditioning (HAVC)[sic] systems. These damper assemblies are located close to, but not within, the fire barrier penetration. To compensate for the damper location, the applicant enclosed the ductwork from the fire barrier to the damper assembly with 3- hour fire-rated barrier material.*
>
> *In the March 27, 1985, letter, the applicant also informed the staff that although all of the fire damper assemblies were purchased as UL-labeled units, the manufacturer had removed the UL label from the assemblies because they were not tested in the series configuration, and because they were not tested with carbon dioxide fire- suppression-system-actuated release devices.*
>
> *For a fire to spread between fire areas through an HVAC system duct, it would have to burn through the duct in one fire area, through two 1 1/2-hour fire-rated dampers, and finally, through the duct in the adjoining area. In the staff's opinion, the two 1 1/2-hour fire-rated dampers will provide the equivalent fire resistance of one 3-hour fire-rated damper. The 3-hour fire-rated wrap around the ducts constitutes continuous fire-rated construction which will prevent fire spread through the ductwork between the fire barrier and the fire dampers. The release device is a plunger-operated pin that is in addition to the fusible link for damper actuation. The device is UL-listed for this service and, in the staff's opinion, will not reduce the effectiveness of the dampers actuated by the devices. The staff concludes that the fire dampers, as installed, will prevent fire spread from one fire*

area to another. The damper installation is, therefore, an acceptable deviation from Section C.5.a(4) of BTP CMEB 9.5-1.

Additionally, the installation of 1-hour rated fire wraps was described in NRC SSER - NUREG-1057, Supplement 5, dated May 1987, Section 9.5.1.4, "General Plant Guidelines," that states:

In SSER 3, the staff stated that some fire damper assemblies were located outside of the fire barrier because of a redefining of certain fire areas and that where this took place, the ductwork from the barrier to the fire damper assembly would be wrapped with 3-hour fire-rated material. Section C.5.a(4) of BTP CMEB 9.5-1 states that, 'penetration openings for ventilation systems should be protected by fire dampers having a rating equivalent to that required of the barrier.' In a meeting on November 5, 1986, the applicant stated that 3-hour wrap material could not be used because of weight limitations of the structural supports and stated that the ductwork would be wrapped with 1-hour rated material. This deviation was included in Amendment 14 to the FSAR following the meeting. Fire dampers requiring 1-hour wrap are used as fire barriers between Fire Areas PA-3 and PA-5, PA-4 and PA-5, SB-3 and SB-4, SB-4 and SB-5, and PT-1 and SG-1S. The fire loading is less than ½ hour on either side of the subject dampers. Smoke detection is provided in all areas where the 1-hour wrap will be installed and hose racks are provided for fire brigade use. It is expected that a fire would be detected in its incipient stage and the plant fire brigade would extinguish it using the installed hose racks. Providing additional structural support to the ductwork to accommodate 3-hour wrap would not significantly increase the level of fire safety. Therefore, wrapping ductwork from the barrier to the damper with 1-hour material is an acceptable deviation to Section C.5.a(4) of BTP CMEB 9.5-1.

This approval request applies to other areas whose configuration is similar to the fire areas which received prior approval with 1 hour fire wrap extending from the fire barrier to and including the fire damper outside the plane of the fire barrier to create an equivalent 3-hour fire rated configuration. The configuration does not pose a significant fire hazard in the areas listed below due to the following reasons:

- 2-ASP, 2-CV-2, 2-SB-1, 2-SB-2, 2-SB-6, 2-SB-7, 2-SB-8, 2-SB-9, and 2-SG-1N have low combustible loading (less than 1-hour) and are provided with fire detection and manual suppression. The low combustible loading and presence of early warning detection ensures that a fire would be detected in its initial stage, thus the manual suppression from the fire brigade will minimize the likelihood of fire propagation through the ductwork. Additional structural support to provide the ability to use 3-hour rated fire wrap would not significantly increase the level of fire safety.
- Fire Compartments 2-CB-5, 2-CP-1, 2-CV-4, 2-CV-5, 2-FB-1, and 2-WH-1 have low combustible loading (less than 1.5 hours) and no credited fire detection or automatic suppression; however, manual suppression is available. Given the low combustible loading in these locations, an unmitigated fire would not challenge the fire rating provided by the ventilation ductwork. Therefore, fire detection is not

required to maintain the integrity of the fire barrier. The passive protection of steel ductwork and 1-hour-wrap, the low combustible loading and manual suppression from the fire brigade will minimize the likelihood of fire propagation through the ductwork.

- Fire Compartments 2-CB-1, 2-CV-1, 2-CV-3, and 2-CV-6 have combustible loading less than 2.25 hours and are provided with fire detection, automatic suppression, and manual suppression. It is expected that a fire in these areas would be detected in its initial stage and the early intervention from the fire brigade with manual suppression would minimize the likelihood of fire propagation through the ductwork. The fixed automatic suppression provides additional DID and reasonable assurances that the growth of postulated fires will be controlled prior to fire propagating through the ductwork.
- Fire Compartment 2-CB-6 has a combustible loading of less than 2 hours. Early warning fire detection is credited in the compartment and manual suppression is available. Given the fire detection system and the proximity of 2-CB-6 to the continuously occupied Control Room, a fire in this area would be detected and responded to quickly by the fire brigade to initiate suppression activities within 30 minutes. In the event of a fire, manual suppression is available. Therefore, the integrity of the fire barriers in 2-CB-6 will be maintained due to the presence of the two 1 ½ hour fire dampers installed in series, 1 hour fire wrap installed from the plane of the fire barrier up to and including the external fire damper, and the integrity of the ductwork as indicated in UL testing.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The use of two 1.5-hour fire dampers in series in steel ductwork with 1-hour fire wrap does not adversely affect the nuclear safety performance criteria. For a fire to spread from one compartment to another, it would have to propagate through two 1.5-hour rated dampers. UL testing has demonstrated that the steel ducts without fire dampers are adequate and will not propagate a one-hour fire through the barrier. The two 1.5-hour fire-rated dampers in series will provide the equivalent fire resistance of one 3-hour fire-rated damper and the properties of steel demonstrate that the steel will stay intact. The use of the two 1.5-hour fire dampers in series with 1-hour fire wrap has no adverse impact on the radiological release performance criteria, since there will be no adverse impact on fire suppression activities. The radiological release review was performed based on the potential location of radiological concerns and is not dependent on the type of fire dampers and fire wraps used for the ventilation ductwork.

