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14  
15 IN THE UNITED STATES DISTRICT COURT  
16 FOR THE NORTHERN DISTRICT OF CALIFORNIA

17 TRI-VALLEY CARES, NUCLEAR WATCH )  
18 OF NEW MEXICO, MARYLIA KELLEY, )  
19 JANIS KATE TURNER, TARA DORABJI, )  
20 HENRY C. FINNEY and CATHERINE )  
21 SULLIVAN, )  
22 Plaintiff, )

23 v. )

24 UNITED STATES DEPARTMENT OF )  
25 ENERGY, NATIONAL NUCLEAR )  
26 SECURITY ADMINISTRATION, )  
27 LAWRENCE LIVERMORE NATIONAL )  
28 LABORATORY and LOS ALAMOS )  
NATIONAL LABORATORY, )  
Defendant )

Case No.: C-03-3926 SBA

**DECLARATION OF MARION  
M. FULK IN SUPPORT OF  
PLAINTIFFS' MOTION FOR  
SUMMARY JUDGEMENT**

I, Marion M. Fulk, declare:

1. I am a Chemical Physicist, retired from the University of California, Lawrence Livermore National Laboratory (LLNL) in 1984, where I served for eighteen years as a staff scientist in chemical physics and material sciences. At LLNL most of my work was classified, but it included the study of radioactive rainout and aerosols; their dynamics, initiation and

1 growth. At LLNL, I studied problems associated with aerosolized particles and their capture by  
2 High Efficiency Particulate Air filters, commonly called HEPA filters. I also studied various  
3 toxic and radioactive materials including uranium and plutonium.

4 2. From 1952-1967, I was employed by the National Bureau of Standards, Atomic  
5 Energy Commission Cryogenic Laboratory in Boulder, Colorado and Ball Brothers Research,  
6 also in Boulder. At NBS, I worked in low-temperature physics, properties of materials, heat  
7 transport and optical properties of metals. My work there involved handling experimental  
8 quantities of uranium. At Ball Brothers, I developed spacecraft for the National Aeronautics and  
9 Space Administration (NASA), where I studied surface phenomena and properties of materials.

10 3. From 1951-1952, I worked for the University of California/Scripps Institute in La  
11 Jolla, California where I studied tsunamis in the ocean and low frequencies in the atmosphere.

12 4. From 1947-1951, I worked for the University of Minnesota in Minneapolis, where  
13 I did research in nuclear physics, including work on neutron scattering cross-sections. I am  
14 currently an Emeritus member at large, Sigma Xi, the Scientific Research Society, and an honor  
15 society for scientists and engineers.

16 5. From 1945-1947, I worked for the University of Chicago in Chicago, Illinois,  
17 where I did research on biological systems.

18 6. I am a past member of the American Mathematical Society, the American  
19 Physical Society, and the American Association for the Advancement of Science.

20 7. I am the author of the American Institute of Physics Handbook, Section 6;  
21 Optics, Radiometry, 2nd edition, published by McGraw Hill, 1963. I have written numerous  
22 classified reports on the properties of nuclear materials and various research and development  
23 issues associated with nuclear weapons systems for LLNL.

24 8. In 1974, I received the NASA/Skylab Achievement Award for my work on  
25 Skylab dealing with scientific instruments and packages, heat calculations, radiation studies on  
26 materials, and verification of equipment functioning.

27 9. Throughout my professional career I have worked as a consultant to various  
28 governmental agencies and private corporations. My consulting for NASA included work at  
Martin Marietta Corporation in Denver, Colorado, and work at Cape Canaveral, Florida, where I  
consulted on rocket motors, heat transport problems and optical properties of materials. I also did  
classified work for the Atomic Energy Commission in Livermore (predecessor to the Department  
of Energy). I have done consulting work for various aerospace companies including TRW in

1 Los Angeles, California, where I worked on instruments and equipment for spacecraft, and  
2 Hughes Aircraft in Los Angeles, where I worked on moving materials in space, as well as  
3 various industrial companies including Union Carbide Company in Tonawanda, New York,  
4 where I consulted on low-temperature properties of fine materials and heat transport.

