Assessment of "Potential for harm" from Universal Urethane Yellow Primer and Paint stored at Prime Incorporated's Salt Lake City facility

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Background. Following a fire during transport, a burned trailer containing thirty-two 55-gallon drums of paint and primer were stored outdoors at an industrial facility belonging to Prime Inc. at 3720 W. 800S, Salt Lake City. The burned trailer and drums were covered with tarps and located on a large concrete pad from approximately October 1st, 2015 to September 19th, 2016. On August 24th, 2016, the drums were sampled by individuals from EPA's National Enforcement Investigation Center (NEIC) and 20 tested positive for strontium and chromium via on-site x-ray fluorescent spectography (XRF) consistent with a strontium chromate primer (Universal Urethane Yellow Primer, Product Code BP1Y100B). Eight of those 20 drums were sampled with a composite liquid waste sampler (COLIWASA), and taken for analysis at the NEIC site in Denver, CO. Strontium chromate was measured following extraction via Toxicity Characteristic Leaching Procedure (TCLP; SW-846 Method 1311) and Inductively Coupled Plasma-Atomic Emission Spectometry (NEICPROC/00-0625R5; SW-846 Method 6010). Flashpoint, an indication of ignitibility or fire hazard, were also measured on an upper, clear liquid layer with suspended yellow solids from those same samples. This upper fraction of the sample was estimated at 0.5% to 3.8% of the total sample by volume (except for one sample estimated at 49.5%); this clear fraction likely represented the more volatile ingredients of the primer. Chromium levels for 7 of the drums were measured ranging between 36.8 – 65.5 mg/L, with one sample recorded at 352 mg/L; flashpoints were reported as ranging from 43-46 degrees C (109-113 degrees F). These measurements confirm that the materials were improperly stored hazardous waste.

Assessing potential for harm. EPA's Resource Conservation and Recovery Act (RCRA) Civil Penalty Policy (2003) describes a gravity-based penalty assessment consisting of "potential for harm," and "the extent of deviation from a statutory or regulatory requirement." Potential for harm is based on "the risk of human or environmental exposure to hazardous waste and/or hazardous constituents that may be posed by noncompliance," and "the adverse effect noncompliance may have on statutory or regulatory purposes or procedures for implementing the RCRA program." This report deals solely with the former: risk of human or environmental exposure, and acknowledges further guidance from the RCRA policy in assessing risk to consider 1) Probability of Exposure and 2) Potential Seriousness of Contamination. It summarizes my opinion on the likelihood of exposure to nearby human and ecological receptors of the stored materials, and what can be known about the potential toxicological impact on those receptors. Considerations included potential exposures under the actual stored conditions, a theoretical scenario if the drums leaked, and a low-probability, worst-case theoretical scenario if a fire occurred.

Summary of findings. No evidence exists that any human or environmental harm or harmful exposure occurred from the primer stored at the Prime facility. Probability of exposure to primer by humans or environmental receptors is low: no individuals appear to have been in sufficient proximity for any duration to experience adverse effects; even if a leak in a drum had occurred this remains true. Given the evidence reviewed, my opinion is that the probability of the materials catching on fire is extremely low. A fire represents the worst-case scenario for potential exposure of human and environmental receptors. Potential seriousness of contamination is also low, given relatively low quantities of material, unlikely significant environmental transport if leaking had occurred, and low density of nearby human and potentially vulnerable environmental receptors (e.g. waterways).

Toxicology is the scientific characterization of the adverse effects of chemical (e.g. PCBs, cyanide), physical (e.g. asbestos, radiation), or biological (e.g. snake venom) agents on living organisms and the ecosystem. Risk of those adverse effects occurring is a product of the intrinsic hazard of a given agent AND the likelihood of exposure. For instance, your risk of experiencing swelling, difficulty breathing, and tissue necrosis from a rattlesnake bite is zero if a snake does not bite you. Another foundational concept in risk assessment and toxicology is dose-response: the severity or extent of a given response or adverse effect is directly related to the amount, or dose, which was experienced. This innate complexity and variability of biological systems, as well as the probabilistic nature of assessing theoretical risk of exposure, confers the need to carefully identify sources of uncertainty and state assumptions that must be made when attempting to calculate any risks. When evaluating the potential exposures and associated toxicities poised by the storage of the primer, it is useful to draw from the literature for workers who are occupationally exposed to chromium primer and/or ingredients in the primer. Occupational exposures are typically magnitudes higher than potential environmental exposures that result from releases into the environment; thus, any potential health effects can be more easily detected. Safe exposure levels for workers, i.e. those determined by OSHA or other regulatory bodies, can then be put into context and considered for assessment of potential health risk at much lower levels anticipated from environmental exposures.