Safety Margin and Defense-in-Depth:

The use of two 1.5-hour fire dampers in series with 1-hour fire wrap in power block areas does not introduce additional fire hazards and the safety margin is maintained due to low combustible loading, mitigating fire protection systems and features, availability of the fire brigade, and the ability to maintain safe and stable conditions.

Therefore, the safety margin inherent in the analysis for the event of a fire has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by this configuration. Echelons 2 and 3 are met through fire prevention procedures, which maintain the functionality of the credited fire detection, and automatic and manual fire suppression systems. In addition, maintenance procedures are in place for the performance of periodic preventive mechanical maintenance of fire dampers and inspection of the fire wrap. Also, the fire brigade is trained to respond to and extinguish fires and the deviation does not result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

A balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for the use of two 1.5-hour fire dampers in series with 1-hour fire wrap for ventilation ductwork in the power block areas listed in Table 1. Based on the above analysis, the low level of risk encountered by maintaining this current configuration is acceptable. Additionally, similar configurations have previously been approved by the NRC.

BVPS has determined that the performance-based approach satisfies the following criteria:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 6

NFPA 805 Section 3.3.5.3 states:

"Electric cable construction shall comply with a flame propagation test as acceptable to the AHJ."

There are electric cables installed at Beaver Valley Power Station Unit 1 (BVPS-1) and Beaver Valley Power Station Unit 2 (BVPS-2) and Common Area Fire Compartments[1] that have limited information regarding flame propagation test results.

In the absence of this information, a review was performed to determine the type, quantity, and locations of cables in "risk significant" fire compartments in BVPS-1 and BVPS-2. The term "risk significant" refers to those fire compartments that were determined to require detailed fire modeling. It was determined that the majority of electric cables in "risk significant" fire compartments are thermoset cable. Some fire compartments in BVPS-1 and BVPS-2 were excluded from the detailed fire modeling analysis because their risk was already acceptably low and these compartments were conservatively modeled as whole-room damage. The fire spread characteristics of cable in these areas are, therefore, bounded and no additional analysis was required.

NRC Approval is requested for this item in accordance with 10 CFR 50.48(c)(2)(vii), which presents a performance-based alternative approach to compliance with NFPA 805, Section 3.3.5.3. This request justifies the presence of wiring that may not pass the flame propagation test requirements of IEEE-383, or other qualification standards outlined in FAQ 06-0022. This request demonstrates the configuration satisfies the nuclear safety and radiological release performance goals, performance objectives and performance criteria, maintains safety margins, and maintains fire protection defense-in-depth.

Basis for Request:

There is a small percentage and/or number of cables in risk-significant compartments in BVPS-1 and BVPS-2 that are either thermoplastic or contain unknown cable material. It has been conservatively assumed in this request, and in the Fire PRA, that all of these cables would not pass the flame propagation testing criteria of IEEE 383-1974 or equivalent.

Generally, detailed fire modeling and other documents referenced herein use the terms "thermoset" and "thermoplastic" when referring to flame propagation properties of electric cables. Regulatory guidance documents have characterized "qualified" cables as those which exhibit "thermoset"-type burning qualities (i.e., char and will not melt/drip, self-extinguishing, and capable of passing flame propagation tests). "Non-qualified" cables have been characterized as those that exhibit "thermoplastic" burning qualities (i.e., melt and drip, not self-extinguishing, and not capable of passing flame

[1] Wherever BVPS-1 and BVPS-2 are discussed collectively herein, the intent is to include Main Control Room (3-CR-1), Yard Area (3-YARD-1), Intake Structure (3-IS-1 through 3-IS-6), and Alternate Intake Structure (3-AIS-1), which are common to BVPS-1 and BVPS-2, unless otherwise noted.

propagation tests). In general, cables that pass IEEE-383 testing (i.e., are IEEE-383 qualified) are thermoset cables. Section A.4.2 of NUREG-1805 states: "Cables using thermoset insulation are usually qualified to IEEE Std. 383. In general, cables that do pass IEEE 383 (i.e., IEEE 383 qualified) are thermoset cables." Also, Section 7.4 states: "Typically, the IEEE-383-qualified cables are thermoset material, while the unqualified cables are constructed of thermoplastic material."

It is therefore expected that the majority of the cables installed at BVPS-1 and BVPS-2 would pass the flame propagation testing criteria of IEEE 383-1974 or equivalent per NFPA 805 Section 3.3.5.3. The presence of small quantities of electric cables at BVPS-1 and BVPS-2 that are either thermoplastic or of unknown flame propagation characteristics will not preclude the capability to achieve the nuclear safety performance criteria of NFPA 805 Section 1.5. Defense-in-depth is also achieved in accordance with NFPA 805 Section 1.2 as described herein, thus meeting the intent of the electrical cable construction requirements of NFPA 805 Section 3.3.5.3.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The quantity and location of thermoplastic and thermoset cables in the fire compartments at BVPS-1 and BVPS-2 was used as input to the Fire PRA cable selection, performance-based analysis and detailed fire modeling. In some raceways, it was confirmed that certain cable types are thermoplastic; however, not all cables types could be confirmed. The BVPS-1 and BVPS-2 thermoset and thermoplastic electric cable report conservatively accounted for the cables of unknown jacket or insulation type by including them in the thermoplastic category. The anticipated heat release rates for cable trays containing a mixture of thermoplastic and thermoset cables are bounded by the heat release rate assumptions in the detailed fire modeling.

