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STATE OF CALIFORNIA
STATE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION

In the Matter of: REVISED APPLICATION FOR CERTIFICATION FOR THE HYDROGEN ENERGY CALIFORNIA PROJECT	Docket No. 08-AFC-08A REPORT TO COMMITTEE AND REQUEST TO REINITIATE AFC PROCEEDINGS

On May 5, 2015, Hydrogen Energy California LLC ("HECA") filed a Request for Suspension of the Application for Certification ("AFC") proceedings for the Hydrogen Energy California Project ("Project") (08-AFC-08A).[1] The Committee granted the Request for Suspension on July 3, 2015, for a six-month period commencing on July 6, 2015 and ending on January 6, 2016, subject to certain conditions.[2] Condition 2 of the Committee Order provides as follows:

[1] See Applicant's Request for Suspension, May 5, 2015, TN# 204500.

[2] See Committee Order Denying Motion to Terminate Application for Certification and Granting Request for Suspension, July 3, 2015, TN# 205238-1.

> No later than the end of the suspension period, Applicant shall docket a report to the Committee providing the information and documentation requested in items a, b and c below.
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> a. Documentation of an executed CO_2 off-take and carbon sequestration agreement, for a site that is both feasible and available for such use;
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> b. A letter dated June 18, 2015 (CEC Docket TN 205090) from Lorelei Oviatt, Director, Kern County Planning and Community Development Department, sets forth the County's position that the project is not authorized under current land use designations to operate a chemical production facility at the proposed site. Applicant shall provide an up-to-date listing of any and all commercial products proposed to be produced by the project. In addition, Applicant shall provide a written discussion of whether or not, and why, the production of each such commercial product is or is not in compliance with Kern County's General Plan and zoning ordinance;
>
> c. Completed docketed responses to all presently outstanding data requests from the parties. To the extent that any such outstanding data requests are no longer applicable due to changes in the HECA project since issuance of the data requests, Applicant shall provide a discussion of what changes to the project render the data requests inapplicable. To the extent possible, Applicant shall modify the inapplicable data requests so that they apply to the changes in the project and respond to those modified data requests.

HECA hereby provides the information requested above and requests that the Committee reinitiate the AFC proceedings.

Sequestration Site

As has been suggested in its monthly status reports, HECA has determined to permanently sequester CO_2 beneath the Project site utilizing Class VI wells permitted by the U.S. Environmental Protection Agency (EPA). This approach eliminates the need to contract with a CO_2 off-taker, as well as the need to permit facilities and analyze associated environmental impacts at a site other than the Project site, all of which greatly simplify the environmental review and permitting of the Project.

The Project site lies within the geologic basin known as the Southern San Joaquin Valley. The West Coast Regional Carbon Sequestration Partnership (WESTCARB) has studied the geologic CO_2 storage potential of the rock formations in the Southern San Joaquin Basin in detail. The findings of these studies, which are summarized below, indicate that there is significant storage potential in the rock formations below the Project site.

Previous Studies

Previous studies demonstrate that the formations of the Southern San Joaquin Basin are a very large potential storage resource based upon criteria developed by the National Energy Technology Laboratory (NETL) and applied to California by the California Geological Survey. These criteria include:

- depth to target storage reservoirs exceeding 800 meters;
- target formations with suitable thickness and permeability to provide storage; and
- suitable thickness of overlying shales or other impermeable cap rock formations to prevent upward migration of stored CO_2 over time.

The San Joaquin Basin extends about 350 km (220 mi.) from the Stockton Arch to its southern terminus at the northern Transverse Ranges, and averages 80–110 km (50–70 mi.) wide. It is bounded on the east by the Sierra Nevada and on the west by the Central Coast Ranges and the San Andreas Fault. The basin is filled with predominantly marine sedimentary rocks that attain an aggregate thickness of over 9,150 m (30,000 feet). These rocks are interbedded sequences of sands and shales that make ideal CO_2 storage sites. The California Geological Survey notes that the Southern San Joaquin Basin contains many more rock sequences with geologic carbon sequestration potential than any other California basin. The great thickness of these rock sequences means that there are potentially several stacked target sand formations that may be usable for storage at the Project site.

