APPENDIX C

DETERMINATION OF HEPA FILTER LIFE

Despite the difficulty of determining HEPA-filter life based on research data, a conservative interpretation of these data can be used to set age limits. The age limit[1] can be set based on the data derived from the observed decreases in the tensile strength of dry filter media with age and the further reduction in strength due to water exposure.

Although filter life cannot be directly estimated using the data, there is a significant decrease in tensile strength with age for both the unfolded and folded media. Test results also showed a decrease in media tensile strength with age, although the trends were not as distinct because of the scatter in the data.

The extrapolated unfolded data suggests the tensile strength fails at 13 years. Tests indicated that folded media do not have the required 2.5-pound/inch tensile strength even when new and is extremely low at 7 years. Research showed that the tensile strength of new filter media is directly proportional to the pressure drop at which the HEPA filter shows structural failure at the pleats. By applying this relationship to aged HEPA filters, the minimum pressure drop for structural damage decreases with age. Similarly, the burst-strength data show several filters with very low burst strength after 7 to 8 years. Thus, under dry conditions, the filter media fail the required tensile strength or have very low burst strengths after 7 to 13 years, or an average of 10 years. Based on this data, it is recommended that HEPA-filter life under dry conditions be set at 10 years.

When the filter have been exposed to water, the strength of the filter media is further decreased, thereby reducing effective filter life. Even if a demister is used, the high humidity resulting from the water sprays would most likely cause the filter to become wet. Tests have shown the combined effect of both age and water exposure. Water exposure reduces the age limit for the same strength criterion. For example, the occurrence of water exposure would shift the age limit for a dry media form 7 years to 3 years. Exposure to water will reduce the HEPA tensile strength to less than the initial acceptance tests. Thus, a filter that could fail at 7 to 13 years when dry could fail at about 3 to 7 years, or an average of 5 years, when the potential for water exposure exists. Filters that actually become wet should be replaced quickly.

The water repellency of the filter media also appears to decrease with age. However, this decrease may be largely due to water adsorption by deposited particles. Research found that folding the filter media decreases the water repellency even for new filter media. Tests also showed a decrease in water repellency with folded media and found that even the pleats of new media absorb water. The pleat water absorption coupled with its inherent weakness, makes the pleats especially prone to structural failure.

A 5-year maximum age of HEPA filters for ventilation systems having in-duct water sprays can be justified because of decreased tensile and burst strengths and decreased water repellency resulting from age and with media folding.

The age limits in this report are based on highly variable data, but more accurate age limits can be derived from controlled experiments in real time over 5 to 10 years using a specific filter-media roll. Until such long-term studies are conducted, establishing a 5- and 10-year HEPA filter life for wet and dry ventilation systems,

[1] *Lawrence Livermore National Laboratory, Maximum HEPA-filter Life, Werner Berman, Hazards Control Department, UCRL-AR-134141, June 1999.*

respectively, will ensure that most (although not all) HEPA filters will not suffer a significant loss in strength due to age.

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The following flow chart depicts Savannah River Site's methodology for determining system specific service life and is presented merely for guidance.