5 10. I have reviewed the final Environmental Assessment for the Proposed  
6 Construction and Operation of a Biosafety Level 3 Facility at the Lawrence Livermore National  
7 Laboratory (LLNL) and the Finding of No Significant Impact (FONSI) issued by the Department  
8 of Energy (DOE) in December 2002.

9 11. The final Environmental Assessment (EA) and FONSI are fatally flawed by the  
10 DOE's failure to adequately consider and fully analyze potential scenarios for worker and off-site  
11 exposure to biological agents such as live anthrax, Q fever, botulism, bubonic plague and  
12 numerous other pathogens and toxins that may be handled in the LLNL Biosafety Level 3 (BSL-  
13 3) facility. Due to this failure, the EA and FONSI provide an insufficient basis for proceeding  
14 with a decision to build and operate the BSL-3 facility at LLNL.

#### 15 **HEPA Filter Problems and Health Implications Under Normal Operating Conditions**

16 12. High Efficiency Particulate Air, or HEPA, filters are the primary method used at  
17 LLNL to filter hazardous and radioactive emissions. So, too, will HEPA filters be the last bastion  
18 of defense before biological agents escape into the environment from the proposed BSL-3  
19 facility at LLNL.

20 13. Most HEPA filters at LLNL are flimsy, weak, fiberglass paper and glue  
21 structures mounted in wood or metal frames. HEPA filters are a generic nuclear safety issue at  
22 all nuclear installations. The performance of these filters controls the quality of the air released  
23 into the workplace and the environment. HEPA filters can fail completely when wet, plugged,  
24 hot and over-pressured from fires, explosions, blowers and even severe storms. With age, minor  
25 forms of these threats can cause filter blowouts. E.H. Carbaugh, in a survey of DOE facilities,  
26 found that filter failures occur in approximately 12% of all installed paper-glue HEPA filters.  
27 Handling or installation damage accounted for about 20% of the reported failures<sup>1</sup>. A fragile  
28 HEPA filter system is all that stands between nearby residents and workers and routine processes  
and accidents in the LLNL BSL-3 that will produce potentially deadly biological aerosols.

14. When HEPA filters are operating normally, under the best of circumstances, they  
have a translucency for particles of approximately 0.1 micrometer in size. (Approximately 1 out

1 of 1000 gets through the filter<sup>2</sup>.) I have appended a diagram from the 23<sup>rd</sup> Department of  
2 Energy/Nuclear Regulatory Commission Air Cleaning and Treatment Conference, Session 14,  
3 July 1994, co-chaired by LLNL physicist Werner Bergman to my declaration as Exhibit 1. The  
4 diagram at Exhibit 1 shows that HEPA filters have a reduced efficiency (effectiveness) capturing  
5 particles between approximately 0.05 and 0.3 micrometers in size, with the largest inefficiency in  
6 the 0.1 micrometer range.

7 15. Numerous biological agents that may be used in the LLNL BSL-3 are also of the  
8 particle size range most likely to escape capture by HEPA filters, even when the filter is  
9 operating properly<sup>3</sup>. These 0.1 size particles (difficult for HEPA filters to capture and remove)  
10 will stay suspended in air for long periods of time. Therefore, they may travel with the winds for  
11 long distances.

12 16. Many of the potentially lethal viruses that will be used in the BSL-3 are between  
13 0.015 micrometers and 0.3 micrometers, with some viral species in the 0.1 micrometer range  
14 where the HEPA filter capture is least efficient. Nanobacteria and bacteria that may be used in a  
15 BSL-3 range from 0.05 microns to 0.3 microns, including some in the 0.1 micrometer range.  
16 Under perfect conditions, on average, 1 out of every 1000 of these biological agents in the 0.1  
17 micrometer range can escape the HEPA filter.

