UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR AUTHORIZATION UNDER 10 CFR 20.1703(a)(2) AND EXEMPTION FROM CERTAIN 10 CFR PART 20 REQUIREMENTS RELATED TO THE USE OF SELF-CONTAINED BREATHING APPARATUS WITH ENRICHED OXYGEN IN SUBATMOSPHERIC CONTAINMENTS AT THE SURRY POWER STATION, UNIT 1 AND UNIT 2 DOCKET NUMBERS 50-280 AND 50-281

INTRODUCTION:

Virginia Electric and Power Company (VEPCO, the licensee) in its letter dated March 27, 1997, as supplemented by submittals datted July 28, 1997, March 3 and May 5, 1998, requested authorization under 10 CFR 20.1703(a)(2) and an exemption from 10 CFR 20.1703(a)(1) and (c), and certain requirements of 10 CFR Part 20, Appendix A, Footnote d.2.(d), to use certain models of Mine Safety Appliances, Inc. (MSA) open-circuit self-contained breathing apparatus (SCBA). These SCBAs will provide the wearer with enriched oxygen while working in a subatmospheric, oxygen-deficient primary containment. While providing the worker with an adequate breathing supply (by using a gas mixture of 35% oxygen and 65% nitrogen) in an oxygen-deficient environment, the SCBAs fall outside the respiratory protection equipment certification issued by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) required by 10 CFR Part 20. NIOSH/MSHA limits breathing air oxygen content to 23.5% for open-circuit SCBAs, in order to reduce and limit the probability of flammability/material problems during use.

In an effort to use an existing NIOSH-certified SCBA that would supply at least 35% oxygen to the user, the licensee evaluated the use of closed-circuit (rebreather) SCBAs. These units provide elevated oxygen levels to the user, sufficient to compensate for the effects of the subatmospheric containment. However, the results of the licensee's overall evaluation of these devices were negative, given the identified disadvantages, including the problem of high temperature of the supplied air to the user. The high-temperature breathing air provided by the closed-circuit device unnecessarily added to the worker's heat stress, and was uncomfortable to the wearer. This contrasts with the licensee's long history (21 years) of successful open-circuit SCBA use and widespread user acceptance of the open-circuit design at its facilities.

Under 10 CFR 20.1703(a)(1), the use of NIOSH/MSHA-certified equipment is required to limit worker intakes of radioactive materials. A licensee may seek authorization to use respiratory equipment that has not been tested and certified by NIOSH/MSHA pursuant to 10 CFR 20.1703(a)(2). This subsection requires the licensee to demonstrate by testing that a respirator is capable of safely providing the necessary level of protection under the anticipated

conditions of use. Additionally, 10 CFR 20.1703(c) requires that only NIOSH-certified equipment be used as emergency devices. 10 CFR Part 20, Appendix A, Footnote d.2.(d), in part, requires ".....Respirable air shall be provided of the quality and quantity required in accordance with NIOSH/MSHA certification (described in 30 CFR part 11)." The 30 CFR Part 11 requirement is that oxygen content be less than 23.5%.

The footnote further cautions "Oxygen and air shall not be used in the same apparatus". This prohibits the use of respirators that have been used with normal compressed breathing air, from later being used with enriched oxygen concentrations because of potential combustion/explosion hazards from buildup of oil contamination from normal compressed air. However, VEPCO is not seeking exemption from this requirement.

The fire brigade requirements in the licensee's approved fire protection program require the use of NIOSH approved, full scale, positive pressure SCBAs that provide the user with a rated minimum of 30 minutes of supplied air.

Test data and results to ensure material compatibility with enriched oxygen use, administrative controls to segregate the containment-use only (CUO) SCBAs, and a sustained period of successful use of similar SCBAs form the basis for the licensee's request for an appropriate Part 20 exemption and authorization to use various MSA SCBAs during normal and emergency conditions in primary containment. Criteria and background information used for the staff's evaluation include Section 20.1703(a)(2) of 10 CFR Part 20; Section 19.12 of 10 CFR Part 19; Regulatory Guide 8.15; NUREG/CR-0041; 30 CFR Part 11 and American National Standards Institute (ANSI) Z88.2-1992, "Practices for Respiratory Protection".

DISCUSSION AND EVALUATION OF TESTING

The subatmospheric containments at both VEPCO nuclear facilities present an oxygen deficiency challenge for the workers who enter that environment. The containment pressure can range from about 9 to 11 pounds per square inch absolute (psia), which equates to oxygen concentrations of 12-15% at normal atmospheric pressure. These containments thus constitute oxygen-deficient areas. Because open-circuit SCBAs sense ambient pressure (supplied breathing air pressure from the SCBA is proportional to that pressure), workers with SCBAs (with normal 21% oxygen breathing air) in reduced-pressure work areas will not receive adequate oxygen. In order for the workers to avoid oxygen deficiency problems (e.g., dizziness, shortness of breath, cramps) in subatmospheric areas, the open-circuit SCBA must supply the wearer with enriched oxygen. However, aside from negating the NIOSH certification, the use of 35% oxygen enriched breathing air does present an increased risk of certain types of SCBA material failure and flammability problems under extreme conditions of use.

