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Responses to Informal Data Request Set 1

Submitted to
California Energy Commission

Prepared by
Morton Bay Geothermal LLC

With assistance from
Jacobs

Morton Bay Geothermal Project
(23-AFC-01)

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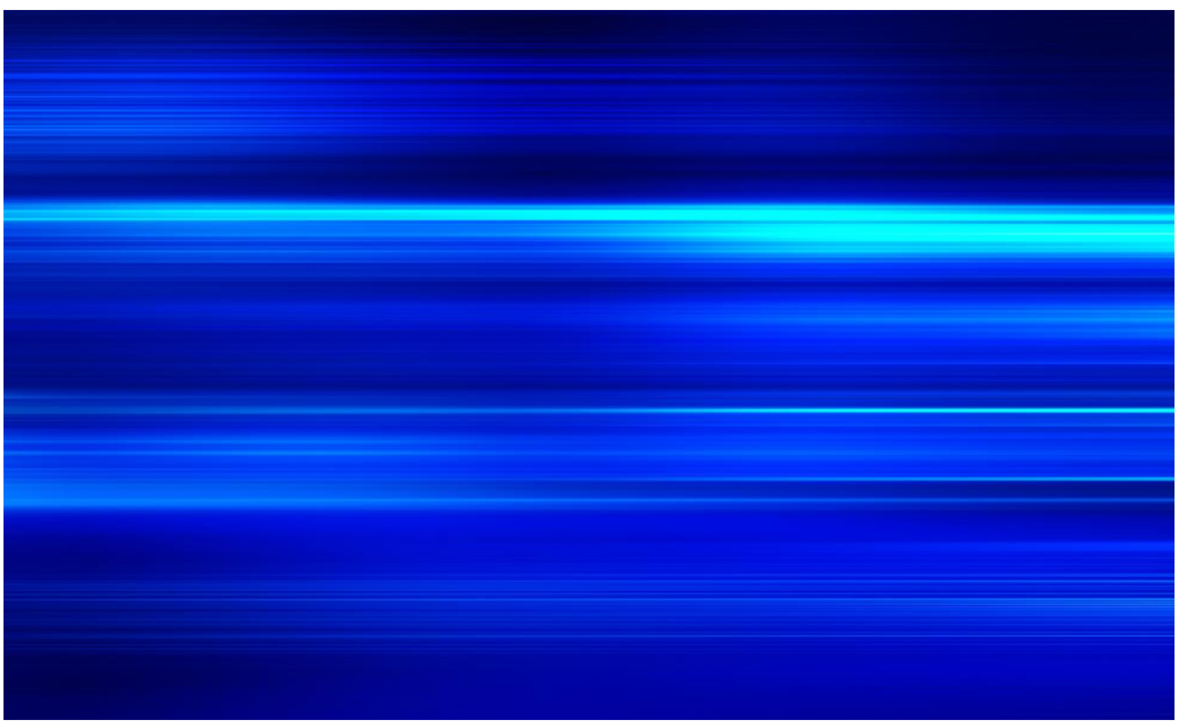

Introduction

Attached is Morton Bay Geothermal LLC's[1] (Applicant) response to the California Energy Commission (CEC) Staff's *Informal Data Requests Set 1* regarding the Application for Certification (AFC) for the Morton Bay Geothermal Project (MBGP) (23-AFC-01).

New or revised graphics or tables are numbered in reference to the Informal Data Request number. For example, the first table used in response to Informal Data Request 28 would be numbered Table IDR28-1. The first figure used in response to Informal Data Request 28 would be Figure IDR28-1, and so on. Figures or tables from the MBGP AFC that have been revised have a "R" following the original number, indicating a revision.

Additional tables, figures, or documents submitted in response to an informal data request (for example, supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of each discipline-specific section and are not sequentially page numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

[1] An indirect, wholly owned subsidiary of BHE Renewables, LLC (BHER).

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Acronyms and Abbreviations

ACC	Air Cooled Condenser
ACHE	Air Cooled Heat Exchanger
AFC	Application for Certification
AFY	Acre-feet per Year
BRGP	Black Rock Geothermal Project
CEC	California Energy Commission
CPUC	California Public Utilities Commission
DOD	Department of Defense
DVCM	Desert Valley Company Monofill
EDP	Equitable Distribution Plan
ENGP	Elmore North Geothermal Project
IDR	Informal Data Request
IID	Imperial Irrigation District
IWSP	Interim Water Supply Policy
MBGP	Morton Bay Geothermal Project
NCGs	Non-condensable Gases
SCR	Selective Catalytic Reduction
SSGF	Salton Sea Geothermal Field
SSGR	Salton Sea Geothermal Resource
TLCFP	Temporary Land Conversion Fallowing Policy
TN	Transaction Number
WSA	Water Supply Assessment

1. Geological Resources

Background: Salton Sea Geothermal Resource Sustainability (IDR 1)

Informal Data Request:

1. *Cyrq Energy, operator of the Hudson Ranch Power I (HR1) (60 mW nominal), asserts that the proposed adjacent Morton Bay Geothermal Project (140 mW proposed) would "adversely impact the SSGF (Salton Sea Geothermal Field) as well as generation at Hudson Ranch Power I" due to increased power density resulting in reduced enthalpy and pressure of the geothermal reservoir in the vicinity. Please provide a response to their assertion, including, but not limited to:*
    a. *Additional engineering details about the proposed MBGP production wells including wellhead and bottom hole location, production zone depths, and proximity to Hudson Ranch I production wells.*
    b. *A specific response to Cyrq's allegation that the power density of 217 MW per square mile far exceeds a sustainable level of 78 per square mile currently in production in the Salton Sea resource area.*
    c. *Proposed plans for ongoing monitoring to demonstrate that well placement and well interactions have been adequately considered to ensure sustainable use of the resource.*

Response: The informal data requests address certain assertions raised in the public comments docketed by Cyrq Energy on behalf of Hudson Ranch 1 (HR1) entitled, "Morton Bay Geothermal Project Impact Screening Study" (Screening Study; TN#: 254691.) The Screening Study includes an opinion from the Geothermal Resource Group (GRG Opinion) that assesses and reviews the assertions raised in the Screening Study. As explained in further detail below, the assertions in the Screening Study and GRG Opinion are incorrect.

With respect to the SSGF, the *Numerical Reservoir Simulation of the Salton Sea Geothermal Resource for Power Generation* (SSGR Numerical Resource Simulation) prepared by GeothermEx, Inc. (GeothermEx) is the superior, industry standard methodology for determining the resource capabilities of the Salton Sea Geothermal Field (compared to the less rigorous power density methodology utilized in the Screening Study and GRG Opinion. As acknowledged in one paper cited in the GRG Opinion, "The most robust resource capacity estimates are made using a 3D numerical model of the reservoir, coupled to well bore models of the production and injection wells, and informed by extensive and detailed geoscientific data."[2] As further described in Grant (2000), another paper cited in the GRG Opinion, while power density modeling may have some application to provide rough estimates of resource capacity, reservoir simulation is the preferable method for development decisions.[3] In short, power density may be useful in the absence of field-wide numerical reservoir models or when there is insufficient data to establish a field-wide reservoir model to evaluate the power potentials for a geothermal reservoir in a very general sense, yet is not preferred when detailed field-wide data is available.

