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DEPARTMENT OF HEALTH

STATE OF HAWAI‘I

DEPARTMENT OF HEALTH, STATE OF HAWAI‘I Complainant, vs. UNITED STATES DEPARTMENT OF THE NAVY, Respondent.	Docket No. 21-UST-EA-02 DECLARATION OF LAURENCE THOMAS RAMSEY

DECLARATION OF LAURENCE THOMAS RAMSEY

1. My name is Laurence Thomas Ramsey, Emeritus Professor of Mathematics at the University of Hawaii. I earned a BA degree in 1970 from the University of North Dakota, with a major in mathematics and a minor in the German language. I earned my Ph.D. in mathematics from Louisiana State University in 1975. I was a mathematics professor at the University of Hawaii Department of Mathematics from 1975 until retirement in 2015. I served as chair of the department twice. I was named an emeritus professor in 2016 and continue unpaid service to the

university as a volunteer. I taught mathematics, including probability, statistics, actuary courses (probability and statistics related to the insurance industry) and mathematical finance.

2. I have reviewed ABS Consulting's report titled "Quantitative Risk and Vulnerability Assessment Phase 1 (Internal Events without Fire and Flooding): Red Hill Bulk Fuel Storage Facility NAVSUP FLC Pearl Harbor, HI (PRL)" (November 12, 2018), focusing primarily on the executive summary. I have been asked to explain in lay terms the meaning of the statistics discussed in the executive summary.

3. ABS Consulting evaluates the likelihood of both "acute" and "chronic" fuel release scenarios from the Red Hill Bulk Fuel Storage Facility. The report states (on page ES-1) that "[a]cute release scenarios involve sudden, scenario-specific, one-time fuel releases," while "[c]hronic release scenarios are combined into the class of generally undetected, potential continuous fuel releases from the [Red Hill Facility]." Regardless of whether fuel releases from the Red Hill Facility are deemed "acute" or "chronic," the report states that they "could potentially impact public water table safety."

4. In Table ES-1, ABS Consulting provides an annual probability for 9 different sizes of acute fuel release scenarios. ABS Consulting assumes that every year is fresh roll of the accident dice or a fresh spin of the barrel in Russian roulette. The technical word for this is "independent".

5. When doing probabilities of "and" among non-overlapping years, you multiply the probabilities for the separate years. For example, from fourth column of Table ES-1, the probability of a 1000-to-30000-gallon spill in each of the years 2022, 2023 and 2024 is 0.2760623 (second row of the fifth column). Hence the probability of a 1000-to-30000-gallon spill in 2022 **and** 2023 **and** 2024 is 0.2760623 * 0.2760623 * 0.2760623 = .0210388.

6. Similarly, the probability of a spill **not** occurring over the course of several years is calculated by multiplying the chance that a spill will not occur in each year. When *x* is the probability of an accident of size *z* in any given year, 1-x is the probability of **no** accident of size *z*. Having no accidents of size *z* for 100 years is a giant "and" sentence. It means that there is no accident of size *z* in year 1, **and** no accident of size *z* in year 2, **and** no accident of size *z* in year 3, etc.

7. Given these mathematic truths, it is easy to know the chances of an accident not occurring over a span of years.

8. The probability of a leak of between 1,000 and 30,000 gallons over the next year is 27.6%.

9. The probability of a leak of between 1,000 and 30,000 gallons over the next five years is 80.1%.

10. The probability of a leak of between 1,000 and 30,000 gallons over the next ten years is 96.0%. For a more personal comparison, please imagine that there was a 96% chance over the next 10 years that the brakes on your car fail. I would personally judge that risk unacceptable and uncomfortably close to certainty.

11. The probability of a leak of between 1,000 and 30,000 gallons over the next twenty years is 99.8%.

12. The probability of a leak greater than 30,000 gallons over the next ten years is 17.7%.

13. The probability of a leak greater than 30,000 gallons over the next twenty years is 32.2%.

14. The probability of a leak greater than 120,000 gallons over the next one hundred years is 34.1%. Page ES-4 of the report gives this probability as 34.2%, which is correctly calculated if one first rounds the annual probability to 0.00417 and calculate from that rounded annual probability. For items 8 through 14, my final numbers are expressed in percent and rounded to the nearest 0.1%.

I declare under penalty of perjury that the foregoing is true and correct.

DATED: Honolulu, Hawai'i, December 16, 2021.

Laurence Thomas Ramsey

LAURENCE THOMAS RAMSEY