In addition to these basin-scale studies, WESTCARB also undertook more detailed studies of the storage potential of the rock formations in the Southern San Joaquin Valley around a specific site, the Kimberlina power plant, which is located at the intersection of Highway 99 and Kimberlina Road, north of Bakersfield. The radial distance from the Kimberlina site to the Project site is approximately 30 km. This is well within the 50 km radius of the three-dimensional geomodel developed by WESTCARB centered on the Kimberlina site.

The Kimberlina site model was developed for saline storage within rock formations that were delineated in three dimensions and assigned porosity and permeability characteristics by using well data from the Division of Oil Gas and Geothermal Resources (DOGGR) for exploration and production wells located in oilfields and wildcat wells within the 50 km radius of the model. Over 1500 well datasets were used. The WESTCARB geomodel for Kimberlina can be used to provide greater detail on the storage potential of the four formations at the Project site, which lies within its boundaries. The Kimberlina geomodel indicates that the rock formations which are potentially good targets for CO_2 storage in the Southern San Joaquin Basin at Kimberlina include the Vedder, Olcese, Stevens (Monterey and Fruitvale) and Etchegoin. All of these formations are also present at the Project site within the model volume.

The Vedder is Oligocene–lower Miocene in age and was deposited predominantly in a marine shelf environment as sea level was rising. At moderate depths of 1,525– 2,745 m (5,000–9,000 feet), porosities range from 20–40 percent and permeabilities from 31–2,400 md. Vedder sandstones are overlain by the lower Miocene Jewett and Pyramid Hills sandstones and the Freeman silt. The Freeman silt gradationally overlies and intertongues with the Jewett sandstone and the overlying lower Miocene Olcese Sandstone. Porosities between 15–22 percent are typical in sandstones below 3,050 m (10,000 feet), while higher porosities of up to 38 percent occur in shallow sands. Permeabilities range from 6–5,000 md (DOGGR, 1998).

Olcese sands range in depth from 700 m (2,300 feet) in the Ant Hill Field to 2,715 m (8,900 feet) in the Mountain View Field. Porosities range from 20–34 percent and permeabilities from 150–2,000 md (DOGGR, 1998).

During the Late Miocene, the Southern San Joaquin Basin underwent rapid tectonic changes. Localized uplifts shed sands into a deep water basin so that the Stevens sandstones also include the interbedded shales of the Monterey Formation and laterally equivalent Fruitvale Formation on the east side of the basin. Stevens sandstones are generally medium–fine grained sands between 2–76 m (5–250 feet) thick. However, thick sections of interbedded sandstone and shale can exceed 1,525 m (5,000 feet) in aggregate thickness. Depths range from less than 60 m (200 feet) on the west side of the basin to over 4,270 m (14,000 feet) in the south central basin. Porosities in sandstones shallower than 3,050 m (10,000 feet) range from 20–35 percent with permeabilities of up to 6,500 md in the shallowest sandstones. Below 3,050 m (10,000 feet), porosity and permeability decline to 10–20 percent and 0.2 to 1,000 md, respectively (DOGGR, 1998). The Stevens sandstones provide significant oil production in the area and were the main formations targeted for CO2-EOR operations at Elk Hills using HECA's CO2.

The Etchegoin Formation consists largely of sands and mudstones deposited in transitional marine to coastal bay and riverine environments throughout much of the west and central basin where it reaches a thickness of about 1,680 m (5,500 feet). Individual sandstone units are generally thin, ranging from 2 to over 60 m (5 to over 100 feet) but total sandstone thickness is considerably more. Sandstones are enclosed in or overlain by Etchegoin shales ranging from >1m (a few feet) to over 300 m (1,000 feet) thick. Porosities range from 12–40 percent and permeabilities from 1 to 22,320 md in sandstones up to 2,290 m (7,500 feet) deep, and decline to 17 percent and 200 md, respectively, at 3,170 m (10,400 feet) in the Yowlumne Field (DOGGR, 1998).

The primary target formation for storage chosen at Kimberlina was the Vedder Formation. The Kimberlina geomodel was used to develop a simulation of a large-scale CO_2 injection of approximately 1 million tonnes over four years into the Vedder. The simulation indicated that this volume could be successfully injected into the Vedder, provided information for leakage risk assessment over the predicted interval for migration of the CO_2 and stabilization after twenty years, and provided a basis for planning injection and monitoring well placement and operations.

