April 23, 2018

Members of the Board
California Air Resources Board (CARB)
1001 I Street, Sacramento, CA

**RE: Draft Low Carbon Fuel Standard's (LCFS) CCS (Carbon Capture and Sequestration) Protocol**

Dear Chairwoman Nichols and Members of the Board:

Occidental Petroleum appreciates CARB's leadership role in developing the LCFS's CCS protocol and submits these comments in support of the proposal. Many of the world's leading climate research organizations have recognized CCS as an essential tool for achieving the carbon dioxide (CO2) emission reductions necessary to meet California and global climate goals. We believe that the influence CARB wields beyond California's borders can enhance public confidence in CO2 reductions made via geologic sequestration. It is vital to the success of CCS as a carbon mitigation tool to create a CARB standard that is robust and transparent while encouraging responsible parties to develop the full potential of CCS.

Occidental is an industry leader in enhanced oil recovery (EOR) technology. We have extensive experience injecting CO2 for EOR doing so successfully and safely at commercial scale since 1983. We currently operate 34 floods and inject more than 2.5 billion cubic feet of CO2 per day making us the world's largest injector of CO2. Sequestration is an inevitable consequence of injecting CO2 for EOR, therefore, virtually all of the CO2 becomes permanently sequestered in the rock formation of the reservoir. In 2015, the U.S. EPA approved Occidental's first-of-its-kind Monitoring, Reporting and Verification (MRV) plan for quantifying the amount of CO2 stored

during EOR. The plan is authorized and regulated under Subpart RR of EPA's Greenhouse Gas reporting rules (40 CFR Part 98 Subpart RR) and reporting began in 2016. As reported into EPA's electronic Greenhouse Gas Reporting Tool (eGHGRT) for 2016 and 2017, 8,542,343 million metric tons of CO2 was sequestered and 19,395 metric tons of CO2 was released via leaks, fugitive emissions and other operational upsets. Therefore, only 0.2 percent of the CO2 injected was released to the atmosphere.

The EPA approved MRV plan has protocols for estimating emissions and escalating remedies in the event of an uncontrolled release. We believe this level of transparency is imperative to gain public acceptance and to insure the integrity of any benefit derived from the permanent sequestration of the CO2.

The MRV plans, deliberations, and greenhouse gas reporting data are all available on EPA's website (https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide).

Injecting CO2 into mature oil reservoirs can increase ultimate oil production by 10 to 25 percent. Outside of California, Occidental produces an additional 150,000 barrels of oil equivalent per day through EOR. EOR presents an alternative to "greenfield" exploration and productions in newly discovered fields and could displace oil produced using more energy intensive operations. Based upon research by the International Energy Agency (IEA), it has been shown that CCS in the form of EOR with anthropogenic $CO_2$ can provide a significant reduction in life-cycle per barrel $CO_2$ emissions compared to oil produced using non-EOR techniques (https://www.iea.org/publications/insights/insightpublications/CO2EOR_3Nov2015.pdf).

EOR using anthropogenic $CO_2$ could enable develop of a lower carbon transportation fuel to help further reduce greenhouse gas emissions.

There are several advantages to geologic sequestration of CO2 accomplished by employing enhanced oil recovery. As with other geologic sequestration, the first and most important decision is selecting the right site. A well-selected site with no transmissive faults or fractures is the best defense in ensuring that leaks are prevented and that CO2 stays within the area of the rock inside the formation that was intended. It goes without saying that sites with faults and fractures that might provide pathways for CO2 to escape sequestration should never be used for geologic sequestration. Operators engaged in CO2 EOR have detailed knowledge of their producing formations and geological conditions. This knowledge is essential to maintaining the injection rate of an EOR flood equal to the withdrawal rate. In turn, constant injection and withdrawal rates ensure that constant pressure in the reservoir is maintained, which is necessary to maximize the production of the oil. This constant pressure, which is very close to the original reservoir pressure prevents the chance of over-pressurization which could lead to damage to the cap rock layer above the reservoir. It also prevents any risk of forcing the CO2 into other geologic zones.

After faults and fractures, the biggest risk of leakage in EOR operations are penetrations (i.e., well bores) into the rock comprising the sequestration zone. States likes California and Texas have extensive experience, understanding and regulations that require the identification and proper plugging and abandoning of unused wells. It is also important to have robust well and

mechanical integrity management systems in place so that potential issues are avoided through the maintenance and care of existing wells. Additionally, leak detection and repair programs are vital. We cannot overemphasize the importance of these requirements which, combined with this protocol, will eliminate future risks of leak from CO2 sequestration. Moreover, as mentioned before, all of these programs and systems are critical to operating a successful EOR project.

In closing, Occidental thanks CARB for considering the inclusion of carbon capture and sequestration accomplished through EOR as part of its low carbon fuel standard and as part of the state's strategy to reduce CO2 emissions by all means practical. With over 40 years of successful implementation, geologic sequestration of CO2 accomplished during EOR is a verifiable, proven and safe technique for avoiding and reducing CO2 emissions. Since the EOR operator purchases CO2 as a process "feedstock", there is an economic incentive for those that capture their CO2 emissions that other forms of geologic sequestration do not offer. Additionally, many of the techniques and tools needed to successfully operate a CO2 flood are the same tools and techniques needed to monitor the CO2 to assure it stays within the area of review and necessary to quantify the amount of CO2 that is sequestered. Therefore, EOR offers a low cost, proven approach to CO2 sequestration.

As a leader, California is poised to demonstrate the path forward for other states and countries. Your decisions will likely have influence far beyond California's borders. We encourage you to include EOR as part of your suite of solutions, we commend you on the amount of transparency and inclusion with which you and your excellent staff has approached this

process. We welcome the opportunity to offer our experience and expertise in CO2 EOR technology and look forward to the finalized framework.

Sincerely,

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