The fire hazard potential of the non-qualified/unknown (thermoplastic) cable types identified in the BVPS-1 and BVPS-2 thermoset and thermoplastic electric cable report has been incorporated into the detailed fire models for the identified fire compartments and subsequently used as an input during the NFPA 805 Section 4.2.4 (performance-based approach) Nuclear Safety Capability Assessment. The postulated effects of a fire in areas that contain thermoplastic cables are analyzed in each of the supporting compartments' Nuclear Safety Capability Assessment for NFPA 805 Section 4.2.4. For the thermoplastic/unknown cable types, bounding case thermoplastic flame propagation/spread, heat release rates, and thermal damage criteria were assumed in the fire modeling analysis. In addition, the fire modeling analysis assumed a bounding case (thermoplastic) flame propagation/spread rate, heat release rate, and thermal damage criteria, for raceways containing a mixture of thermoplastic and thermoset cable types. This results in a conservative and bounding fire modeling analysis with regard to cable material types and associated flame propagation rates.

For those fire compartments in BVPS-1 and BVPS-2 that were excluded from the detailed fire modeling analysis because their risk was already acceptably low, all cables

were conservatively modeled by assuming whole-room damage. The flame propagation/spread rates, heat release rates, and thermal damage criteria characteristics of cable in these areas, are therefore, bounded.

Additionally, it has been confirmed by review of the BVPS-1 and BVPS-2 thermoset and thermoplastic electric cable report that power cables in risk significant areas are thermoset cables. Based on this and the guidance provided in Appendix R, "Cable Fires" to NUREG/CR-6850 and PRA FAQ 13-0005, self-ignited cable fires were screened as non-challenging ignition sources in the fire modeling reports.

The guidance in NUREG/CR-6850 states: "It is common practice to consider only self-ignited cable fires to occur in power cable trays since they carry enough electrical energy for ignition. Control and instrumentation cables typically do not carry enough electrical energy for self-ignition." The guidance in PRA FAQ 13-0005 states: "Self-ignited cable fires should be postulated in rooms with unqualified cables only or a mix of qualified and unqualified cables." Based on the above, there is no adverse impact on the nuclear safety performance criteria.

The presence of a small percentage and/or number of thermoplastic/unknown cables has no adverse impact on the radiological release performance criteria. The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Attachment E), which is not affected by the flame spread characteristics of a small percentage/number of cables.

Safety Margin and Defense-in-Depth:

The deviations from the cable construction requirements of NFPA 805 Section 3.3.5.3 do not significantly diminish any safety margins based on the conservative assumptions regarding the cables in the Fire PRA, the mitigating fire protection systems and features, the availability of alternate success paths for nuclear safety and the fact that no additional damaging ignition sources are introduced. Therefore, the safety margins inherent in the analyses for the postulated fire events have been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1: A review of BVPS-1 and BVPS-2 thermoset and thermoplastic electric cable report has determined that BVPS power cables are thermoset-type cables. Based on this, self-ignited cable fires are therefore screened as non-challenging ignition sources in the fire modeling reports.

Additionally, industry experience has shown that in the unlikely event of a self-ignited cable tray fire, the fire is not expected to spread beyond the cable tray of fire origin. The EPRI fire events database shows that self-ignited tray fires have only led to localized failures in a small number of cables within a single raceway. No event has led to sustained open flaming fires, or damage to cables beyond the initially impacted raceway. The presence of a small percentage of thermoplastic or unknown cables therefore does not introduce any additional challenging ignition sources, thus meeting the intent of Echelon 1.

Echelon 2: Thermoplastic and unknown cables were included in the detailed fire modeling analyses reflecting the as-built, as-operated plant conditions. Cables of unknown material were conservatively modeled as thermoplastic. Suppression and detection systems are credited in the fire modeling analysis where necessary for risk improvement. The presence of small percentage and/or number of thermoplastic or unknown cables does not introduce any significant additional challenge to the fire protection systems. The intent of Echelon 2 is therefore met.

Echelon 3: Fire-rated barriers between fire areas will limit fire propagation in the plant. The flame spread characteristics of the cable jacketing are conservatively treated in the Fire PRA. This data is used as input for the preparation of the NFPA 805 Section 4.2.4 (performance-based approach) Nuclear Safety Capability Assessment. The Fire PRA conservatively bounds the thermoplastic and unknown cables in the analysis. The small percentage and/or quantity of thermoplastic/unknown cables will not present a significant additional challenge to the fire barriers. The results of the Fire PRA are reflected in the fire risk evaluations that include appropriate defense-in-depth and safety margins. The intent of Echelon 3 is therefore met in maintaining a success path free of damage.

Based on maintaining a balance of the three echelons above, defense in depth is achieved.

Conclusion:

NRC approval is requested for the acceptance of this Performance-Based (PB) method to demonstrate an equivalent level of fire protection for the requirement of NFPA 805, Section 3.3.5.3 regarding an acceptable flame propagation test for electric cable construction.

This request has determined the following:

- The majority of the electric cables in risk significant compartments are thermoset and expected to meet the flame propagation testing criteria of IEEE 383-1974 or equivalent and are in compliance with NFPA 805 Section 3.3.5.3. Furthermore, power cables are thermoset-type.

- There exists a small percentage and/or number of electric cables at BVPS-1 and BVPS-2 that are not confirmed to be qualified to an accepted flame propagation test, such as IEEE 383-1974. These cables were conservatively modeled in the Fire PRA, and the performance-based analyses have determined the existence of these cables will not preclude the capability to achieve the nuclear safety performance criteria and maintain defense-in-depth per NFPA 805 Sections 1.5 and 3.3.5.3. Therefore, the presence of these non-qualified cables was determined to be acceptable.

As described above, this approach is considered acceptable because it:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 7

NFPA 805 Section 3.3.7.2 states:

"Outdoor high-pressure flammable gas storage containers shall be located so that the long axis is not pointed at buildings."

The hydrogen storage tanks in the outdoor yard at BVPS are arranged such that the long axes are pointed at the Unit 2 Turbine Building, specifically Fire Compartment 2-TB-1. This configuration therefore does not meet Section 3.3.7.2 of NFPA 805, for which NRC approval is requested.

Basis for Request:

There is currently an array of eight (8) hydrogen storage tanks located to the east of the BVPS Unit 2 Turbine Building, approximately 135 feet away. The capacity of the hydrogen system is approximately 56,000 cubic feet for the eight tanks.