Additional Studies to Improve Storage Potential Assessments

It is clear from the above described studies that at least four sandstone formations underlying the Project site meet the criteria for high storage potential. As noted above, however, the porosity, permeability and thicknesses of these units vary significantly across the Southern San Joaquin Basin. The Kimberlina geomodel interpolates these values from surrounding well data and is inclusive of the Project site, but needs to be manipulated to provide preliminary semiquantitative estimates of storage capacity at the Project site. Further reductions in the uncertainty of storage assessments would involve obtaining site-specific data by drilling a characterization well and performing a pilot CO_2 injection at the Project site.

The next steps for finalizing site location for storage and sequestration of HECA's captured CO_2 are:

- Manipulate the Kimberlina geomodel to obtain volumetric estimates of the storage potential of the four target sand formations at the Project site and produce preliminary simulations of CO_2 injections at the volume and rate of projected CO_2 from the HECA plant. These simulations will predict the movement of the injected CO_2 underground, and determine the distance the CO_2 may travel away from the injection point over time

for purposes of risk assessment and measurement, monitoring and verification (MMV) design; and

- Drill a characterization well and perform a pilot injection at the Project site to obtain direct site-specific data on rock formations, including depths, thicknesses, porosities and permeabilities of target storage and overlying sealing formations.

Compliance with County General Plan and Zoning Ordinance

HECA understands the concerns expressed by Kern County in its June 18, 2015 letter (TN #205090), which reiterates concerns expressed in a letter from the County dated July 12, 2012 (TN# 66243):

> This Department has continued concerns related to the land use compatibility of the revised project application, as it was submitted to the CEC in May 2012. The new chemical manufacturing component of the project, as part of the power plant, changes this Department's determination of compatibility. If the project were to produce only fertilizer strictly for agricultural uses, then the proposal would be consistent with Conditionally Permitted Uses listed in the Kern County Zoning Ordinance. However, the May 2012 application package includes several references to the production of items that are beyond the scope of the production of fertilizer for agricultural uses. Specifically, language is included throughout the revised application which states that the "Manufacturing Complex" portion of the project will produce products (including urea, urea ammonium nitrate [UAN], anhydrous ammonia, etc.) that will be used for transportation and industrial applications.

The County initially raised these concerns in a letter dated June 11, 2012 (TN #65837). In response to that letter, HECA sent a letter to the County dated July 31, 2012 indicating that it intended to "restrict its manufactured products for the purpose of 'fertilizer manufacture and storage for agricultural use only,'" consistent with applicable zoning and General Plan designations for the Project site (Attachment A103-1 to Applicant's Response to CEC Data Request A103, TN# 66876). HECA hereby confirms that it will limit the manufacture of

products to those for agricultural use only. HECA apologizes for the confusion created by the discussion of other potential applications for urea during the Committee Status Conference held on May 16, 2015.

Outstanding Data Requests

Outstanding data requests relate primarily to facilities and activities that were to occur on and in the Elk Hills Oil Field for enhanced oil recovery (EOR) and CO_2 sequestration. These data requests pertained to both surface impacts (e.g., biological and cultural resource impacts) and the details of the proposed EOR and sequestration. Given that both the proposed location and nature of the sequestration have changed, the outstanding data requests are no longer relevant. There will be no surface impacts associated with sequestration outside the Project site, which has been fully evaluated for topics such as biological and cultural resources. Applicant will prepare and submit a revised sequestration plan, including MMV plan, intended to address any questions related to the proposed sequestration, following the additional Project site studies described above. Applicant will coordinate preparation of the revised sequestration plan with CEC and other relevant agency staff in an effort to ensure that it addresses any questions.

Conclusion

Applicant has used the period of suspension to identify a viable alternative for CO_2 sequestration, and is now prepared to move forward with Project review and licensing. The alternative plan eliminates the need to coordinate with an independent CO_2 off-taker and to review and permit facilities outside of the Project site, which simplifies Project review and licensing. Applicant requests that the Committee reinitiate the AFC proceedings to allow Applicant to coordinate with CEC staff on the development of the revised sequestration plan.

Dated: November 30, 2015

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