The licensee requested authorization to use several types of MSA SCBAs as CUO devices: 1) Model 401, with either brass or aluminum parts, 2) Ultralite, and 3) Custom 4500 Dual-Purpose SCBA (the latter two types have only aluminum parts). The licensee designates CUO

devices as such and segregates and controls these devices to ensure no exchange with other SCBAs using normal compressed air. The Custom 4500 SCBA operates at pressures up to 4500 psia and uses aluminum components, while the other models' operating pressures are less than 2100 psia. Given that the material failure problems with compressed air systems are heightened with increased operating pressures and aluminum parts are more prone to failure than brass parts, the Custom 4500 SCBA was used in the testing program to envelope the lower pressure applications of the Model 401 and Ultralite units. As discussed below, the results of the testing program demonstrated that, given certain conditions, these MSA SCBA units will perform safely under adverse conditions.

The licensee contracted with the National Aeronautics and Space Administration (NASA) and Lawrence Livermore National Laboratory (LLNL) to conduct controlled testing. NASA's White Sands Test Facility (WSTF) examined ignition and combustion within the SCBA regulator, and compressive heating of hoses and regulator softgoods (e.g., O-rings). The test results showed that the Custom 4500 materials did not promote ignition under conditions up to 51% oxygen at 4500 psig. However, with hydrocarbon contamination present, combustion testing showed ignition and failure of nonmetal regulator parts, and some metal parts did melt. The compressive heating tests were conducted under worst-case conditions -- during rapid pressurization during start up. The test results showed that only at ambient temperatures greater than 135°F did some non-catastrophic regulator O-ring failures occur. As a result of the WSTF testing, the licensee committed to follow procedures in place which address the following actions and conditions of use for the CUO units. All maintenance and repair activities and environments will be free of hydrocarbon contamination - the CUO units are maintained to preclude introduction of hydrocarbon contamination (e.g., oil). This is normal maintenance practice with compressed, high pressure, supplied-air systems, and is consistent with MSA normal maintenance and repair recommendations and procedures. To prevent compressive heating problems, the CUO units will not be started up in environments with temperatures greater than 135°F (users will start up the CUO units before entry into elevated temperature areas).

As recommended by NASA's WSTF, LLNL conducted testing to address the use of the CUO units in firefighting applications. The concern focused on the potential effects of exhalation and leakage of enriched oxygen mixture from the SCBA facepiece into a fire-charged environment. All three types of MSA SCBAs can use the same types of facepieces. LLNL tested two types of interchangeable facepieces against the National Fire Protection Association (NFPA) heat and flame requirements, which simulate typical fire conditions. The HighCarb facepiece failed the test due to sustained burning at the back of the exhalation valve; this was the only failure point on the mask. As a result, the testing continued with a silicone facepiece, and these tests were successful. LLNL concluded that a SCBA equipped with a silicone facepiece meets the NFPA Flame and Heat Test. The licensee implementing procedures will require that CUO SCBAs be equipped only with silicone facepieces.

RESPIRATORY PROTECTION PROGRAM REQUIREMENTS

Subpart H of 10 CFR Part 20, Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas, establishes the requirements for implementing a respiratory protection program. These programmatic requirements ensure that worker doses from airborne radioactive materials are maintained as low as reasonably achieveable (ALARA). The licensee intends to integrate the use of the enriched-oxygen SCBAs into the existing respiratory programs that satisfy Part 20 requirements and support fire brigade activities in primary containment.

Certain 10 CFR Part 20 requirements, pertinent to the use of enriched-oxygen CUO SCBAs, and the licensee's programs to meet the requirements are discussed below:

1. Fit testing individual users

   The licensee follows the latest consensus industry guidance provided in ANSI Z88.2-1992, and worker fit testing procedures employ a a minimum fit factor of 1000, greater than the minimum industry standard of 100. The licensee's program includes fit testing workers prior to initial use and periodically afterward. Providing an adequate fit of the facepiece to a worker's face ensures that face-seal leakage will not be excessive and will not lead to significant shortening of the SCBA-rated air supply. Since the licensee provides a wide selection of different sizes, the licensee can provide acceptable fits to essentially 100% of the qualified workers.

2. Maintenance and testing of respirators

   The licensee conducts a CUO SCBA maintenance program that is implemented by station personnel trained and certified by the respirator vender, MSA. The SCBAs are maintained in accordance with MSA recommendations for preventative maintenance and repair, and this maintenance is governed by management-approved station procedures. These procedures take into account and implement the special needs and techniques required as a result of the use of the enriched oxygen (e.g., oil-free maintenance area). Additionally, these procedures specify the type and frequency of each required maintenance/surveillance item, e.g., regulator inspection and O-ring replacement.

