Duquesne Light

Nuclear Construction Division
Robinson Plaza, Building 2, Suite 210
Pittsburgh, PA 15205

2NRC-5-076
(412) 787-5141
(412) 923-1960
Telecopy (412) 787-2629

May 24, 1985

United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
Fire Protection - Trip Report Responses

Gentlemen:

On December 5, 1984, the NRC staff visited the Beaver Valley Power Station Unit No. 2 to obtain information to aid in the resolution of the open item concerning the use of CO_2 in the cable spreading room. As a result of the meeting, the staff had several concerns, which were submitted to Duquesne Light Company (DLC) in their trip report dated January 30, 1985. Attached are DLC's responses to these concerns.

If you should have any questions, please contact Mr. E. T. Eilmann at (412) 787-5141.

DUQUESNE LIGHT COMPANY

By _____
J. J. Carey
Vice President

ETE/wjs
Attachment

cc: Mr. B. K. Singh, Project Manager (w/a)
Mr. G. Walton, NRC Resident Inspector (w/a)

SUBSCRIBED AND SWORN TO BEFORE ME THIS
24th DAY OF May, 1985.

_____
Notary Public

SHEILA M. FATTORE, NOTARY PUBLIC
SHIPPINGPORT BORO, BEAVER COUNTY
MY COMMISSION EXPIRES SEPT. 16, 1985
Member, Pennsylvania Association of Notaries

B002
1/1

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF BEAVER)

On this 24th day of May, 1985, before me, a Notary Public in and for said Commonwealth and County, personally appeared J. J. Carey, who being duly sworn, deposed and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge.

Sheila M Fattore
Notary Public

SHEILA M. FATTORE, NOTARY PUBLIC
SHIPPINGPORT BORO, BEAVER COUNTY
MY COMMISSION EXPIRES SEPT. 16, 1985
Member, Pennsylvania Association of Notaries

NRC TRIP REPORT

DECEMBER 5, 1984

CONCERNS

1. NRC Concerns

In our SER, we indicated that CO_2 extinguishing systems have been installed in accordance with NFPA-12. During our site visit, we observed manual release stations and fire alarm control panels which may not be listed for use with CO_2 extinguishing systems. The applicant should provide verification that all components of the CO_2 extinguishing systems are listed for use with CO_2 systems.

Response

The CO_2 systems at Beaver Valley Power Station Unit No. 2 are designed in accordance with NFPA-12.

The equipment is UL listed for use in CO_2 systems. This list includes: valves, fittings, nozzles, manual pull stations, hoses, and hose reels.

All the components of the Cardox zone panels, the interface panels and the Pyrotronics XL-3 fire detection panel are UL listed. The design drawings have been reviewed by American Nuclear Insurers (ANI) and with minor modifications have received ANI approval.

However, the panels themselves are not UL listed because the panels are custom-built to meet the more stringent requirements of the Beaver Valley Valley Power Station - Unit 2 (BVPS-2). All modifications to the original Cardox UL-listed design have been performed by "Automatic" Sprinkler Corp (ASCOA), which is licensed by Cardox to manufacture CO_2 control panels.

2. NRC Concerns

2.A. CO_2 does not remove heat adequately.

Response

CO_2 does not extinguish a fire by heat removal. CO_2 extinguishes a fire by displacing the oxygen in the area (that is removes the oxygen or acts as a smothering agent). However, CO_2 does have some heat removal capabilities. Based on the NFPA handbook, CO_2 removes approximately 100 Btu of heat per pound of CO_2.

The CO_2 system is actuated by a cross-zoned smoke detection system which will operate in the early stages of a fire. Therefore, a fire will be extinguished while it is still small and has not had a chance to generate a large amount of heat.

NRC Concern

2.A.1. Deep-seated fire, especially with cables in the vertical configuration.

Response

CO_2 is especially advantageous in putting out a fire in a cable tray because CO_2 total flooding basically inerts the entire area by displacing the oxygen which is necessary to support combustion. One of the major advantages of CO_2 for this type of hazard is its capability as a gas to effectively penetrate complex/congested cable tray systems, including cable trays that are installed with tops and/or bottom solid covers. All cables in trays are IEEE-383-rated cable. IEEE-383-rated cable is self-extinguishing when the fire source is removed.

NRC Concern

2.A.2 Hot gas layer, CO_2 being heavier than air and cables located near ceiling.