In this case, the SSGF is a well-studied resource. Here, the geothermal leaseholds dedicated to the Morton Bay Geothermal Project, Elmore North Geothermal Project, and Black Rock Geothermal Project, along with BHER's existing geothermal facilities, have proven resources to support 990 net megawatts (MW).[4] The

[2] Maxwell Wilmarth and James Stimac, *Power Density in Geothermal Fields,* Proceedings World Geothermal Congress 2015 (2015), available at: https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2015/16020.pdf (hereinafter, Wilmarth (2015)).

[3] Malcolm A. Grant, *Geothermal Resource Proving Criteria*, Proceedings World Geothermal Congress 2000 (2000), available at: https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2000/R0792.PDF.

[4] CalGEM, Geothermal Resource Evaluation Testimony by Charlene Wardlow and Jesus M. Salera (23-AFC-01) p. 3 (TN#: 250207).

SSGR Numerical Resource Simulation, which utilizes a field-wide numerical reservoir model, was based on a model previously developed by GeothermEx in 2009, updated to incorporate current information regarding the SSGF, and calibrated with actual measured reservoir data and historical production data from all existing geothermal power plants in the area.[5] The SSGR Numerical Resource Simulation clearly establishes that the SSGF is robust and can accommodate both existing geothermal power plants, including the Hudson Ranch Power I (HR1) geothermal power plant, and the proposed Morton Bay Geothermal Project. In contrast, the Screening Study relies on a 2010 analysis from GeothermEx that does not have the benefit of actual reservoir or well performance data, or information from more recent modeling and study of the SSGF, and calculations regarding the power density that rely on incorrect assumptions and performed incorrectly. A more detailed response to the inaccuracies in the power density calculations presented in the Screening Study and GRG Opinion are provided below in response to Informal Data Request 1.b.

With respect to HR1, the Screening Study relies on four primary approaches to support its claims. First, the Screening Study relies upon a Resource Diligence Report from 2010. Reliance on a report of this vintage from 2010 is problematic, given the plethora of more current and more reliable data available. Further, the referenced analysis contains limited amounts of actual reservoir and well performance data. Based on the numerical model grid in Figure 2 and Figure 3 of the Screening Study, the extent of the reservoir model was very limited and based on brief well tests on wells 13-1 and 13-3 and historic well data from exploration wells that are now more than 30 years old. More importantly, the accuracy of the 2010 reservoir model and more specifically how it was calibrated and validated is unknown, undermining the purported value of the 2010 report. Therefore, the Resource Diligence Report cannot be relied upon to accurately reflect reservoir conditions in 2024.

Second, the Screening Study relies on simplified "radial flow models" to examine the potential impacts of the MBGP on HR1.[6] These radial flow models and results presented in the Screening Study relied upon the following assumptions:

- Consolidation of production from MBGP into a single point;
- Omits the impact of MBGP injection; and
- All wells are drilled vertically.[7]

Utilizing "simplified" or simplistic modeling assumptions undermines the proffered analysis, because, as admitted in the Screening Study, the results are "likely to differ from reality."[8] In addition, the three assumptions above are not consistent with the proposed MBGP. For example, production from the MBGP will not occur at a single point, which is the assumption of the radial flow model, but will instead occur from nine separate points (production wells), assuming a 500-meter buffer, as suggested by Wilmarth (2015). The production area for MBGP would be 5.09 square kilometers rather than a single point. Assuming all production from the MBGP occurs at a single point skews the analysis by inaccurately overestimating the potential effects on pressure.

Next, the omission of the known beneficial effects of MBGP injection is a fatal error. MBGP is estimated to inject in excess of 85 percent of the produced fluid annually, which greatly helps with pressure support. Not including injection in the simplified model grossly overestimates the potential for pressure effects, thereby overstating the potential effects on pressure.

[5] SSGR Numerical Resource Simulation (TN#: 250042), p. vi.

[6] Screening Study, pp. 9-10.

[7] Screening Study, p. 9.

[8] Screening Study, p. 9.

Furthermore, Figure 3.1 of the SSGR Numerical Resource Simulation shows the forecasted reservoir pressure as a result of production and injection from all existing geothermal projects, including HR1, the proposed Black Rock Geothermal Project, Elmore North Geothermal Project, and MBGP, and Controlled Thermal Resources' proposed 49.9 MW geothermal project. The pressure decline shows the combined impact of all the above geothermal operations on reservoir pressure as a whole and cannot be interpreted as pressure decline caused by one facility to another facility.

Finally, the MBGP wells will all be drilled directionally, as described in the MBGP AFC,[9] and as depicted more fully in Figure IDR1.b-1 below. Specifically, each of the MBGP production wells will be directionally drilled to access the geothermal leasehold specifically dedicated to the MBGP.[10] Assuming vertical well drilling taints the predicted impacts set forth in the Screening Study by underestimating the production area of the wells. Given these and other factual inaccuracies underlying the Screening Study, the proffered information cannot be relied upon to accurately evaluate the potential impacts from MBGP's operation.

Background: Salton Sea Geothermal Resource Sustainability (IDR 1.a)

Informal Data Request:

a. *Additional engineering details about the proposed MBGP production wells including wellhead and bottom hole location, production zone depths, and proximity to Hudson Ranch I production wells.*

Response: Figure IDR1.b-1 provides a map locating the wellheads and proposed well courses, including bottom hole locations of the proposed production and injection wells for the MBGP. Production wells will be drilled to an average total depth of about 7,500 feet. (AFC, pp. 2-6.) Casing shoe depths will be around 3,500 to 4,000 feet, resulting in a production zone depth between about 3,500 feet and 7,500 feet. The proposed MBGP production wells are directed largely away from the HR1 production wells. Specifically, the production well nearest to the outer mineral property boundary is located approximately 380 feet from the property line, and the production well nearest is approximately 1,400 feet from the closest HR1 production well, 13-1. Further engineering details about the MBGP production wells will be submitted confidentially to California Geologic Energy Management Division (CalGEM) as part of the Notice of Intention to Drill a Geothermal Resources Well process.

Background: Salton Sea Geothermal Resource Sustainability (IDR 1.b)

Informal Data Request:

b. *A specific response to Cyrq's allegation that the power density of 217 MW per square mile far exceeds a sustainable level of 78 per square mile currently in production in the Salton Sea resource area.*

Response: The GRG Opinion asserts that the MBGP, as proposed, will result in a power density of 85 MW/km^2, which the GRG Opinion claims is "nearly three times the known sustainable power density of the overall SSGF."[11] These claims are incorrect.

Correct application of the power density methodology demonstrates that the MBGP results in a power density of 28.7 MW/km^2, well within the alleged range of the sustainable development potential of the SSGF.

[9] MBGP AFC, pp. 5.11-17.

[10] MBGP AFC, Figure 2-3.

[11] GRG Opinion, p. 3.

Power density is calculated using the following formula (Wilmarth (2015)):

Power Density = Power (net megawatts) / Area (square kilometers)

Where, Power equals Net Power Output (capacity) in megawatts for the production area.