The material of potential toxicological concern in this scenario is Universal Urethane Yellow Primer; information on this product was obtained from PPG's Product Data Sheet and the Safety Data Sheet (SDS) (1). The product data sheet for Universal Urethane Yellow Primer describes it as the corrosion inhibitive primer of a two-part coating system that also includes application of a fluoropolymer topcoat. It is recommended for use in storefronts, building panels, curtainwalls, and roof panels. The primer contains chromium, as strontium and barium chromate, which has been widely used for decades in paint to protect against corrosion in many settings, including the aerospace industry. Due to their high effectiveness, commercial value, and widespread use, chromium paints have been well-studied as chromium, like all naturally occurring metals with commercial uses such as arsenic, lead, manganese, mercury, and cadmium, can be toxic depending on the valence or oxidation state, bonded ligand(s), and dose. Chromium is abundant in the earth's crust and found in multiple valence states, but Cr(III), and Cr(VI), or hexavalent chromium, are the forms of biological significance (2). While Cr(III) is an essential nutrient, Cr(VI) is a yellow powder typically produced by and used for industrial applications, and associated with health concerns. The SDS lists a total of 14 ingredients that are classified as hazardous to human or environmental health, including strontium and barium chromate, and several solvents.

The potential for and seriousness of exposure to health hazard risk under the stored conditions or resulting from a potential leak is assessed as low for the following reasons:

The evaporation rate of the primer is low. The SDS describes the primer as a stable, water-insoluble liquid, with a low evaporation rate of 0.21 (reference butyl acetate = 1). Evaporation rate is a measure of how fast a liquid will change from a liquid to a vapor, and is useful in the evaluation of health or fire hazard. Benchmarked to a reference standard, typically butyl acetate, a rate can be categorically classified as high/fast, medium, or low/slow. For example, a substance with a high evaporation rate, defined as > 3.0, may readily form a vapor that could be inhaled or explode. Any evaporation rate under 0.8 is considered "slow"; thus the evaporation rate for the primer (0.21) is also slow. Vapor pressure, another measure of the tendency of a liquid to change into a gaseous state mostly determined by the intermolecular forces between the molecules of a substance, of the primer is also low (0.68 kPa or 5.1 mmHg) at room temperature (for reference, water = 4.25 kPa or 23.8 mmHg; acetone = 30 kPa or 225 mmHg). The primer is classified as flammable (Category 2) which indicates that it would not under normal conditions be ignitable, but is potentially ignitable at higher temperatures. The closed cup

flashpoint was measured at 44.44 deg C (112 deg F), which is the lowest temperature at which the material can vaporize to form an ignitable mixture in air *if an ignition source is present*.

Chromium compounds were highly unlikely to from the primer. Under the conditions stored at Prime, the chromium in the primer posed little to no risk to human or environmental health. The toxicity and carcinogenicity of inhalation of Cr(VI) compounds has been predominantly studied in settings where workers are inhaling high levels of chromium particles, dusts and fumes in the welding and electroplating industries that are released as gasses under high temperatures (hundreds to thousands of degrees F); through the dusting or grinding of Cr(VI) containing materials; or through chromate production or chromate pigment production (3-7). In these occupational settings, workers were at elevated risk for respiratory cancers after inhaling high levels (e.g. tens of micrograms to several milligrams per cubic L of air) on a chronic basic (i.e. years of employment) (6-9).

Chromium would not be considered volatile from the primer under anticipated environmental conditions. Strontium and barium chromate must be made bioavailable, that is, taken into a living system and presented to a potential site of physiologic activity to exert a health impact. In the primer under stored conditions, strontium and barium chromate would not evaporate from the paint but would stay in solution with other ingredients. In the stored primer scenario, inhalation of Cr(VI) could only occur via aerosolization, which is difficult to imagine occurring (10).