The existing hydrogen tanks are in compliance with Section 10 of NFPA 55-2010 "Gaseous Hydrogen Systems", with the following exceptions:

- 7.3.1.3.2 (incorporated by reference in Section 10.2.1) – A review of the BVPS-2 hydrogen system identified the absence of a backflow prevention device near the bulk storage containers. The installation of such a device will bring this section into compliance and is being tracked by Attachment S item BV2-1571.

- 10.2.5.2 – Walkdowns of BVPS-2 identified that the area outside the Volume Control Tank had inadequate signage, where the end of the hydrogen piping was unmarked. The installation of proper signage is being tracked by Attachment S item BV2-1570.

Compliance with the remaining requirements of Section 10 ensures that the likelihood of fire or other damage to the hydrogen tanks is minimized. Based on the safety relief devices installed, the distance from the BVPS-2 Turbine Building, lack of ignition sources and combustibles, and the physical protection afforded to the tanks, a fire exposure that is prolonged and severe enough or physical damage that could result in a rocketing tank damaging the Turbine Building is very unlikely.

The BVPS-2 Turbine Building is located approximately 135 feet away from the hydrogen storage tanks, which is 90 feet greater than any of the distances required in Table 10.3.2.2.1(a) of NFPA 55-2010. It is expected that hydrogen tanks would not cause damage to the Turbine Building due to the separation distance and the unlikely scenario of a rocketing tank. The guidance in NUREG/CR-6850, Attachment N, for hydrogen tanks, does not require analysis of a fire scenario beyond 10-15ft. However, for purposes of this request for approval, it is assumed that the hydrogen tank could result in damage to the Turbine Building.

Fire Compartment 2-TB-1, was analyzed via a Fire Risk Evaluation (FRE) and found to meet the requirements of NFPA 805 and the guidance of Regulatory Guide 1.205. Therefore, Fire Compartment 2-TB-1 is compliant with the risk-informed, performance-based approach. The FRE for 2-TB-1 determined that the risk contribution of VFDRs are very low risk significance. The findings of the analysis also confirmed that even in the very unlikely event that Fire Compartment 2-TB-1 is subject to whole area damage due to a hydrogen fire or rocketing tank, adequate defense-in-depth and safety margins are maintained.

Additionally, the potential risk associated with the hydrogen tanks has been evaluated for purposes of this approval request. The conclusion is that the potential fire scenario is not risk significant. This is due to the very low frequency of occurrence for hydrogen storage tank explosions based on historical review, as described in NUREG/CR-6850, Attachment N, and the low conditional core damage probability (CCDP) value, even when conservatively assuming whole room damage for Fire Compartment 2-TB-1.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The probability of the hydrogen storage tanks penetrating the Unit 2 Turbine Building wall is unlikely, and the fire risk evaluation results indicate that adequate defense-in-depth and safety margins would remain available in this scenario. Therefore, there is no adverse impact on the nuclear safety performance criteria.

The configuration of the hydrogen storage tanks has no adverse impact on the radiological release performance criteria. The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Attachment E), which is not affected by the hydrogen storage tank configuration.

Safety Margin and Defense-in-Depth:

Although the configuration of the hydrogen storage tanks does not comply with Section 3.3.7.2 of NFPA 805, the hydrogen tanks meet the design requirements of NFPA 55-2010. An explosive event or rocketing tank has a very low probability of occurrence and the deviation does not compromise the nuclear safety capability assessment. Therefore, the safety margin inherent in the analysis for the event has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is maintained by NFPA 55-2010 compliance including planned implementation items to correct known minor deficiencies. Automatic fire protection systems are not required for the protection of these tanks, and there are fire hydrants in the vicinity of these tanks, such that defense-in-depth Echelon 2 is also met. Echelon 3 is maintained due to the low probability of a hydrogen storage tank damaging the Unit 2 Turbine Building and adequate defense-in-depth and safety margins are maintained if 2-TB-1 is damaged. The deviations do not result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire nuclear safety capability. Since a balance of the elements is provided, defense-in-depth is maintained.

Conclusion:

NRC approval is requested for the acceptance of the BVPS-2 bulk hydrogen storage tanks orientation for the requirement of NFPA 805, Section 3.3.7.2. As described above, this request and the level of risk encountered by this configuration is considered acceptable because it:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 8

NFPA 805 Section 3.5.5 states:

"Each pump and its driver and controls shall be separated from the remaining fire pumps and from the rest of the plant by rated fire barriers."

BVPS-1 and BVPS-2 fire pump control cables are routed together in some areas of the plant and are not separated by rated fire barriers. The configuration of the control cables are such that a single fire in the following locations could impact activation of both fire pumps; 3-CR-1 (Control Room), 1-CS-1 (Cable Spreading Room), 1-CV-3 (Cable Tunnel), and 3-YARD-1 (Yard). The fire pump controllers have a remote start capability from the control room. A fire in one of the above locations could cause a fault on the cable between the control room remote start pushbutton and the fire pump controller in the fire water pump house (Intake Structure). The fault would cause electrical protective devices in the respective fire pump control panels to actuate. If this were to occur, the loss of control power to the panel would prevent the pumps from starting, either remotely or automatically.

Basis for Request:

The fire pump remote control circuits are routed through fire compartments 3-CR-1, 1-CS-1, and 1-CV-3. The control cables for each fire pump then are routed through separate underground ducts through 3-Yard-1 and terminate in their respective cubicles within the Intake Structure (1-IS-1 and 1-IS-4).

BVPS-1 and BVPS-2 fire protection water systems are supplied by an electric motor driven fire pump, BV-1FP-P-1 and a diesel engine driven fire pump BV-1FP-P-2. These pumps supply the yard loop, which serves both Unit 1 and Unit 2. A fire in one of the above locations could cause a fault in the cables between the Control Room remote start pushbutton and the fire pump controller in the Intake Structure, resulting in loss of both fire pumps. Alternate supplies are available through use of portable pumps (i.e., fire truck) and the warehouse diesel driven fire pump (1FPWH-P-1) in accordance with site procedures. Pump 1FPWH-P-1 has automatic start on low fire protection system pressure and would provide sufficient capacity for fire hose use. Hose stations therefore remain available due to alternate water supply capabilities.