Response

The CO_2 system is designed to maintain a 50-percent concentration of CO_2 for a period of 20 minutes throughout the entire enclosure. To achieve this goal, radial discharge nozzles are used. These nozzles are specifically designed to entrain the air surrounding the nozzles and thoroughly mix it with the discharging CO_2. This mixing will pull the hot gas layer into the CO_2 discharge, mixing the hot gases with the extremely cold CO_2 and the cooler air flow from below the layer. This mixing will greatly reduce the temperature of the hot gases, dispersing it.

Fires in cables, especially IEEE-383-rated cables, generally develop as slow smoldering-type fires which generate considerable amounts of smoke before much heat is developed. The CO_2 system uses reliable cross-zoned ionization detectors to actuate the sytem. Therefore, it is highly unlikely that the fire would ever develop to a size where the gas layer would reach a high temperature.

With the use of IEEE-383 cable, early detection and actuation, and the mixing effect of the CO_2 nozzles, the development of a hot gas layer at the ceiling does not constitute a credible event.

NRC Concern

2.A.3. If door is opened before the necessary heat is dissipated, the fire may rekindle - the pyrolites may explode.

Response

The cable spreading area, cable tunnel, and relay room are a limited access area. There are warning lights at each door to warn of CO_2 discharges. Therefore, only qualified personnel of the fire brigade will be opening any doors.

Standard fire fighting practice is to test the door for heat before opening a door. If the door is hot, a fog nozzle is applied to cool the door and provide a water curtain while opening and entering the space. This is done to prevent the escape of the fire from the space.

For an explosion to occur within a space, there has to be a mixture of oxygen and volatiles or suspended particles to provide the explosive mixture required for an explosion. For sufficient volatiles to be generated to produce an explosive mixture, a flaming fire would have to have developed for a long period of time.

Since only a 34 percent concentration of CO_2 is required to suppress a flaming fire, it is highly unlikely that a flaming fire would continue more than two minutes after CO_2 discharge begins and a smoldering fire would not generate enough volatiles to create an explosive mixture.

IEEE-383-rated cable is self-extinguishing when the fire source, such as the 1500° flame used to test the cables, is removed. It is unlikely that a smoldering cable fire would reignite into a flaming fire, even if all the CO_2 was removed before the fire was extinguished.

NRC Concern

2.B. Toxicity

Response

Carbon dioxide as defined in the NFPA handbook, Section 4, 15th edition is nontoxic. However, carbon dioxide will cause asphyxiation due to the displacement of air.

In order to safeguard personnel within the areas of CO_2 systems, the following features have been incorporated into the design:

- Warning signs are furnished at all entrances to CO_2 areas to inform personnel that the area is protected by an automatic CO_2 suppression system. Additionally, personnel will be trained in evacuation procedures on the release of CO_2.

- Flashing red lights are provided at all entrances to CO_2 areas to warn personnel of the fact that CO_2 has been discharged into the space.

- Cross-zone detection/actuation logic has been provided for the CO_2 systems. The CO_2 system upon detecting a fire will provide a fire alarm warning bell in the area. However, a second detection circuit is required before the CO_2 discharge cycle starts. At this time, horns will be actuated, thus warning personnel to evacuate the area. A 30-60 second delay (depending on the size of the area) will allow personnel to evacuate prior to actual CO_2 discharges.

- As an additional means of assuring that personnel are aware that CO_2 may be within an area, odorizers are installed in the CO_2

system which activate on CO_2 discharge. These ordorizers generate a wintergreen scent that alerts personnel to the fact that CO_2 is within the area. This feature will allow personnel ample time to evacuate the area.

NRC Concern

2.B.1. Effects of inadvertent operation on operators.

Response

The following design features have been incorporated to minimize the possibility of inadvertent operation:

- The CO_2 system is provided with a cross-zoned smoke detection system which, as stated earlier, requires two separate detection circuits to go into alarm before it actuates.
- There are two valves, master and zone valves, which have to be opened before CO_2 will discharge into a space.
- The manual pull stations require two actions: pull down and then push to discharge CO_2.

There is no equipment within this area for which an operator is normally required to monitor. Seals are provided between those areas and the main control room. Therefore, even if there is an inadvertent operation of the CO_2 system, it will not affect the operators.

NRC Concern

2.B.2. Consequences of leakage to adjacent areas through deteriorated fire stops.

Response

To prevent leakage from deteriorated seals, there are technical specifications and surveillance procedures to inspect all fire barrier stops and seals on a regular basis. However, should CO_2 leak from a fire area into an adjacent space, the smell added to the CO_2 by the odorizers will warn personnel of this fact and allow them time to evacuate the area.