18 17. *Rickettsia burnetti* (also called *Coxiella burnetti* or Q fever) is listed in the LLNL  
19 EA and is one of many dangerous biological agents that will be handled in the BSL-3. *Rickettsia*  
20 is easy to aerosolize (make airborne) and it makes fomites, meaning it has the ability to  
21 contaminate clothing, food, dirt and other media that is likely to come into contact with humans.  
22 *Rickettsia* can be very hardy and can survive and remain a potent health threat in the  
23 environment over time.

24 18. The LLNL EA states that the BSL-3 facility will handle a maximum of 10 liters  
25 of biological agents at a time, with up to one liter of any single agent. The LLNL BSL-3 will  
26 operate with organisms in a concentration of up to  $10^8$  per milliliter. This means that there will  
27 be up to one hundred billion (100,000,000,000) cells or organisms in each liter of each biological  
28 agent at any given time.

19 19. The aerosolizing unit in the LLNL BSL-3 will use one milliliter (or more) of  
20 bioagent at a time. A single milliliter will make airborne approximately one hundred million  
21 (100,000,000) cells or organisms at each use. At the concentration specified in the EA, a single  
22 milliliter of aerosolized biological agent measuring about 0.1 micrometer in size will release one  
23

1 hundred thousand (100,000) organisms through a HEPA filter under perfect operating  
2 conditions.

3 20. If there are two HEPA filters in series, each milliliter of aerosolized bioagent will  
4 release one hundred (100) organisms measuring about 0.1 micrometers in size through the entire  
5 filter system. This estimate is very conservative and may understate the number of organisms  
6 released to the environment because it not only assumes perfect operation but also gives the  
7 second HEPA filter in series the same mathematical efficiency as the first HEPA filter in the  
8 series. In reality, the second HEPA in series will be less efficient because, among other factors,  
9 (a) particles will be less charged, (b) their velocity and streaming potential will be different, and  
10 (c) their size distribution will change. In sum, more than one hundred organisms per milliliter  
11 may be released through a double bank of HEPA filters.

12 21. Rickettsia (the class to which Q fever belongs) is a bioobligate bacteria measuring  
13 about 0.2 micrometers, and is therefore still in the size range most difficult to capture by HEPA  
14 filters. I am using Rickettsia to calculate potential disease spread because it is the pathogen used  
15 in the EA, some of the pathogens that may be used in the LLNL BSL-3 are more virulent. On  
16 page 52, the EA states that the Centers for Disease Control and Prevention considers ten  
17 Rickettsia microorganisms capable of causing illness in a healthy adult, with other sources cited  
18 by CDC placing it as low as one to five Rickettsia microorganisms. In this case one  
19 microorganism is one cell. Therefore, one milliliter of aerosolized Rickettsia in the LLNL BSL-3  
20 is capable of causing from 10 to 100 illnesses (e.g., cases of Q fever) under perfect operating  
21 conditions.

22 **HEPA Filter Problems and Health Implications Under Accidental**  
23 **or Abnormal Operating Conditions**

24 22. An overarching deficiency of the EA is its failure to analyze in depth or detail any  
25 of the potential bioagent release scenarios from the BSL-3 at LLNL, whether through deliberate  
26 means (e.g., a disgruntled employee scenario) or due to an accident (e.g., employee error, HEPA  
27 filter rupture, earthquake or other containment breach).

28 23. The EA does not discuss potential scenarios wherein the BSL-3 HEPA filters may  
become wet. For example, the EA does not disclose whether or not the BSL-3 will be equipped  
with any sort of fire suppression system. If it is, the fire suppression system could run the risk of  
wetting the HEPA filters. HEPA filters, if they are the standard fiberglass paper and glue variety

1 generally used at LLNL, become soggy and can fail catastrophically when wet. This is a well  
2 recognized problem that is briefly alluded to but not analyzed in the EA.