Where, Area equals horizontal area in square kilometers of merged production well tracks, including a 500-meter buffer.[12]

According to the GRG Opinion, its erroneous power density number of 85 MW/km^2 was derived utilizing the information depicted in the grid cell provided as GRG Opinion Figure 1.1. Based on a review of this figure, the power density assessment in the GRG Opinion omits several key inputs and uses incorrect information for others. Specifically, the area of production analyzed in the GRG Opinion is grossly understated. For example, the well course of HR1 production well 13-2, while depicted on the figure, is excluded from the area considered in GRG Opinion's power density assessment. This is inconsistent with Wilmarth (2015), which specifically includes consideration of the well course as part of the area of production. The well courses for the MBGP production wells are similarly not considered, nor does the GRG Opinion include a 500-meter buffer around the MBGP well courses or HR1 production wells 13-2 and 13-4. The GRG Opinion also utilizes the gross generating capacity for the MBGP rather than the net, which is again inconsistent with Wilmarth (2015).

An accurate representation of the area that should be used to calculate power density is shown in Figure IDR1.b-1 below:

[12] Maxwell Wilmarth and James Stimac, *Power Density in Geothermal Fields,* Proceedings World Geothermal Congress 2015 (2015), available at: https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2015/16020.pdf.

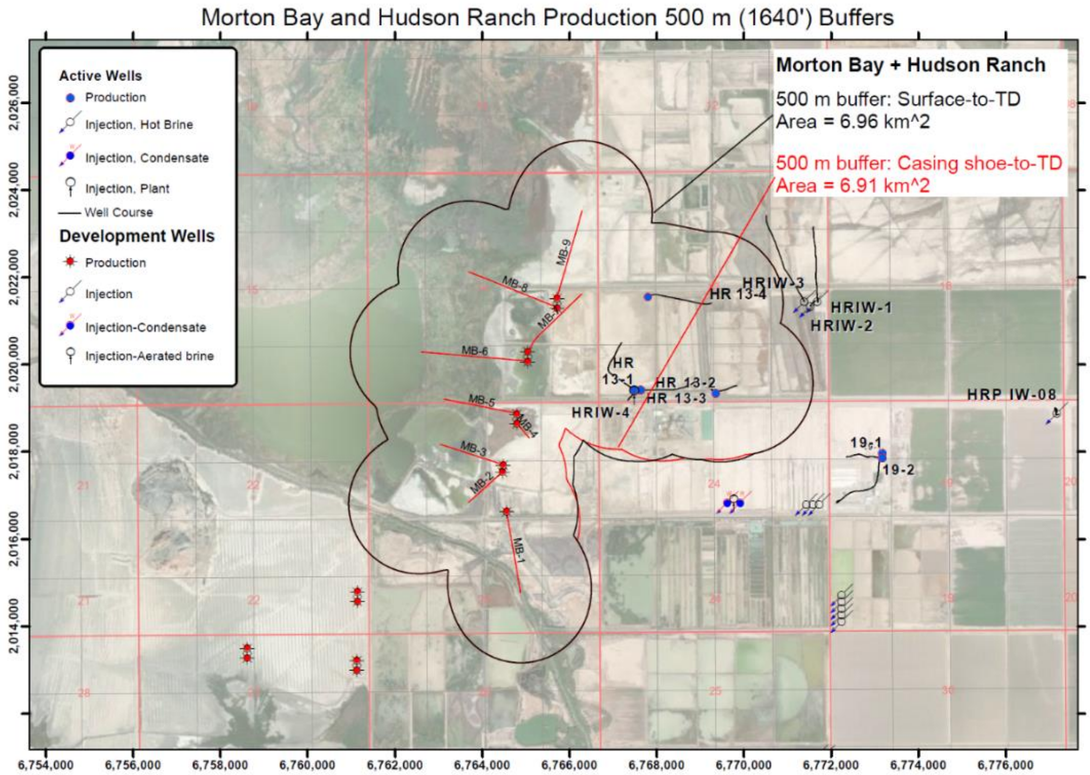

Figure IDR1.b-1. Map of the Hudson Ranch Power 1 and Morton Bay production area with well course tracks with 500-meter merged buffers and area calculations based on Wilmarth (2015) methodology.

Therefore, to properly calculate power density consistent with Wilmarth (2015), the following inputs should be used:

Wilmarth (2015) Factors for Methodology Inputs	Inputs Used in GRG Opinion to Calculate MBGP Power Density	Correct Inputs to Calculate MBGP Power Density Pursuant to Wilmarth (2015)
To calculate area, a 500-meter buffer should be applied to the merged area of the production well courses.	2.59 km^2; no buffer area around MBGP production wells and courses or HR1 wells 13-2 and 13-4 used. Well courses for 13-2 (Hudson Ranch Power 1 production well) and MBGP excluded from the analysis.	6.96 km^2, including the 500-meter merged buffer of the well course tracks
Net megawatt output should be used as the numerator	217 MW used as the numerator • 157 MW(gross): MBGP • 60 MW: Hudson Ranch	200 MW (net) total used as the numerator • 140 MW (net): MBGP • 60 MW: Hudson Ranch
Power Density	**83.78 MW/km^2**	**28.7 MW/km^2**

Utilizing the correct inputs per the Wilmarth (2015) methodology results in a conservative power density of 28.7 MW/km^2. This conclusion is well within the range of power densities of 25-35 MW/km^2 for the

SSGF articulated in the GRG Opinion, and the "guideline" of 30 MW/km^2 identified by GRG as "proven sustainable."

Taking an even more conservative approach, beyond Wilmarth (2015) methodology, if only the open-hole section of the production wells is used to calculate area (yielding an area 6.91 square kilometers), the power density of the MBGP and HR1 would be 28.9 MW/km^2.

Furthermore, given the field-wide numerical reservoir modeling of the SSGF that has already been conducted, and the heavily studied nature of the SSGF, the statements that a power density of 30 MW/km^2 is an appropriate guideline for a "sustainable power density" of the SSGF are incorrect.

For example, using the power density methodology, all the production for Salton Sea Units 1 through 5 (Region 1), which have a total net generating capacity of 164 MW, comes from about 2.72 square kilometers (See, Figure IDR1.b-2). This results in a power density of 60.3 MW per square kilometer using the methodology referenced in Wilmarth (2015). The portion of the Salton Sea geothermal resource that supports Region 1 has sustained its capacity without issue for over 24 years.