NRC Concern

2.C. Design

Response

The CO_2 system is part of a defense in-depth philosophy of which no one part is complete by itself. This defense in-depth philosophy can best be summarized as three independent levels of fire defense. They are:

1. Provide a low probability of a fire by:

a. Three-hour barriers separating the different fire areas.

b. Restricted access by electrically supervised security access locks, which places the areas of concern out of normal travel routes, and reduces the probability of the introduction of transient combustibles.

c. Low activity area (mostly cable and conduit with no large machinery).

d. All cable is IEEE-383-qualified or run in conduit.

e. Adminstrative control: procedures control access, transient combustibles, ignition sources, and work activities within the areas.

2. Detection and Suppression Capability:

a. Two separate fire detection systems are provided to protect the area; one an ionization smoke detection system called the "Early Warning System" provides alarm/warning of a fire throughout the plant. The other is the smoke detection/ actuation system called the "XL-3 system" which provides local alarm and warning, and actuation of the CO_2 system.

b. The CO_2 suppression system utilizing two complete discharges at 50 percent concentration of CO_2 and a 20-minute soak time.

c. A well-trained fire brigade with water from hose stations, and portable extinguishers as backup fire protection.

d. The local fire departements have been trained in response to a fire at Beaver Valley Power Station.

3. Alternate Shutdown Capability

a. A fire in the cable spreading area, cable tunnel, and relay room is considered to destroy all cables in these areas; therefore, an independent alternate shutdown capability is provided which is electrically independent and not affected by the loss of these areas.

The CO_2 system is designed in accordance with NFPA-12. The system is fully automatic and is actuated by a cross-zoned smoke detection system. The major design features include:

1. 50 percent concentration of CO_2

2. Double discharge capability

3. Two separate storage tanks that are independent of each other

4. A designed 20-minute soak time

5. Automatic, manual electric, and manual means of actuation are provided

6. Meets CO_2 design criteria of BTP CMEB 9.5-1, Section C.6.e

7. Local, remote, and predischarge alarms

8. Odorizers in the CO_2 system, designed to warn personnel of the presence of CO_2

NRC Concern

2.C.1. The cold CO_2 impinging on cables may deteriorate the insulation.

Response

The cables in the areas of the CO_2 nozzles will be protected from direct CO_2 impingement by providing shielding in the form of cable tray covers or bottoms as required.

NRC Concern

2.C.2. Consequence of excessive pressure, if pressure relief panels do not work as designed.

Response

The CO_2 system will be placed into operation only after all of the acceptance tests have been successfully performed. This includes full CO_2 system discharge and observation of the integrity of the area boundary components.

NRC Concern

2.C.3. Effects of expected overpressure on fire seals.

Response

The fire stops and seals will be designed to withstand the potential CO_2 overpressurization.

NRC Concern

2.C.4. Consequences of multireleases due to seismic events.

Response

The consequences of a multi-release of CO_2 was reviewed, with other equipment failures, due to a seismic event in the worst-case mode, which for CO_2 is complete discharge of the entire CO_2 system. The effect of multi-release was analyzed to ensure that the plant could shut down safely.

NRC Concern

2.C.5 Consequence of electrical shorts created by an extended fire.

Response

In the event of an extended fire, the alternate shutdown panel is available to shut down the plant safely. An analysis is being done at this time to ensure that no electrical shorts will inhibit the plant from being shut down safely.

NRC Concern

2.D. Availability

Response

During normal plant operation, the CO_2 system will be in an automatic mode of operation. This is based on the facts that:

a. These areas are security monitored limited access areas for personnel with proper security clearance only.

b. It is not a normal travel route.

c. Contains mainly cable and conduit with few electrical components that will require periodic monitoring.

The CO_2 system is also technically specified so that if, for any reason, the CO_2 system is not fully operational, a fire watch will be stationed in the area.

The CO_2 system is designed so that a key is required to lock out the CO_2 system (Note: this only disables the automatic actuation system). Locking out the system actuates alarms locally and in the control room, notifying the operators of the system abnormal status.

Abort switches are provided for personnel safety. The abort switches are designed to interrupt the automatic evacuations of the CO_2 system, thereby extending the evacuation time. The abort switches are of the spring return "dead-man" type, so that the abort switch has to be held in the abort position. The operation of an abort switch will cause an alarm in the control room and locally.

The abort switches are overridden by the manual-electric pull boxes and by manual operation of the CO_2 system.

Also, to increase availability, the CO_2 system is powered from the 125-V dc system which has both black diesel and battery back-up on loss of ac power.

NRC Concern

2.D.1 Lack of availability becuase CO_2 system is disabled during maintenance when probability of fires is greatest.