If a fire occurred in 3-CR-1, 1-CS-1, 1-CV-3, or 3-Yard-1, alternate fire protection suppression capability is available as described below.

In the Control Room (3-CR-1), the control cables for both primary fire pumps are installed on separate equipment trains in the Building Service Control Panel and are separated by a fire barrier behind the control panel. The Control Room is continuously occupied by operators, which constitutes a continuous fire watch. Manual suppression such as portable extinguishers are provided. In addition, hose stations are provided in the area upon utilization of alternate water supplies, and automatic detection is also provided. The continuous occupation and availability of manual suppression within the

Control Room significantly minimizes fire risk in the area and increases the ability to rapidly detect, control and extinguish fires that could occur, thereby limiting damage.

In the Cable Spreading Room (1-CS-1), the control cables are routed together and are not separated by a rated fire barrier. However, the Cable Spreading Room is equipped with a total flooding CO_2 system, which is normally automatic but also can be actuated manually. System actuation and trouble alarms are provided in the Control Room. Manual suppression such as portable extinguishers are provided. In addition, hose stations in the vicinity of the area are available upon utilization of alternate water supplies, and automatic smoke detection is provided as well. The available fire protection features ensure that a fire in the area will be rapidly detected, controlled and extinguished, without relying on the primary fire pumps.

In the Cable Tunnel (1-CV-3), the control cables are routed together and are not separated by a rated fire barrier. However, the Cable Tunnel is equipped with a total flooding Halon system, which is normally automatic but also can be actuated manually. Additional manual suppression is available from portable extinguishers in the yard, as well as fire hydrants upon utilization of alternate water supplies. Automatic smoke detection is also provided. The available fire protection features significantly minimizes fire risk in the area and increases the ability to rapidly detect, control and extinguish fires that could occur, thereby limiting damage.

In the underground yard (3-YARD-1) duct lines, the control cables are routed separately in different duct lines. The yard is comprised of underground electrical manholes and associated electrical duct lines. Neither detection nor suppression is available in the duct lines. Each electrical manhole is spatially separated from other fire compartments providing reasonable assurance that postulated fires would be confined to the compartment of origin. Spread of fire between manholes is highly unlikely due to the physical separation; therefore, loss of both control cables due to a single fire event is highly unlikely.

The areas in which the primary fire pumps control circuits are not separated by fire barriers do not rely on automatic wet pipe suppression or hose stations. Fire protection systems in these areas include detection and alternate means of suppression such as automatic gaseous suppression systems and portable fire extinguishers. Sufficient pressure could be provided for hose stations for manual suppression if required, due to the availability of backup alternate water supplies. Therefore, a fire in 3-CR-1, 1-CS-1 or 1-CV-3, which results in loss of the fire pumps control circuits does not adversely affect the capability to extinguish fires within these compartments.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The current configuration of the primary fire pump remote control circuits does not adversely affect nuclear safety, as alternate manual, fixed suppression capability, or adequate separation remain available for these areas. Therefore, there is no adverse impact on nuclear safety performance criteria.

The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Attachment E). The potential loss of the fire protection water supply does not change the radiological release evaluation, which concludes that potentially contaminated water is contained and smoke is monitored. Therefore, the results and conclusions of Attachment E remain valid.

Safety Margin and Defense-in-Depth:

The current configuration of the fire pump remote control circuits used at BVPS will not adversely impact the ability of the station to achieve and maintain post-fire safe shutdown, as alternate manual, fixed suppression capability, or adequate separation is provided in these areas. Therefore, the safety margin inherent in the analysis for the event of a fire has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by this configuration. Echelon 2 is maintained due to the suppression systems located in the areas, as well as hose stations or hydrants that are expected to remain available from the use of alternate water supplies. Also, with the exception of 3-YARD-1, these areas are provided with either thermal heat or smoke detectors which increases the ability to rapidly detect, control and extinguish fires that could occur, thereby limiting damage. Echelon 3 is maintained as these areas are provided with rated fire barriers, which will prevent the propagation of fire to other locations where essential equipment is located. For the subject plant locations, the deviation from NFPA 805 Section 3.5.5 does not result in compromising the credited fire protection systems or features, or post-fire safe shutdown capability. Since a balance of the elements is provided, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for fire pump control circuits that are routed in common areas without rated fire barriers separating the cables. As described above, this request and the level of risk is considered acceptable because it:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 9

NFPA 805 Section 3.7 states:

"Where provided, fire extinguishers of the appropriate number, size, and type shall be provided in accordance with NFPA 10, Standard for Portable Fire Extinguishers. Extinguishers shall be permitted to be positioned outside of fire areas due to radiological conditions."

The code of record for fire extinguishers at BVPS-1 and BVPS-2 is NFPA 10-1981. NFPA 10-1981, provides requirements for portable fire extinguisher size, type and placement.

FENOC has evaluated portable fire extinguishers at BVPS-1 and BVPS-2 within the power block for compliance with NFPA 10-1981 requirements regarding size, type, and placement (i.e., location and number of extinguishers). The evaluation has determined that, in some fire compartments, type B:C portable fire extinguishers are provided where type A:B:C portable extinguishers are required. In addition, portable fire extinguisher placement in fire compartment 2-FB-1 (Fuel and Decontamination Building) is not in accordance with NFPA 10-1981 requirements. FENOC requests NRC approval for the current configuration of portable fire extinguishers at BVPS-1 and BVPS-2 based on adequacy for the hazard.

Basis for Request:

Portable fire extinguishers provided in certain fire compartments of the plant, shown in Table 1 below, are provided with type B:C extinguishers in lieu of the required type A:B:C extinguishers. Although these areas contain type A combustibles, they are provided with type B:C extinguishers rather than type A:B:C dry chemical extinguishers. Some areas contain small amounts of miscellaneous Class A combustibles or potential transients and other areas contain sensitive plant equipment. Due to the potential for the chemicals contained in type A:B:C extinguishers to promote corrosion of stainless steel piping and sensitive plant equipment, these areas only contain type B:C extinguishers.