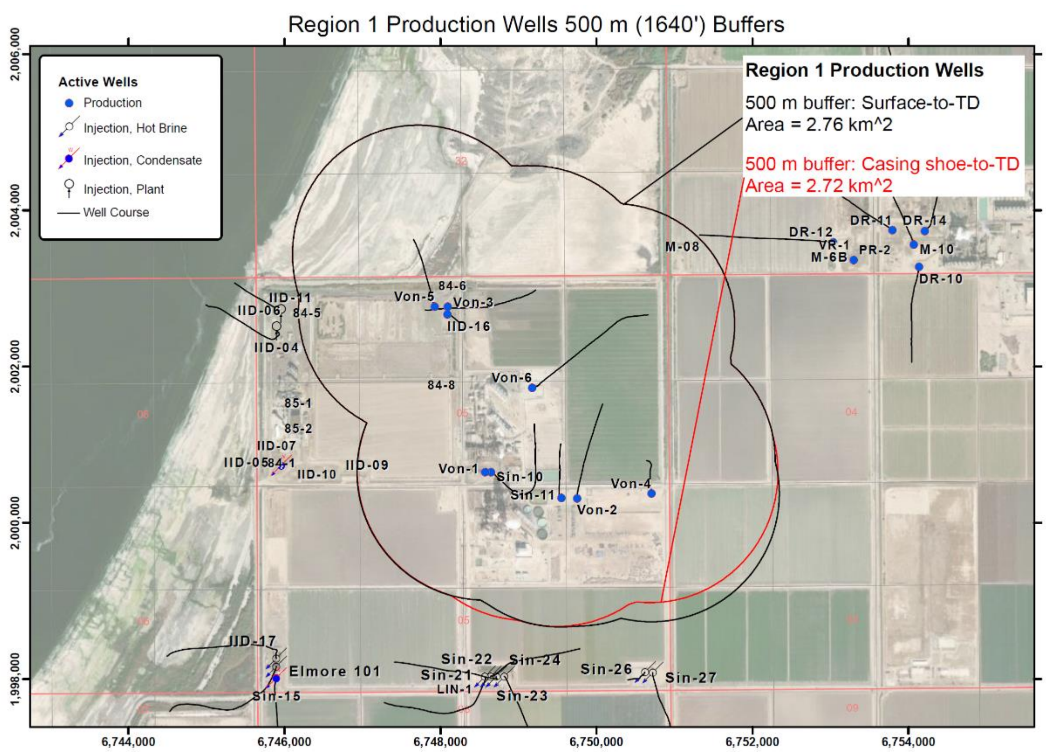

Figure IDR1.b-2. Map of Region 1 production well courses and merged 500-meter buffers around production well courses.

In summary, the power density methodology and "guideline" proposed in the GRG Opinion demonstrate that the MBGP does not exceed the sustainable level of development for the SSGF.

Background: Salton Sea Geothermal Resource Sustainability (IDR 1.c)

Informal Data Request:

c. *Proposed plans for ongoing monitoring to demonstrate that well placement and well interactions have been adequately considered to ensure sustainable use of the resource.*

Response: In accordance with the Warren Alquist Act, the County of Imperial (County) and CalGEM have regulatory oversight over the permitting and operation of the MBGP well field. The County will issue a conditional use permit for the well field. CalGEM is responsible for reviewing and approving the Notice of Intention to Drill a Geothermal Resources Well. CalGEM supervises the drilling, operation, maintenance, and abandonment of geothermal resources wells. (Pub. Resources Code § 3714.) The Notice of Intention must be approved prior to drilling. (14 CCR § 1931.) As part of this oversight, CalGEM ensures that the drilling, operation, maintenance, and abandonment of geothermal resource wells "encourage the greatest ultimate economic recovery of geothermal resources, to prevent damage to life, health, property, and natural resources, and to prevent damage to, and waste from, the underground geothermal deposits." (Pub. Resources Code § 3714.) To exercise this supervisory role, CalGEM collects information regarding geothermal resource wells to advise well operators "as to the best means of protecting geothermal resource deposits." (Pub. Resources Code § 3716.)

As previously discussed, the SSGR Numerical Resource Simulation confirmed the adequacy of SSGF to accommodate both existing projects including HR1, and the proposed MBGP, ENGP, and BRGP. Once MBGP is operational, the Applicant will collect, maintain and report well data to CalGEM in accordance with applicable statutory and regulatory requirements. Currently, geothermal well owners and operators are required to maintain information relating to wellhead pressure, temperature and flow rate in accordance with the requirements by CalGEM. Geothermal well owners and operators also perform annual project reviews with CalGEM. These actions will ensure that the SSGR is utilized in accordance with the State's established policies regarding the development of geothermal resources.

Background: Industry Practices and Standards Regarding Geothermal Well Installation (IDR 2)

Informal Data Request:

2. *Please provide current industry practice and standards regarding geothermal well installation or operation that could provide a template for successful deployment of the SSGF geothermal resource. Include any methods or technologies, such as directional drilling, or supplemented reinjection that would offset or reduce potential adverse impacts on neighboring users or on the general over-utilization of the geothermal resource.*

Response: Public Resources Code section 3715 provides for the utilization by owners and operators of geothermal wells "all methods and practices known to the industry for the purpose of increasing the ultimate recovery of geothermal resources and which, in the opinion of the supervisor, are suitable for such purpose in each proposed case." This is balanced with the obligation of geothermal well owners and operators to ensure that recovery of the geothermal resource is done in a way that prevents damage to, and waste of, the geothermal resource, and is implemented through extensive monitoring and reporting of geothermal well information to CalGEM. (See, Pub. Resources Code §§ 3714, 3716.)

Consistent with best industry practices, the Applicant performed numerical reservoir modeling to confirm that the SSGF is capable of supporting not just the generating capacities of the proposed facilities, but all existing and known imminent projects as well over a 40-year horizon.[13] The numerical reservoir modeling confirmed that there are sufficient geothermal resources to support 2,950 net MW of generating capacity for the entire area analyzed in the study.[14] The geothermal leaseholds for the three geothermal projects currently before the CEC, along with BHER's existing facilities (345 net MW), are proven capable of supporting 990 net MW, nearly three times the total proposed net generating capacities.

[13] SSGR Numerical Resource Simulation, p. 1-1.

[14] CalGEM, Geothermal Resource Evaluation Testimony by Charlene Wardlow and Jesus M. Salera (23-AFC-01) p. 2 (TN#: 250207.).

All wells will be designed in accordance with statutory and regulatory requirements applicable to production and injection wells. Production well placement will occur consistent with Public Resources Code sections 3757 and 3757.1. Section 3757 provides that geothermal production wells must be located: (1) 100 feet from the outer boundary of the parcel of land on which the well is situated and (2) 100 feet from a public road, street, or highway dedicated prior to the commencement of drilling of the well. Section 3757.1 provides that different locations may be approved by the State Oil and Gas Supervisor of the California Department of Conservation, Geologic Energy Management Division “where a parcel of land contains one acre or more and all or substantially all of the surface is unavailable for the location of a geothermal well.” In these circumstances, the Supervisor may approve well locations “at whatever locations the supervisor determines to be advisable for the purpose of properly developing the geothermal resources,” so long as the wells are located 25 feet from the outer boundary of the parcel of land on which the well is situated, and 25 feet from a public road, street, or highway. Other applicable statutory and regulatory requirements include casing requirements and blowout prevention measures. (See generally, 14 CCR §§ 1930 et seq., 1941 et seq.) As explained above, the recording and maintenance of well records will ensure that the SSGR is utilized in accordance with the State’s policies regarding the development of geothermal resources. Further, as described in Section 2.3.2.2 of the Application for Certification and in CURE Data Response Set 1, Data Response 14 (TN#: 253374), all wells will be directionally drilled to access the MBGP’s geothermal leasehold, which allows for a smaller surface footprint, optimization of production output per well, and greater well spacing within the productive resource. The Applicant also expects that any conditional use permit issued by the County relating to the geothermal field and wells will include a requirement for injection of 70-75% of production fluids by mass annually, consistent with other geothermal conditional use permits that have been issued in the past. Reinjection of geothermal fluid provides pressure support in the SSGF and allows for replenishment of available geothermal fluids.