3 24. The EA does not discuss other ways in which HEPA filters can get torn, reducing  
4 their efficiency to near-zero or zero. HEPA filters may become structurally damaged under a  
5 variety of conditions and expose the public and the environment to large quantities of pathogens  
6 from the BSL-3 at LLNL, with each one liter container of a single biological agent containing as  
7 many as one hundred billion (100,000,000,000) cells or organisms.

8 25. Breakage of the HEPA filter is a risk that must be taken into account. HEPA  
9 filters can rip during the installation process with DOE facilities like LLNL suffering a 12%  
10 incidence of tearing during installation, according to DOE's own survey. HEPA filters can  
11 become torn due to the blower pulse during operation. HEPA filters have a tendency to break at  
12 the accordion fold. Other changes in pressure can also damage HEPA filters, including the  
13 opening and shutting of doors. A damaged or torn HEPA filter will fail to capture biological  
14 agents, with the magnitude of the failure being proportional to the amount of damage to the filter.

15 26. As the BSL-3 facility operates, the hazard posed by HEPA filter failure increases.  
16 HEPA filters become brittle with age, and their susceptibility to fatigue and breakage increases.  
17 Because of their fragility, it is recommended that HEPA filters be changed out every six years.  
18 Yet, in the past, LLNL has left HEPA filters unchanged in its plutonium facility for more than a  
19 quarter century.

20 27. HEPA filter blow-outs occur frequently under accident or off-normal conditions.  
21 In January 1999, the Nuclear Regulatory Commission issued an information notice about the  
22 potential for HEPA filter media blow-out and the resulting loss of efficiency when the filters  
23 become moist, whether through wetting by a fire suppression system or by other means<sup>4</sup>. In May  
24 1999, the Defense Nuclear Facilities Safety Board concluded that HEPA filter systems at  
25 Department of Energy facilities like LLNL may be vulnerable to failure when most needed<sup>5</sup>.

26 28. HEPA filters can fail catastrophically in numerous accident scenarios, including  
27 events initiated by earthquake, explosion or fire. In 1969, a fire at the Department of Energy's  
28 Rocky Flats Plant in Colorado blew out multiple HEPA filters<sup>6</sup>. In 1977, an accident at LLNL  
blew the HEPA filter media through an exhaust stack<sup>7</sup>.

Each of these, as well as other potentially catastrophic accidents that may occur in  
the LLNL BSL-3, poses a serious threat to public health and the environment. Yet, the EA does  
not deal with any accident or off-normal HEPA filter events.



1 analysis is completed, which did not happen in the existing EA and FONSI, then mitigation  
2 measures may be instituted, thereby reducing the potential risks posed by the LLNL BSL-3.

3 I, DECLARE under penalty of perjury that the foregoing is true and correct, and if called  
4 as a witness I could and would competently testify thereto.

5  
6 Executed this 10th day of February, 2004, in Livermore, California.

7  
8 By \_\_\_\_\_

9 Marion M. Fulk

10 END NOTES

11 \_\_\_\_\_  
12 <sup>1</sup> 17<sup>th</sup> Department of Energy Air Cleaning Conference, 1982

13 <sup>2</sup> W. Bergman and R.R. Weidler, 23<sup>rd</sup> Department of Energy/Nuclear Regulatory Agency Air Cleaning and  
14 Treatment Conference, 1994

15 <sup>3</sup> Lange, Medical Microbiology, 22<sup>nd</sup> edition, 2001

16 <sup>4</sup> NRC Information Notice 99-01, Deterioration of HEPA Filters in a Pressurized Water Reactor Containment Fan  
17 Cooler Unit, 1999

18 <sup>5</sup> Defense Nuclear Facilities Safety Board, DNFSB/TECH-23, HEPA Filters Used in the Department of Energy's  
19 Hazardous Facilities, May 1999

20 <sup>6</sup> J. Fretthold, Proceedings of the 25<sup>th</sup> DOE/NRC Nuclear Air Cleaning and Treatment Conference, 1998

21 <sup>7</sup> Supplement Analysis for the LLNL site wide EIS, 1999  
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