Table 1: Affected Fire Areas

Fire Compartment	Description
1-CO-2	CO2 Storage & PG Pump Rooms
1-CR-3	Communications Equipment & Relay Panel Room
1-CR-4	Process Instrument Room
1-CTP-1	Cooling Tower Pump House and Cooling Tower
1-FB-1	Fuel and Decontamination Building
1-MG-1	MG & Rod Control Room
1-PA-1A	Primary Auxiliary Building (El. 768')
1-PA-1C	Primary Auxiliary Building (El. 752')
1-PA-1E	Primary Auxiliary Building (El. 735')

Fire Compartment	Description
1-PA-1G	Primary Auxiliary Building (El. 722')
1-PT-1	Pipe Tunnel
1-RC-1	Reactor Containment Building
1-SB-GEN	Service Building General Areas (El. 735', 752', 760')
1-SGPD-1	Steam Generator Blowdown/Purge Duct Rooms
3-ER-1	ERF Substation
2-CB-1	Control Building – Communications, Instrument, Relay
2-CB-5	Control Building – HVAC Equipment Room
2-CB-6	Control Building – West Communication Room
2-CP-1	Condensate Polishing Building
2-CV-1	Cable Vault & Rod Control Area (West)
2-CV-2	Cable Vault & Rod Control Area (East)
2-FB-1	Fuel and Decontamination Building
2-PA-3	Primary Auxiliary Building (El. 710', 718' & 735'6")
2-PA-4	Primary Auxiliary Building (El. 755' 6")
2-PA-5	Primary Auxiliary Building (El. 773' 6")
2-PT-1	Pipe Tunnel
2-RC-1	Reactor Containment
2-SB-1	Service Building – AE SWGR.
2-SB-2	Service Building – DF SWGR.
2-SB-3	Service Building – Cable Spreading Room
2-SB-4	Service Building – Normal SWGR Room
2-SB-5	Service Building (El. 780'6")
2-SG-1N	Safeguards Area – North
2-SG-1S	Safeguards Area – South
2-TB-1	Turbine Building General Area
2-WH-1	Waste Handling Building

The use of type B:C portable fire extinguishers in lieu of type A:B:C extinguishers is considered adequate for the hazard for the fire compartments listed above in Table 1 based on the following:

- These areas also contain Class B and/or C hazards, so the type B:C extinguisher is appropriate for these hazards and utilizing an A:B:C multipurpose dry chemical extinguisher can be extremely corrosive and damaging to plant equipment.

- Carbon dioxide extinguishers, although rated for Class B and C hazards only, are able to extinguish small Class A fires, and re-ignition can be prevented by applying the carbon dioxide to cool the fuel after the fire has been extinguished, resulting in a similar effect to the smothering achieved by the A:B:C multipurpose dry chemical agent.

- Type B:C dry chemical extinguishers provide interim fire suppression prior to utilizing a hose stream. Water suppression can be achieved with the use of hose stations located throughout the plant areas.

- NFPA 10-1981 requires fire extinguishers suitable for Class A fires for the protection of the building structure, in addition to the occupancy hazard. However, most structures within the power block of BVPS-1 and BVPS-2 are of concrete construction, minimizing the need for Class A building protection.

The placement of portable fire extinguishers in fire compartment 2-FB-1 is considered adequate for the hazard based on the following:

- In the BVPS-2 Fuel Building (elevation 735' of 2-FB-1), the current placement of Class B:C extinguishers are along the normal travel paths. In general, the only hazards outside of the required 75' travel distance are small 480VAC pumps and motors and cable insulation. It is considered unlikely that transient combustibles would accumulate in these areas since they are not readily accessible, therefore, installing additional type A:B:C extinguishers is not necessary.

Acceptance Criteria Evaluation

These deviations present no adverse impact to the nuclear safety and radiological release performance criteria, or to the safety margin and defense-in-depth. Areas that do not comply with the intent of NFPA 10-1981 will be modified and tracked by Attachment S item BV1-3017.

Nuclear Safety and Radiological Release Performance Criteria:

The current configuration of portable fire extinguishers does not adversely affect nuclear safety as adequate manual and fixed suppression capability are provided for these areas. Therefore, there is no adverse impact on nuclear safety performance criteria.

The radiological release review was performed based on the fire suppression activities in areas containing or potentially containing radioactive materials and is not impacted by the size, type, or placement of portable fire extinguishers. The use of type B:C in lieu of type A:B:C extinguishers does not change the radiological release evaluation, which concluded that potentially contaminated water is contained and smoke is monitored. The portable fire extinguishers do not add additional radiological materials to the area or challenge system boundaries and therefore have no adverse impact on the radiological release performance criteria.

Safety Margin and Defense-in-Depth:

The current configuration of portable fire extinguishers used at BVPS-1 and BVPS-2 will not adversely impact the ability of the station to achieve and maintain post-fire safe

shutdown, as adequate manual and fixed suppression capability is provided. Therefore, the safety margin inherent in the analysis for the event of a fire has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805 Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by the extinguisher configurations.

Echelon 2 is maintained as the fire brigade is trained to respond to and extinguish fires with the tools provided to them, which include portable fire extinguishers.

Echelon 3 is maintained because there are installed features, which maintain safety functions and portable fire extinguishers do not affect those features or prevent a success path free of fire damage. The size, type, and placement of existing portable fire extinguishers does not adversely impact fire protection defense-in-depth. It does not compromise administrative fire prevention controls, automatic fire detection and suppression functions, manual fire suppression functions, or post-fire safe shutdown capabilities.

A reasonable balance of the elements is provided; therefore, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for the current configuration of portable fire extinguishers at BVPS. BVPS has determined that the performance based approach utilized to evaluate a variance from the requirements of NFPA 805 Chapter 3:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 10

NFPA 805 Section 3.6.2 states:

"*A capability shall be provided to ensure an adequate water flow rate and nozzle pressure for all hose stations. This capability includes the provision of hose station pressure reducers where necessary for the safety of plant industrial fire brigade members and off-site fire department personnel.*"

BVPS-1 and BVPS-2 do not have pressure reducing devices installed at hose station connections, and as a result, the pressure could exceed 100 pounds per square inch (psi) at some hose stations. In these cases, BVPS-1 and BVPS-2 hose stations are not in compliance with NFPA 805 Section 3.6.2. FENOC requests NRC approval of the hose stations as an acceptable variance from the requirements of NFPA 805 Chapter 3.