Response

As discussed above, it is planned that all major maintenance will be conducted during plant shutdowns, that the CO_2 system is technically specified to provide a fire watch if the CO_2 system is disabled, that a key is required to lock the system out of automatic discharge, that manual actuation is still available, and that the system will alarm locally and in the control room if the system is in the locked-out mode.

NRC Concern

2.D.2. Number of LERs on CO_2 systems found disarmed.

Response

There have been no LERs written on BVPS-1 for the disarmement of the CO_2 system.

In review of past LERs, there were only a few instances where CO_2 systems were reported as being disarmed. In each case, the CO_2 system was disarmed for either testing or maintenance purposes, and fire watches were posted in accordance with procedures.

NRC Concern

2.D.3 Poor record on "Acceptance Testing" of CO_2 Systems.

Response

The CO_2 systems will be put into operation only after acceptance tests performed in accordance with NFPA-12 ANI acceptance testing and manufacturers' instructions are successfully passed.

NRC Concern

2.E. Record

2.E.1. Browns Ferry

Browns Ferry fire lessons learned (NUREG-0050). "It is obvious that the longer a fire burns, the more damage it will do. The Browns Ferry fire shows that prompt extinguishing of a fire is in most circumstances, also the way to limit the consequences of a fire on public safety. The Review Group recommends that serious consideration be given to installing or upgrading fixed water sprinkler systems, and to make them automatic. This is especially important in areas containing a high density of cables or other flammable materials, where there is a combination of flammable materials and redundant safety equipment or where safety equipment is located and where access for fire fighting should be considered in the design and procedures."

Response

The above excerpt is from Section 1.6.2 of NUREG-0050. Section 1.6, Principal Recommendations, states "The reader should be reminded that not every

recommendation applies to every nuclear power plant." Additionally, it goes on to state "Other alternatives besides those recommended by the Review Group may be equally acceptable. From among the various alternatives, those appropriate and sufficient should be chosen for a given plant. For different plants, it will quite likely be found that different choices are appropriate and sufficient."

The Review Group acknowledged that the first line of defense with regard to fires is an effective fire prevention program. It was found that Browns Ferry used a highly combustible penetration seal, an unnecessary ignition source (candle to test for air leakage), and a highly combustible type of cable insulation. These concerns do not apply for BVPS-2. All penetration seals use noncombustible material which have been verified to withstand the effects of highly intense fire. BVPS-2 will not check fire seals with open flames. Lastly, BVPS-2 has utilized cable that has passed IEEE-383 flame test for vertical configurations.

The second line of defense pertains to detecting and extinguishing fires promptly to limit the extent of damage. The Review Group stated that the detectors should be designed to detect the products of combustion from the combustible material and should be properly located. For the cable spreading room, relay room and cable tunnel, BVPS-2 has removed the heat detectors that were originally designed to actuate the fire suppression system and replaced these with smoke detectors. This was done to reduce the response time required to detect a fire.

It should be noted that the fire in the Browns Ferry cable spreading room was controlled and extinguished without the use of water. The fire in the Reactor Building, which did not utilize a fixed suppression system, was fought unsuccessfully with portable carbon dioxide and dry chemical extinguishers. Once a hose stream was directed towards the fire, the fire was quickly extinguished. The Review Group is concerned about the reason for using water on cable tray fires. BVPS-2 procedures and fire fighting training emphasized the use of water from the hose racks utilizing nozzles locked in the fog position as a means for manual fire fighting capabilities for areas containing high concentration of cables. Adequate fire hoses will be provided throughout the plant.

The capability for the control of the ventilation system is provided at BVPS-2 to deal with fire and smoke. Upon receipt of a smoke alarm signal, the supply and exhaust fans to the cable spreading area/cable tunnel are shut down.

The Review Group states that provisions should be implemented to assure that systems that are required to safely shutdown the plant are available. BVPS-2 has installed an Alternate Shutdown Panel (ASP) that is completely independent from the cable spreading room, relay room and cable tunnel. That is, a fire in the above-listed areas will not prevent the safe shutdown of the plant.

NRC Concern

2.E.2. NRC Guidelines

Our guidelines reflect the recommendations of NUREG-0050 and summarize them in Paragraph B.2 of BTP CMEB 9.5-1, "Use of Water in Electrical Cable Fires" (page 9.5.1-4).