As described above, the analyses provided by the Applicant confirm that the MBGP will not result in significant adverse impacts to the SSGR. The Applicant also notes that under the California Environmental Quality Act (CEQA), “the question is whether a project will affect the environment of persons in general, not whether a project will affect particular persons.” (*Mira Mar Mobile Community v. City of Oceanside*, 119 Cal. App.4th 477, 492 (2004).) Further, the “rights of one private landowner cannot prevail over the rights of another private landowner except in accordance with uniformly applied standards and policies…” (*Mira Mar Mobile Community v. City of Oceanside*, 119 Cal. App.4th 477, 494 (2004).) In this case, neither the rights of either the Applicant nor HR1 to capture and access the geothermal resources that are part of their geothermal leasehold prevails over the others’ rights. It is typical and standard in the geothermal power industry for the open-hole section of geothermal production wells to be re-drilled, or for make-up wells to be constructed to capture and access the geothermal resources needed to maintain generation output throughout the life of a geothermal facility.

The Applicant does not agree with the analyses presented in, and rebuts the claims of, the Screening Study and GRG Opinion. Nevertheless, the Applicant is sensitive to both other facilities in the area and environmental considerations in the siting of the MBGP and the MBGP’s wells and well pads. Production wells have been located more than 100 feet from the property boundary and will be directionally drilled. Reinjection of a minimum 70-75% of production fluids by mass annually will provide pressure support and replenish available geothermal fluids in the SSGF. Well locations were selected to account for efficient utilization of the geothermal resource, minimizing the potential for significant adverse effects on existing facilities and being mindful of environmental constraints. (MBGP AFC, pp. 2-16.) The Applicant has secured mineral rights to the geothermal resources necessary to support the generating capacity of the MBGP. Finally, the Applicant, in coordination with CalGEM, will monitor the wells to facilitate the greatest ultimate economic recovery of the geothermal resource consistent with statutory and regulatory requirements.

Background: *Morton Bay Geothermal Project Resource Adequacy Report* (Resource Adequacy Report) (TN#: 250042) (IDR 3.a)

Informal Data Request:

3. *GeothermEx prepared a model to evaluate the geothermal resource of the Salton Sea Geothermal Field (SSGF). The results of this model were presented in the Morton Bay Geothermal Project Resource Adequacy Report (Resource Adequacy Report) (TN250042).*
   a. *Figure 2.1 of the report depicts temperature matching of the GeothermEx model at the depth of -1,350 feet mean sea level (msl) that mimics the modeled thermal gradients of previous investigators (Hullen et. al. 2002) in the central and southwest portions of the SSGF. However, Figure 2.1 does not reflect the Hullen modeled thermal anomaly north of the mouth of the Alamo River. What is the significance of the 1,350 feet msl datum? Why do the thermal gradients of these two models differ and what are the implications for the GeothermEx model?*

Response: The purpose of Figure 2.1 in the SSGR Numerical Resource Simulation is to show the quality of model calibration for the initial-state temperature at an example depth (1,350 feet) relative to measured temperature data. In short, 1,350 feet was selected to provide an example depth, rather than as a significant data point.

Temperature contours in Figure 2.1 show the actual initial-state temperature and the colored gird cells show the simulated temperatures from the numerical reservoir model. As the SSGR Numerical Resource Simulation states, the initial-state temperatures were "accurately matched." Figure 3 of the Hulen et al. (2002) paper shows temperature gradient (the rate of temperature increase per unit of depth), not the actual temperature at a specific depth, which makes it different from Figure 2.1 of SSGR Numerical Resource Simulation. Hulen et al.'s (2002) shallow thermal-gradient anomaly has a depth of 30 to 80 meters (98 to 262 feet) and was derived from similar depth (shallow) exploratory wells. Thermal surface expressions, such as mud pots, would affect the shallow thermal gradient, yet would not always affect the deeper measurements and resource models. Trace releases of steam traveling on a path of least resistance (such as a rock fracture) to surface would result in shallow thermal feature(s) and have a limited effect on deeper manifestations, and cause deviations between shallow thermal gradients and deeper resource temperatures.

Background: *Morton Bay Geothermal Project Resource Adequacy Report* (Resource Adequacy Report) (TN#: 250042) (IDR 3.b)

Informal Data Request:

3. *GeothermEx prepared a model to evaluate the geothermal resource of the Salton Sea Geothermal Field (SSGF). The results of this model were presented in the Morton Bay Geothermal Project Resource Adequacy Report (Resource Adequacy Report) (TN250042).*
   b. *History matching of reservoir pressure as seen in Figure 2.2 and enthalpy, total dissolved solids, and non-condensable gases as seen in Figure 2.3, include measured data points to demonstrate the validity of the model. Please include details, with geographic specificity, of measured data points, such as, but not limited to, identity, location, and depth.*

Response: Figure 2.2 of the SSGR Numerical Resource Simulation shows measured and simulated reservoir pressures for the Elmore 2 observation well. Pressure observation Figure 1.1 of SSGR Numerical Resource Simulation shows the location of Elmore 2 (shown as EL 2 in Figure 1.1) amongst the other observation wells. The measured reservoir pressure data from Elmore 2 along with the other pressure observation wells were utilized in the history matching process to calibrate the field-wide reservoir model prior to forecasting the behavior. As the result of the model calibration efforts, the SSGR Numerical Resource Simulation states that "Thus, the model is considered well calibrated for use in forecasting reservoir behavior." This is because the simulated data, including reservoir pressure, temperature, total dissolved solids (TDS), enthalpy and non-condensable gases (NCG), reasonably matches the measured values for all the geographically dispersed wells. The geographic diversity of the observation wells and the match between the simulated data and measured values also demonstrates accuracy throughout the field-wide reservoir model.

Figure 2.3 of the SSGR Numerical Resource Simulation shows the average values and concentrations for enthalpy, TDS, and NCG for Region 1 (Salton Sea Units 1 through 5). Figure IDR3.b-1 through Figure IDR3.b-3 below show the history matching results for the following existing facilities: Region 2, Elmore and Leathers. Figure 2.3 of the SSGR Numerical Resource along with Figure IDR3.b-1 through Figure IDR3.b-3 below show excellent history matching and model calibration.