Basis for Request:

There are two (2) NFPA 14 codes of record at BVPS. For BVPS-1, the code of record is the 1971 Edition, while for BVPS-2 it is the 1974 Edition.

NFPA 14-1971 Edition, Section 442 requires "*Where the static pressure at any standpipe outlet for small hose exceeds 100 pounds per square inch, an approved device shall be installed at the outlet to reduce the pressure so that the nozzle pressure will be approximately 80 pounds per square inch.*

Note: Pressure reducers are not required on standpipe outlets for 2-1/2 inch hose because it is assumed 2-1/2 inch hose will be attached only when the persons likely to use it are trained in handling large streams."

NFPA 14-1974 Edition, Section 442 requires: "*Where the pressure at any standpipe outlet exceeds 100 pounds per square inch, an approved device shall be installed at the outlet to reduce the pressure with required flow at the outlet to 100 pounds per square inch.*"

The intent of the code is to protect an untrained occupant from using a fire hose with a relatively high pressure, which could endanger the safety of the individual. As noted in the NFPA 14-1971 Edition requirement, pressure reducers are not required on outlets for 2-1/2 inch diameter fire hose when the persons likely to use it are trained in handling large streams. BVPS-1 and BVPS-2 do not have 2-1/2 inch diameter fire hose stations. Furthermore, the hose stations are utilized only by members of the trained and qualified fire brigade. The fire brigade members are trained and drilled using the expected pressures available at Beaver Valley for manual fire suppression activities. This variance from NFPA 805 Chapter 3 and applicable code requirements is considered to be acceptable because the intent of both editions of NFPA 14 Section 442 is achieved through the use of the fire hose by trained fire brigade members.

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

The lack of pressure reducing devices does not adversely affect nuclear safety since the fire brigade is trained in the use of all hose stations at the nominal operating supply pressure. Fire brigade personnel safety is not compromised through use of hoses without pressure reducing devices.

The lack of pressure reducing devices has no adverse impact on the radiological release performance criteria. The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Attachment E). Since the fire brigade is trained in the use of the hose stations, the results and conclusions of Attachment E remain valid.

Safety Margin and Defense-in-Depth:

The fire brigade is trained to extinguish fires using the hose stations installed at BVPS-1 and BVPS-2. This does not result in compromising manual fire suppression functions, or the nuclear safety capability assessment. Since manual fire suppression functions are maintained through training and drills, the safety margin inherent in the analysis for the event of a fire has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805, Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is met through plant fire prevention procedures and is not adversely affected by this configuration.

Echelon 2 is maintained as the fire brigade is trained to respond to and extinguish fires with the tools provided to them, which include hose stations that do not have pressure reducing devices.

Echelon 3 is maintained because there are installed features, which maintain safety functions and the hose stations do not adversely affect those features or prevent a success path remaining free of fire damage. The deviations do not result in compromising automatic fire suppression functions, manual fire suppression functions, or post-fire safe shutdown capability.

Since a balance of the elements is provided, defense-in-depth is achieved.

Conclusion:

NRC approval is requested for hose stations that could exceed a pressure of 100 psi and are not equipped with pressure reducing valves. As described above, this approach is considered acceptable because it:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).

Approval Request 11

NFPA 805 Section 3.2.3(1) states:

"Procedures shall be established for implementation of the fire protection program. In addition to procedures that could be required by other sections of the standard, the procedures to accomplish the following shall be established:

Inspection, testing, and maintenance for fire protection systems and features credited by the fire protection program."

This request is to allow BVPS-1 and BVPS-2 to utilize performance based methods to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. Performance-based inspection, testing, and maintenance frequencies will be established as described in EPRI Technical Report 1006756. FENOC requests NRC approval to utilize these performance-based methods as an acceptable variance from NFPA 805 Chapter 3 requirements.

Basis for Request:

NFPA 805 Section 2.6, *Monitoring*, requires that "*A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. Monitoring shall ensure that the assumptions in the engineering analysis remain valid."*

NFPA 805 Section 2.6.1, *Availability, Reliability, and Performance Levels,* requires that *"Acceptable levels of availability, reliability, and performance shall be established."*