The heat from the trailer fire likely reduced the amount of volatile chemicals in the primer, thus reducing risk of significant exposure. The paint and primer stored at Prime had been in a trailer fire; the high temperatures of that fire are likely what caused the bung holes to release from the drums. While the drums were in the flames for an unknown amount of time, it is highly probable that the paint and primer were heated to such degree that the more volatile components of the paint evaporated during the fire. Volumes of paint and primer in the drums were not reported, but due to evaporation or spilling, it is also likely that some or all were no longer filled. Finally, it is notable that despite being heated in a large fire that destroyed the trailer, the paint and primer in the drums stored at Prime did not ignite. The United States Fire Administration (USFA) reports that vehicle fires can generate temperatures upwards of 1500 degrees Fahrenheit (11).

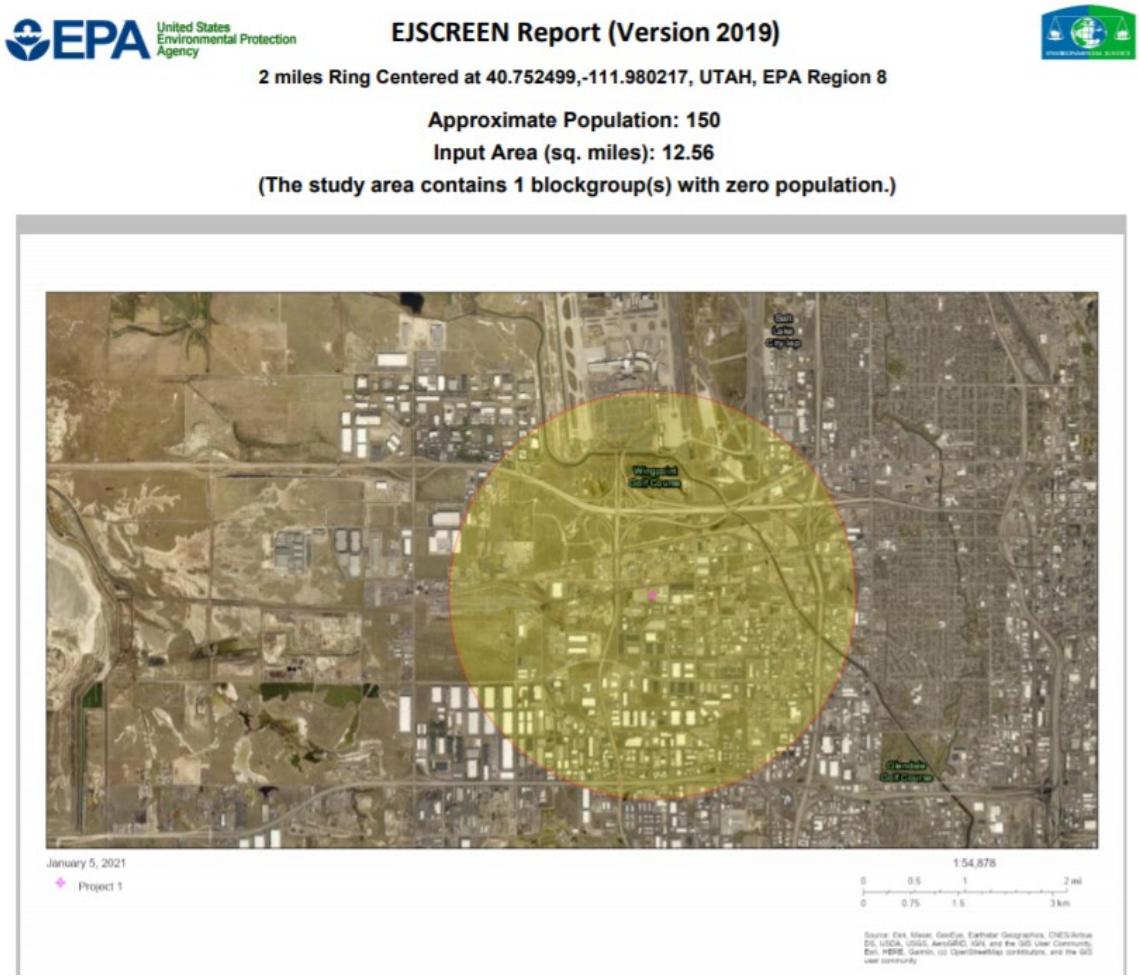
The EPA NEIC report noted a chemical smell as the tarp was removed from the burned trailer. Chemicals more readily evaporating from the stored primer were likely the more volatile ingredients used as solvents in the primer. However, they were probably present at low concentrations due to their relatively high boiling points (i.e. over 205 deg F) and ability to rapidly dissipate into the surrounding outdoor environment. Ingredients listed on the primer SDS suggest such that solvent naptha (petroleum) (low range of boiling point = 275 deg F) may have been one of the primer ingredients to vaporize. Solvent naptha is a mixture of aromatic hydrocarbons with C8-C10 chains; it is categorized on the SDS as a Class 3 health risk as it contains cumene and ethyl benzenes, classified by IARC as possible carcinogens (12,13). Short-term acute toxicities of high vapor concentration exposures, i.e. far higher than were likely present, are reported to potentially include irritation of mucous membranes and dizziness, headache, and drowsiness, but no long-term effects. As far as the evidence indicates, none of these symptoms were reported by anyone examining the primer, nor by any responders to the trailer fire where concentrations would have been anticipated to be potentially much higher.