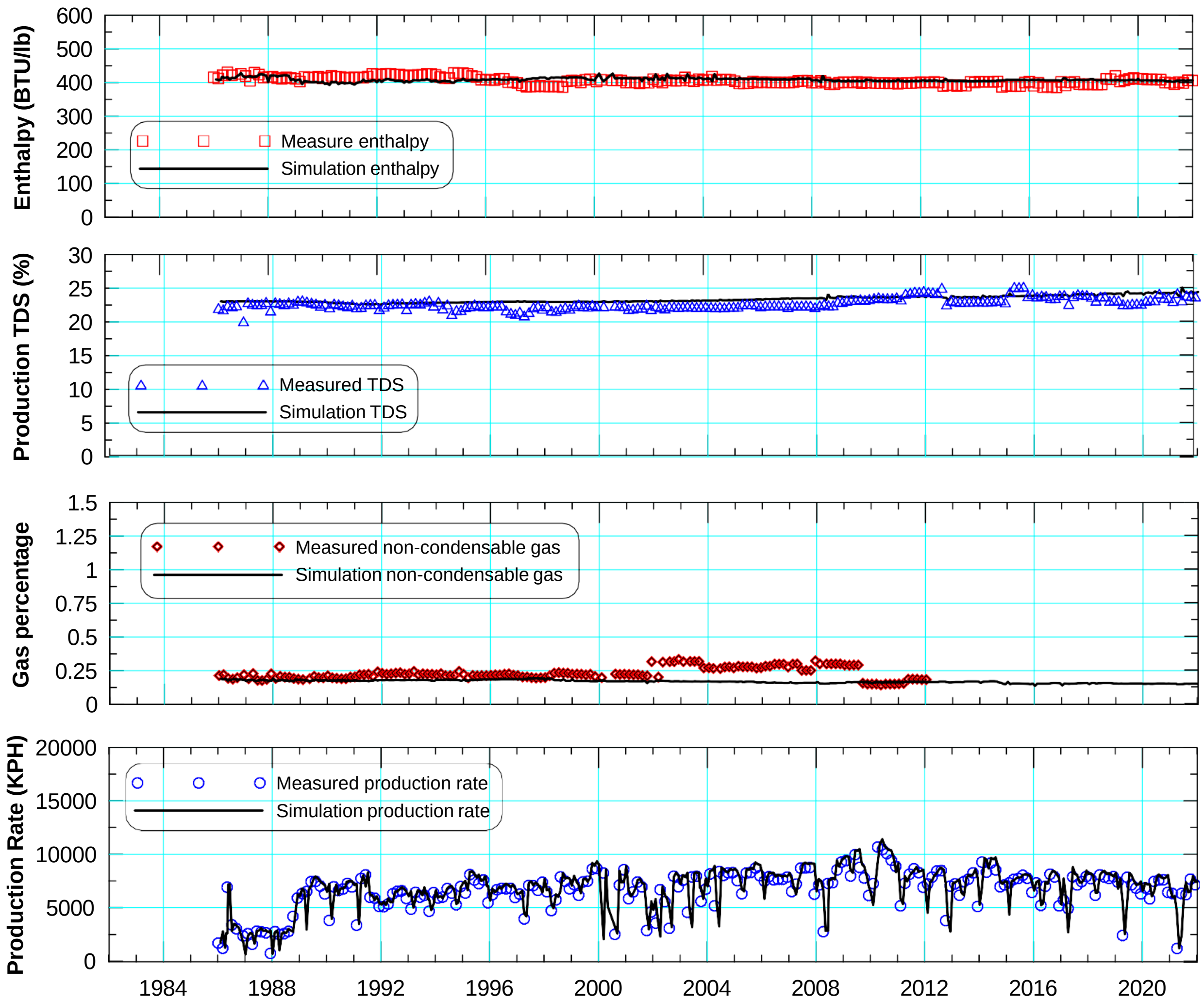

Figure IDR3.b-1. History matching results for Region 2

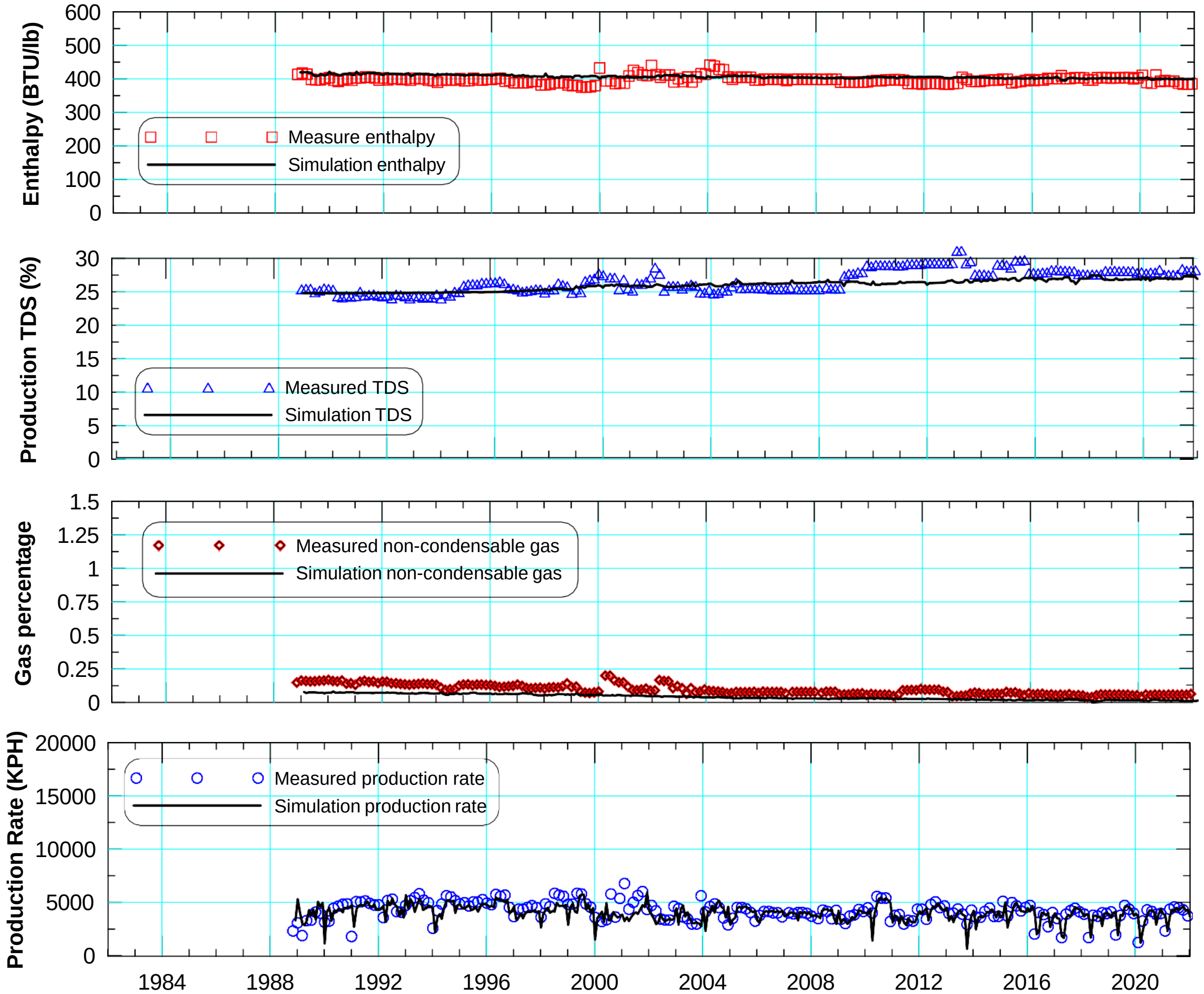

Figure IDR3.b-2. History matching results for the Elmore facility