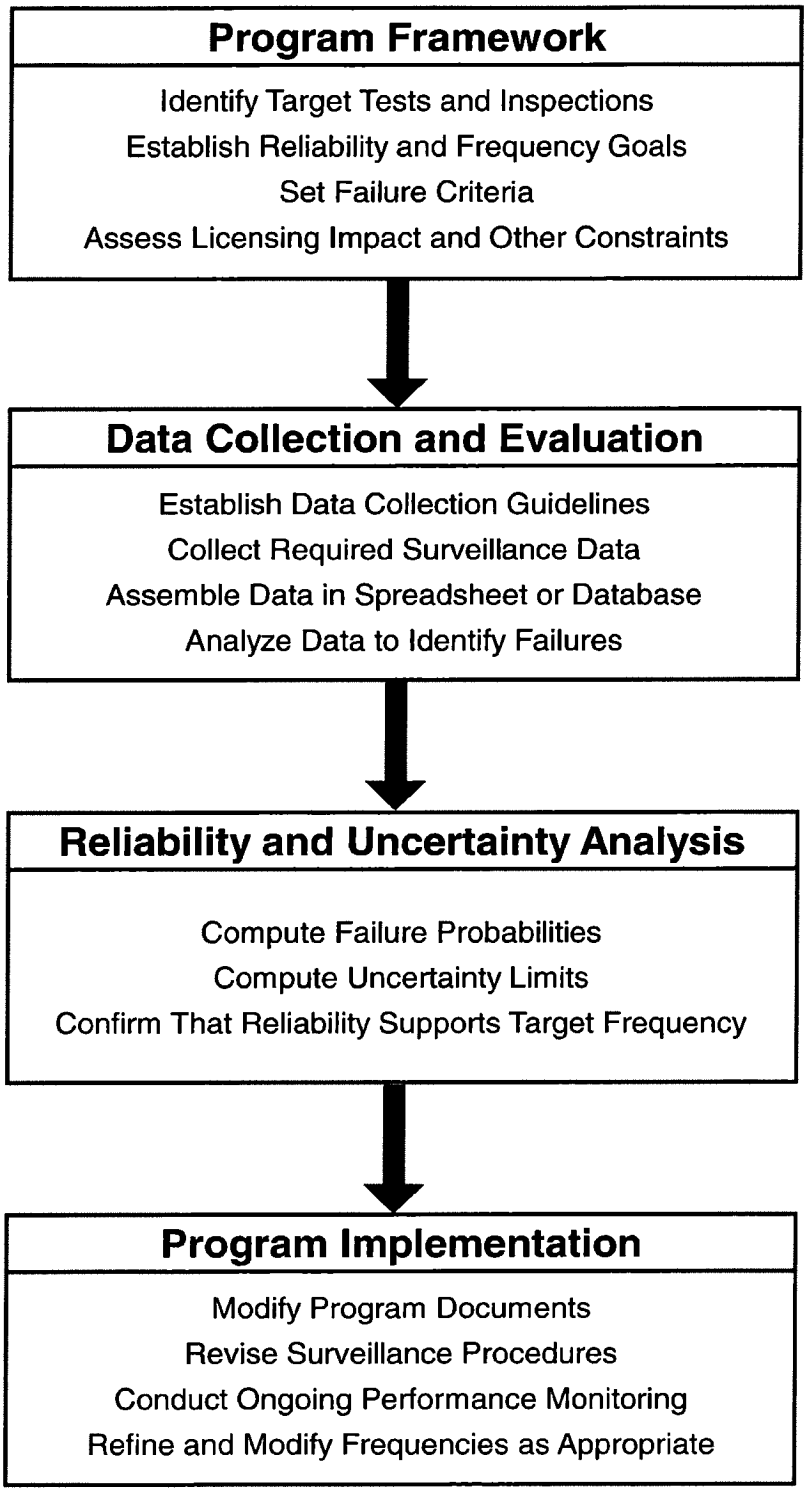
NFPA 805 Section 2.6.2 requires that "*Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience."*

The scope and frequency of the inspection, testing, and maintenance activities for fire protection systems and features required in the fire protection program have been established based on the previously approved Technical Specifications / License Controlled Documents and appropriate NFPA codes. This request does not involve the use of the EPRI Technical Report TR-1006756 to establish the scope of those activities determined by the required systems review identified in Table 4.3 of the LAR.

This request is specific to the use of EPRI Technical Report TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features credited by the fire protection program. As stated in EPRI Technical Report TR-1006756, Section 10.1, "*The goal of a performance-based surveillance program is to adjust test and inspection frequencies commensurate with equipment performance and desired reliability."* This goal is consistent with the stated requirements of NFPA 805 Section 2.6. The EPRI Technical Report TR-1006756 provides an accepted method to establish appropriate inspection, testing, and

maintenance frequencies which ensure the required NFPA 805 availability, reliability, and performance goals are maintained.

The target tests, inspections and maintenance will be those activities for the NFPA 805 required fire protection systems and features. The failure criterion will be established based on the credited functions of the required fire protection systems and features and will ensure those functions are maintained (or appropriate actions are implemented). Data collection and analysis will follow the Technical Report TR-1006756 document guidance. The failure probability will be determined based on the Technical Report TR-1006756 guidance and a 95% confidence level will be utilized. The performance monitoring will be performed in conjunction with the monitoring program required by NFPA 805 Section 2.6 and it will ensure site specific operating experience is considered in the monitoring process. The following is a flow chart that identifies the basic process that will be utilized:



EPRI TR-1006756 - Figure 10-1
Flowchart for Performance-Based Surveillance Program

Acceptance Criteria Evaluation:

Nuclear Safety and Radiological Release Performance Criteria:

Use of performance based test frequencies established per EPRI TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis (or the analysis will be updated accordingly). Therefore, there is no adverse impact to Nuclear Safety Performance Criteria by the use of the performance based methods in EPRI TR-1006756.

The radiological release performance criteria are satisfied based on the determination of limiting radioactive release (Refer to Attachment E of this LAR). Fire protection systems and features are credited as part of that evaluation. Use of performance based test frequencies established per EPRI TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis (or the analysis will be updated accordingly) which includes those assumptions credited to meet the radioactive release performance criteria. Therefore, there is no adverse impact to radioactive release performance criteria.

Safety Margin and Defense-in-Depth:

Use of performance based test frequencies established per EPRI TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels assumed in the NFPA 805 engineering analysis (or the analysis will be updated accordingly) which includes those assumptions credited in the risk evaluation safety margin discussions. In addition, the use of these methods in no way invalidates the inherent safety margins contained in the codes used for design and maintenance of fire protection systems and features. Therefore, the safety margin inherent and credited in the analysis has been preserved.

The three echelons of defense-in-depth are:

(1) To prevent fires from starting;

(2) Rapidly detect, control and extinguish fires that do occur, thereby limiting damage;

(3) Provide adequate level of fire protection for systems and structures so that a fire will not prevent essential safety functions from being performed;

Per NFPA 805, Section 1.2, defense-in-depth is achieved when an adequate balance of each of these elements is provided.

Echelon 1 is not affected by the use of EPRI TR-1006756 methods. Use of performance based test frequencies established per EPRI TR-1006756 methods combined with NFPA 805 Section 2.6, Monitoring Program, will ensure that the availability and reliability of the fire protection systems and features are maintained to the levels

assumed in the NFPA 805 engineering analysis (or the analysis will be updated accordingly). Therefore, there is no adverse impact to echelons 2 and 3 for the defense in depth.

Conclusion:

NRC approval is requested for use of the performance based methods contained in EPRI TR-1006756 to establish the appropriate inspection, testing, and maintenance frequencies for fire protection systems and features required by NFPA 805. As described above, this approach is considered acceptable because it:

(A) Satisfies the performance goals, performance objectives, and performance criteria specified in NFPA 805 related to nuclear safety and radiological release;

(B) Maintains safety margins; and

(C) Maintains fire protection defense-in-depth (fire prevention, fire detection, fire suppression, mitigation, and post-fire nuclear safety capability).