Potential of exposure from the described conditions at Prime appears very low. Although the drums had been in a fire and caps, or bungholes, were missing, the trailer was covered, and described as placed in the far corner of a large yard where employees did not routinely pass by. Anyone briefly doing so likely experienced very low and brief exposures to any solvent vapors that may have been present at much lower levels than those considered

"safe" (permissible exposure limits) as deemed by OSHA. Even if slow evaporation was occurring from the drums, vapors would likely quickly dissipate into the atmosphere and not reach employees at Prime, other adjacent workplaces, or residential areas (in excess of 2 miles away, see EJ screen below).

The area surrounding Prime is industrial with residential areas 2-3 miles away. Using EPA's EJ Screen, it was determined that Prime is in the middle of a large, open, flat industrial area. EJ Screen is a screening and mapping tool created to provide a nationally consistent approach to a preliminary identification of environmental justice issues. EJ Screen reports publicly available data on 11 environmental (e.g traffic proximity and volume from US DOT) and 6 demographic (e.g. percent under high school education from US Census) indicators. Caveats cited by EPA include that there is "substantial uncertainty in demographic and environmental data." Figure 1. shows a mapping exercise using EJ Screen to examine a 12.5 square mile area, mostly industrial, around Prime Inc.'s storage facility and confirms it is in a very low population area (n=150).

Figure 1. Map of surrounding area of Prime Inc. from EJ screen.



Low environmental risk. Environmental health risk from the stored primer is considered low, as environmental transport from the storage site is unlikely. The SDS for Universal Urethane Yellow Primer indicates it is a stable, water-insoluble paint with a low evaporation rate. Stored on a large concrete pad, in the low-probability scenario that leaking paint might have traveled far enough to reach soil, it was unlikely to travel through the environment and contaminate an area of any significance beyond the immediate soil it seeped into. Although the soil/water partition coefficient (Koc) is not reported, chemical transport into the soil and potential desorption from the soil into water is influenced by the aforementioned physical properties. The EPA's Explanation of the Proposed Penalty Assessment reports that there were no nearby waterways, further reducing likelihood of water contamination.

Low risk of a fire occurring. While not an expert on fire risk but given the following facts, the stored primer catching on fire seems improbable scenario due to the physical properties of the primer; the likely evaporation of a significant percentage of the volatile compounds in the paint in the trailer fire accident; and the isolation of the placement of the tarped, burnt trailer and subsequent lack of ignition source. The fact of that the trailer and drums had already burnt once then sat through a few months of summer sun without igniting also seems to indicate fire risk was low. If a fire had occurred, first responders, including Prime employees and emergency responders, may have been exposed to higher levels of chemicals, including carbon monoxide, carbon dioxide, phosphorus oxides, halogenated compounds, and metal oxide/s similar to as experienced at the site of the first fire, though at likely lower concentrations given the smaller amount of material. Whether environmental or human exposures of concern could result from the fire is highly dependent on several features including atmospheric conditions (windspeed and direction, humidity, pressure); the size of the fire; the half-life of the chemicals; terrain, etc. Estimates of exposure are beyond the scope of this report, but it is anticipated that they could be reduced if the fire may have been rapidly discovered and extinguished, a seemingly likely scenario given that the trailer was out in an open, flat, unforested area where it would have been likely to be highly visible. For reference, average U.S. ambient Cr(VI) air concentrations calculated from monitoring data from 2106 stations (1976-84) ranged from 0.005-.525 micrograms/L^3 (14).

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