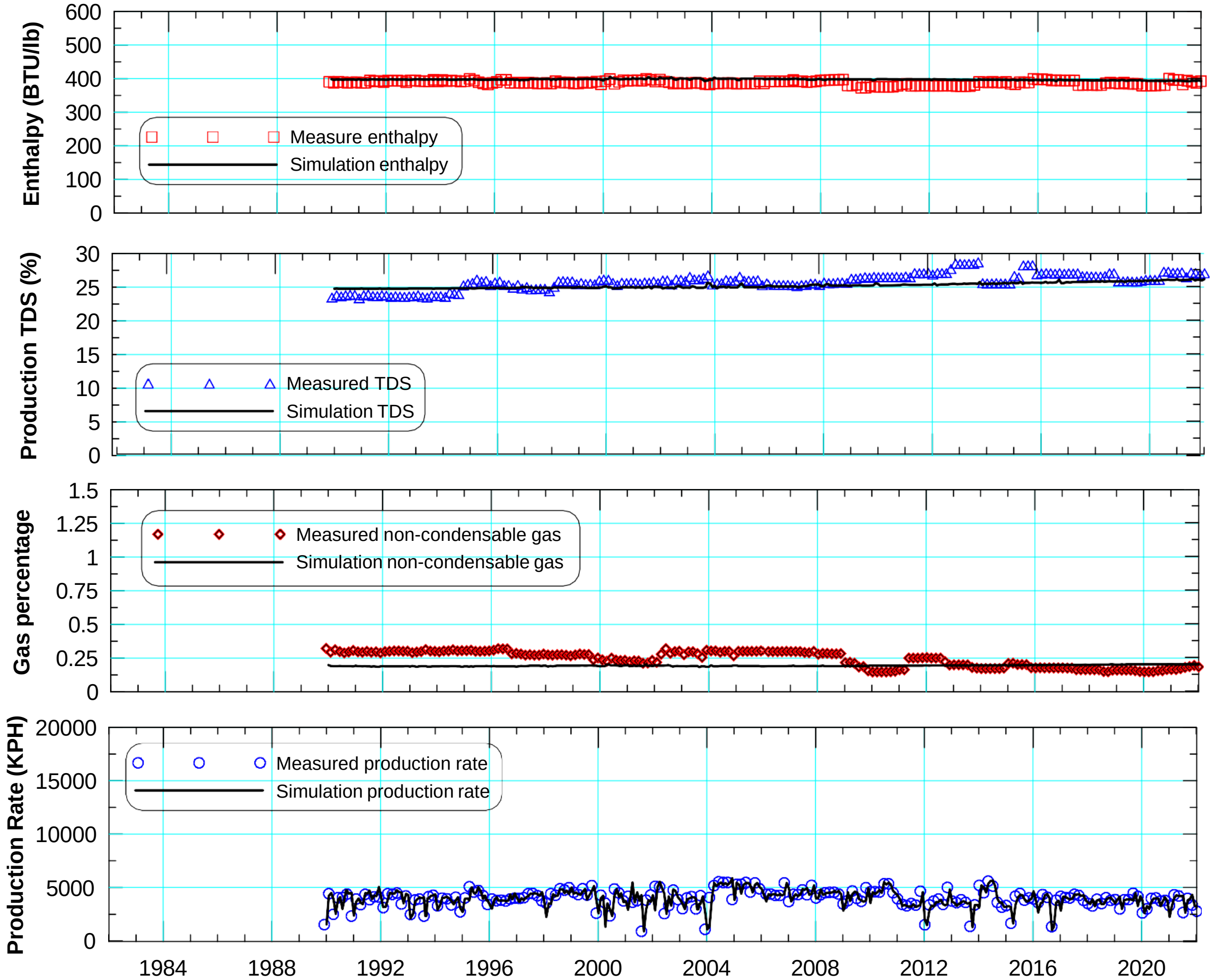

Figure IDR3.b-3. History matching results for the Leathers facility

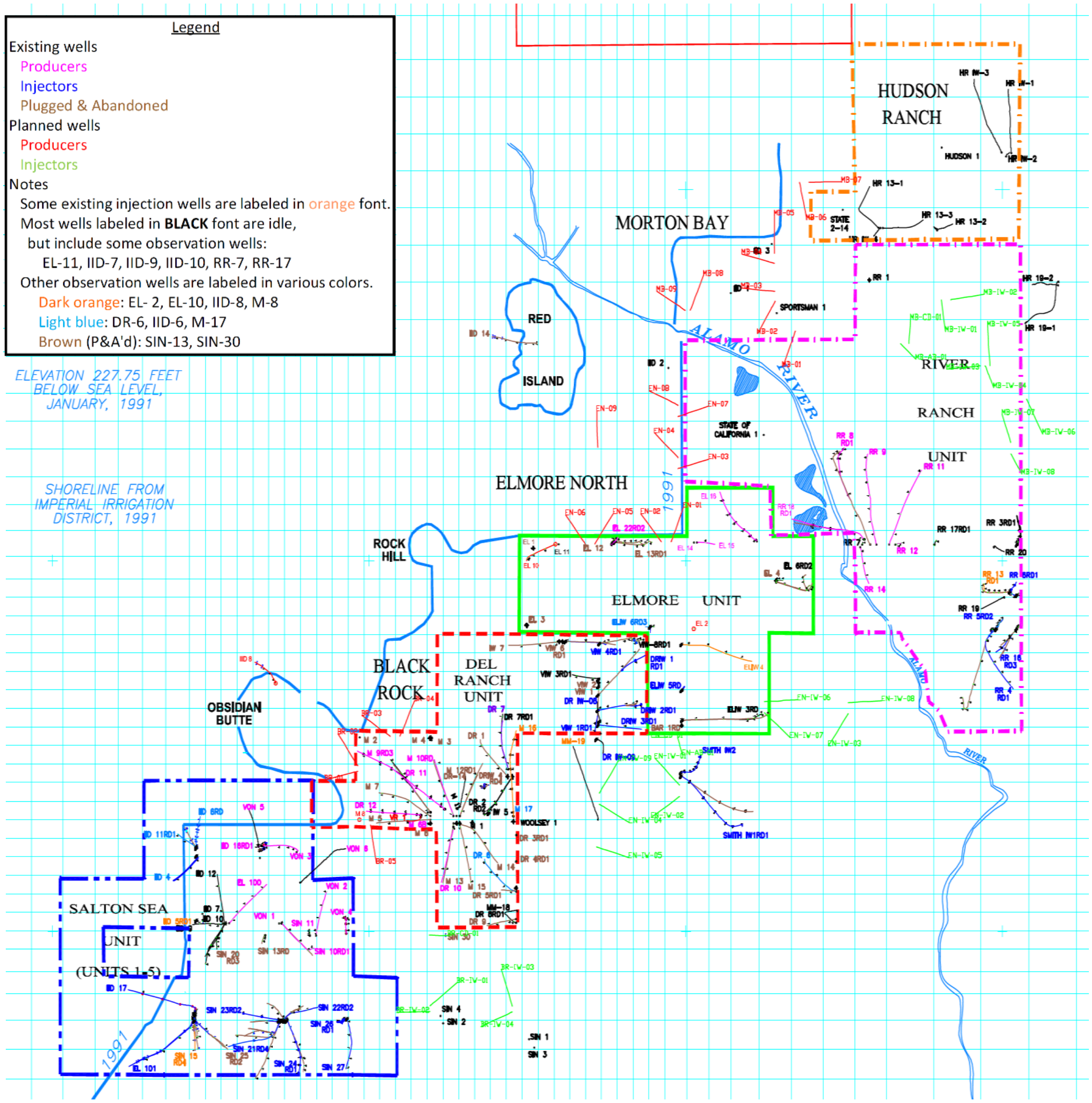

Figure IDR3.b-4. Cropped version of Figure 1.1 of the SSGR Numerical Resource Simulation.