3. Respirable breathing air provided to respirator users

   Breathing gas quality and composition are ensured by strict controls used by the authorized vendor, in accordance with the latest revision of the United States Pharmacopeia (USP)-The National Formulary (NF). The cryogenic process for producing the breathing gas mixtures ensures that no detectable contaminants (e.g., oil) can be present. The onsite gas handling systems (cascades) are dedicated solely for the enriched oxygen/nitrogen mixtures. The appropriate CUO SCBA air cylinders have been

qualified for handling the gas mixtures in accordance with the Compressed Gas Association's Pamphlet C-10, Recommended Procedures for Changes of Gas Service for Compressed Gas Cylinders.

4. Training of workers

The worker training and retraining program includes appropriate hands-on and classroom instruction. Specific training is provided on proper operation and use of the CUO units and actions to be taken in the event of equipment malfunction. The industrial hygiene hazards of the subatmospheric containment and appropriate emergency actions are included in the training program.

5. Initial and periodic medical evaluations

As required by 10 CFR 20.1703(a)(3)(v), under the direction of licensed physicians, periodic physicals (medical evaluations) are performed on workers who may enter the subatmospheric containment using CUO SCBAs. This program is effective in screening and identifying certain workers with existing medical conditions that could hamper their performance while working in the elevated temperatures and humidity of containment. These workers are not authorized to enter the subatmospheric containment. Since the subatmospheric containment does present elevated temperatures and high humidity, to reduce worker stresses, the licensee maintains a heat stress management program. This program includes the use of cooling garments, limiting stay-times, and other techniques.

FIRE BRIGADE RESPIRATORY NEEDS

The testing described above performed by the National Laboratories demonstrates that the three types of MSA units do not present undue hazards to the workers using these devices during adverse conditions, such as firefighting. Manufacturer documentation and NIOSH certification clearly show that these SCBAs are full-face, positive-pressure units that are rated to provide a minimum 30-minute supply of air (at a nominal ambient 14.7 psia). Use of SCBAs at subatmospheric pressures will not reduce this supply duration. Additionally, upon approval of its exemption request, the licensee will not allow use of the older design CUO Model 401 for in-containment firefighting. With a rated flowrate of 40 L/min (regulator output), the Model 401 does not meet the current NFPA requirements of 100 L/min to the user. Higher breathing air flowrates to the users provide greater safety margins against hazardous facepiece in-leakage (e.g., over breathing at high work rates) and enhance worker safety during responses to emergencies. The licensee commitment to use only high-flow SCBA improves worker safety and enhances firefighting capability within primary containment.

CONCLUSIONS

Pursuant to 10 CFR 20.1703(a)(2), VEPCO has requested authorization to use certain respirators that have not been tested and qualified by NIOSH/MSHA for use with an enriched oxygen-nitrogen mixture for worker protection inside the containment. VEPCO has also requested exemption from certain requirements of 10 CFR 20.1703(a)(1), 10 CFR 20.1703(c) and 10 CFR Part 20 Appendix A, Footnote d.2.(d).

Based on the staff's review of the referenced licensee submittals and commitments therein, the staff concludes that the request to use oxygen-enriched breathing air for certain designated SCBAs is in accordance with the intent of the requirements of 10 CFR Part 20 and should be authorized as requested. Granting an exemption from Part 20, related to the use of CUO SCBA, improves worker safety while working in an oxygen-deficient environment. Additionally, by providing an exemption to Part 20 requirements pertinent to the use of NIOSH-certified respiratory equipment, the modified CUO SCBA program improves worker and plant safety by improving protection provided to the fire brigade during in-containment activities and is, therefore, acceptable. Accordingly, the requested exemption is authorized by law and would not result in undue hazard to life or property, and should be granted.

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Date: September 3, 1998

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September 3, 1998

MEMORANDUM TO: Rules and Directives Branch
Division of Administrative Services
Office of Administration

FROM: Office of Nuclear Reactor Regulation

SUBJECT: SURRY POWER STATION, UNITS 1 AND 2 - EXEMPTION FROM 10 CFR 20.1703(a)(1), 10 CFR 20.1703 (c) and 10 CFR PART 20, APPENDIX A, PROTECTION FACTORS FOR RESPIRATORS, FOOTNOTE d.2(d), AND AUTHORIZATION TO USE CERTAIN RESPIRATORS FOR WORKER PROTECTION INSIDE CONTA*

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- ☐ Notice of Receipt of Partial Application for Construction Permit(s) and Facility License(s): Time for submission of Views on Antitrust matters.
- ☐ Notice of Consideration of Issuance of Amendment to Facility Operating License. (Call with 30-day insert date).
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- ☐ Notice of Preparation of Environmental Assessment.
- ☐ Receipt of Petition for Director's Decision Under 10 CFR 2.206.
- ☐ Issuance of Final Director's Decision Under 10 CFR 2.206.
- ☐ Other: _____

*(TAC NOS. M98382 AND M98383)

DOCKET NO. 50-280 and 50-281

Attachment(s): As stated

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