DEPARTMENT OF HEALTH
Contested Case Hearing Re Red Hill Permit Application
19-UST-EA-01
Supplemental Testimony of Robert Jamond

I have reviewed the Expert Report DNV-GL prepared under the supervision of Dr. David M. Norfleet, and provide this supplemental testimony in response to the following characterizations and opinions DNV-GL makes in concerning its Corrosion Analysis in Section 3:

1. **"An undercut pit appears to be present within the cross-section for Coupon 3. Pits within pits and undercutting are morphologies commonly associated with microbiological influenced corrosion. Notably absent from the analyses conducted as part of the metallurgical and corrosion analyses are tests to determine whether MIC may be contributing to the corrosion process. It is well documented within the literature and oil and gas industry that rates of MIC can be much higher than rates of general corrosion."** Section 3 .1. 3 .1 at 40.

Although this pit morphology is present in microbiologically influenced corrosion, it is also present in other forms of pitting corrosion, and its presence alone does not indicate microbiologically influenced corrosion (MIC). Pitting corrosion can be caused by a local breakdown or damage to the passive film created by the concrete. It can also be caused by non-uniformities in the metal structure itself and many other variables. Tests and analysis were conducted to determine if there was any indication of microbiologically induced corrosion. During the extraction of the coupons from Tank 14, the following observations were noted on-site immediately after coupon removal to identify the potential for microbiologically induced corrosion:

- Deposits, coatings, debris scale or biological materials

- The presence of moisture
- Odors consistent with the presence of MIC
- The presence of petroleum product between steel and concrete surface

None of these observations indicated the presence of MIC. Furthermore, chemical analysis was conducted on coupon corrosion products. This testing utilizing Energy Dispersive Spectroscopy (EDS) did not indicate elevated levels of sulfide or sulfur in pit deposits. High levels of sulfide or sulfur could indicate the presence of sulfate reducing bacteria or organic acids, but elevated levels were not identified on the coupons. Exhibit N-020 Appendix A at 68-82.

2. "These posits are flawed because Dr. Johnson and Mr. Jamond ignore evidence from the analysis of the corrosion products (conducted as part of the same study) that identified chlorine concentrations that are one hundred times (100x) higher than the results from the concrete. In fact, seven (7) of the ten (10) coupons exhibited chlorine levels of 0.3 weight percent and greater, up to 1.7 weight percent. These concentrations are in excess of the 0.2 weight percent 'threshold' cited by Mr. Jamond." Section 3 .1. 3 .1 at 31.

Steel inside concrete is susceptible to corrosion when contamination of salts in the concrete causes the chloride content of the concrete at the surface of the steel to exceed the chloride threshold level for corrosion. This chloride threshold level is represented by total chloride by weight of cement. It is not determined by the percentage of chloride found in the steel's

corrosion products. The laboratory measured chloride concentrations from concrete powder taken directly behind the coupons. This testing showed chloride concentrations well below generally accepted thresholds for corrosion. Exhibit N-020 at 41 and Appendix A at 22-23.

Empirical evidence and a preliminary concrete assessment of the Red Hill Bulk Fuel Storage Facility demonstrate that the concrete is in good condition. Further investigations regarding the quality and durability of the concrete, and the potential for corrosion in the reinforcement will be conducted under AOC Section 5.4. This study will include additional analyses on the condition of the concrete structure and embedded reinforcing steel, a study of existing concrete according to principles of American Concrete Institute (ACI) 364-1R, an evaluation of concrete cores including embedded reinforcing steel, and an evaluation of the physical, chemical, and mechanical properties of the concrete.

Executed this 15th Day of January, 2021, Port Hueneme, California

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Robert Jamond