Response

Water in most cases provides the best means of extinguishing an electrical fire, if water can be placed direct onto the fire. The design of the BVPS-2 cable spreading room is not conducive to direct water application. As a result of compliance with Regulatory Guide 1.75, cable tray covers and/or bottoms will be installed on approximately 60 percent of the trays for separation. These covers and/or bottoms provides a barrier which obstructs the direct application of water to the fire. CO_2 by virtue of its gaseous nature will penetrate into these cable trays and provides fire suppression to the fire. Due to the stack arrangement of the cable trays and the fact that the trays are provided with covers and/or bottoms, DLC's position is that the CO_2 system provides prompt extinguishing of the fire and ensures the safety of this area.

In addition to the fixed CO_2 system, hose stations are provided as a backup for use by the onsite fire brigade and offsite local fire departments.

NRC Concern

2.E.3. Implementation

It has been NRC policy since the guidelines were issued in 1976 to require for all NOTLs to install a fixed-water suppression system in each of the cable spreading rooms.

Response

The guidelines applicable to BVPS-2 are those contained in NUREG-0080, Standard Review Plan (SRP). In accordance with the requirements of 10CFR50.34(g)(1), BVPS-2 should be evaluated against the SRP in effect six months prior to the docket date of its application (Application docketed May 18, 1983). 10CFR50.34(g)(3) also establishes that "The SRP is not a substitute for the regulations and compliance is not a requirement." The SRP in effect six months prior to BVPS-2 docket is Branch Technical Position CMEB-9.5.1. Section C.7.c., Cable Spreading states in the first paragraph that the ".... primary fire suppression in the cable spreading room should be an automatic water system .....". However, in the second paragraph of this same section, gaseous systems are discussed along with the criteria of when they are acceptable. These BTP guidelines indicate that both water and gas are acceptable suppression systems.

The guidelines issued in 1976, Appendix A of BTP APCSB 9.5-1, contained specific guidance that "... gas systems may be used for primary fire suppression if they are backed up by an installed water spray system ...". When BTP CMEB 9.5-1 was written, the guidelines of Appendix A to APCSB 9.5-1

were incorporated and Appendix A was deleted. The specific guidance to install a backup water spray system when using a gas suppression system was also deleted.

Appendix R of 10CFR50 is presently the only regulation which contains specific fire protection requirements. Although Appendix R is not applicable to BVPS-2, these requirements have been included in the guidelines of the BTP CMEB 9.5-1. Appendix R does not contain any requirement relative to the unexceptability of CO_2 as a fire suppressant. Since 1976 at least five nuclear plants have been licensed with a CO_2 system without a fixed water suppression system. Similarly, an additional three plants have been licensed with only a Halon system.

NRC Concern

2.E.4. Other Guidelines

The International Guidelines for the Fire Protection of Nuclear Power Plant (1974) also specify water for cable fires.

Response

The International Guidelines for the Fire Protection of Nuclear Power Plants (Revised Edition, 1983) recommend that deluge systems be used to protect areas with extensive cable concentrations. However, these guidelines also state that gaseous suppression should be considered for cable rooms where sprinkler systems are not acceptable for specific reasons. Our insurer, American Nuclear Insurers (ANI), has accepted the concept of carbon dioxide in the cable spreading room based on the fact that the cable trays will have covers and/or bottoms installed.

3. NRC Concern

In our SER, we indicated that the fire alarm system complies with 72D for a Class "A" system. Based on observations during our visit, we raised concerns about the fire alarm systems compliance with NFPA 72D with regard to the list of all equipment and circuit supervision. The applicant should provide verification that the fire alarm systems comply with 72D for Class "A" system.

Response

All safety-related areas of the plant are protected by the "Early Warning" Fire Detection System. The early warning fire detection system is a Honeywell Multiplex system, consisting of smoke detectors (ionization and photoelectric) and flame detectors (ultraviolet).

This system is a Class A circuit as defined in NFPA 72D (1978) or a style D system as defined in NFPA 72D (1980).

For the actuation of the CO_2 and Halon systems, there is a fire detection/actuation system which is called the "XL-3" system. This system provides duplicate coverage to the Early Warning System in areas protected by CO_2 or Halon. The XL-3 detection system consists of "smart detectors," that is,

smoke detectors with computer chips in them, so they can "talk" to the main process panel. This panel is called the XL-3 panel which provides a print-out of detector status and all alarm functions. The circuits between the detectors and the XL-3 system are all Class "A." The XL-3 panel sends a signal to the CO_2 or Halon local fire panels to actuate a fire alarm locally and a second signal (the cross-zoned part) to actuate the CO_2/Halon pre-discharge alarms and discharge cycles. All these circuits and the actuation circuits are Class "A" circuits. The CO_2/Halon system local panels also provide supervised annunciation on the "Building Services Control Panel" located in the control room.