Background: *Morton Bay Geothermal Project Resource Adequacy Report* (Resource Adequacy Report) (TN#: 250042) (IDR 3.c)

Informal Data Request:

3. *GeothermEx prepared a model to evaluate the geothermal resource of the Salton Sea Geothermal Field (SSGF). The results of this model were presented in the Morton Bay Geothermal Project Resource Adequacy Report (Resource Adequacy Report) (TN250042).*
    c. *The aggregated forecast of enthalpy, TDS, and NCG for the Morton Bay Geothermal Project is shown in Figure 3.4 of the Resource Adequacy Report. Please provide similar forecasts, in disaggregated fashion, for all existing Berkshire Hathaway Energy Renewables projects listed in Table 3.1 of the Resource Adequacy Report. In addition, please identify where these results represented in the model are shown in Figures 1.1 and 2.1 of the Resource Adequacy Report.*

Response: By way of background, in Figures 1.1 and 2.1 of the SSGR Numerical Resource Simulation:

- Region 1 is shown with blue boundaries and is titled "SALTON SEA UNIT (UNITS 1-5)"
- Region 2 is shown with red boundaries and is titled "DEL RANCH UNIT"
- Elmore is shown with green boundaries and is titled "ELMORE UNIT"
- Leathers is shown with purple boundaries and is titled "RIVER RANCH UNIT"

Disaggregated forecasts of enthalpy, TDS and NCG for Region 1, Region 2, Elmore, and Leathers are displayed in Figure IDR3.c-1 through Figure IDR3.c-4 below.

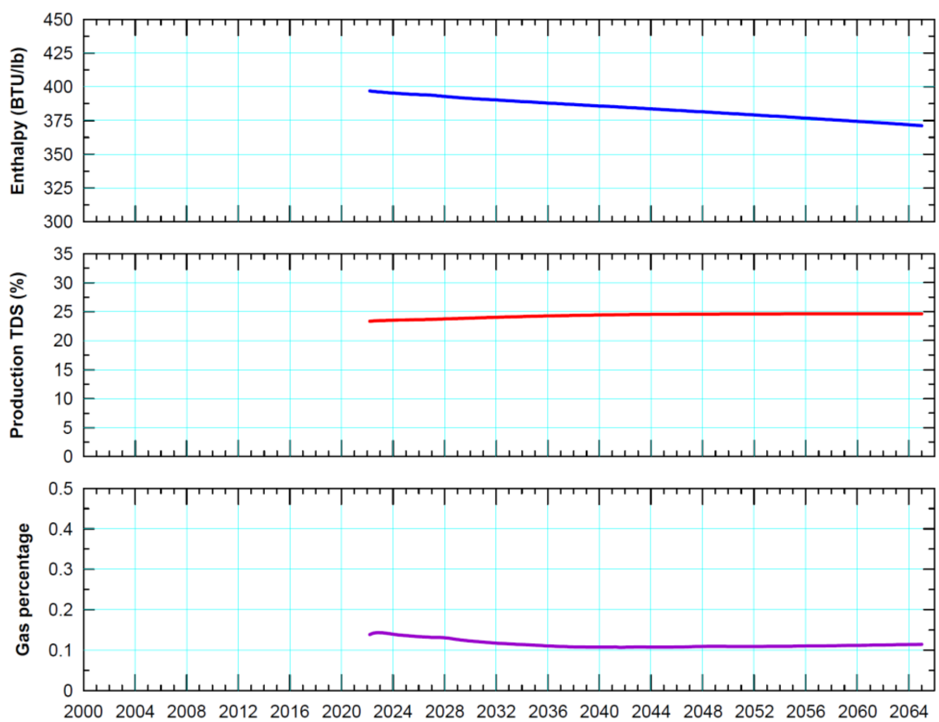

Figure IDR3.c-1. Region 1 (Salton Sea Units 1-5) forecasts for enthalpy, production total dissolved solids, and non-condensable gases

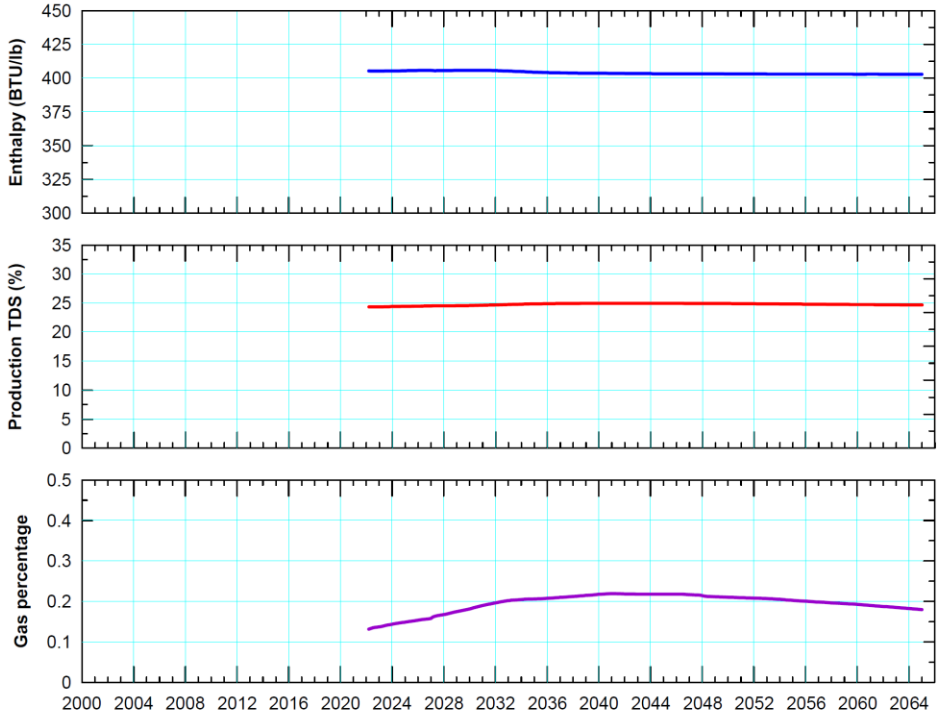

Figure IDR3.c-2. Region 2 (Vulcan, Del Ranch and CE Turbo) forecasts for enthalpy, production total dissolved solids, and non-condensable gases

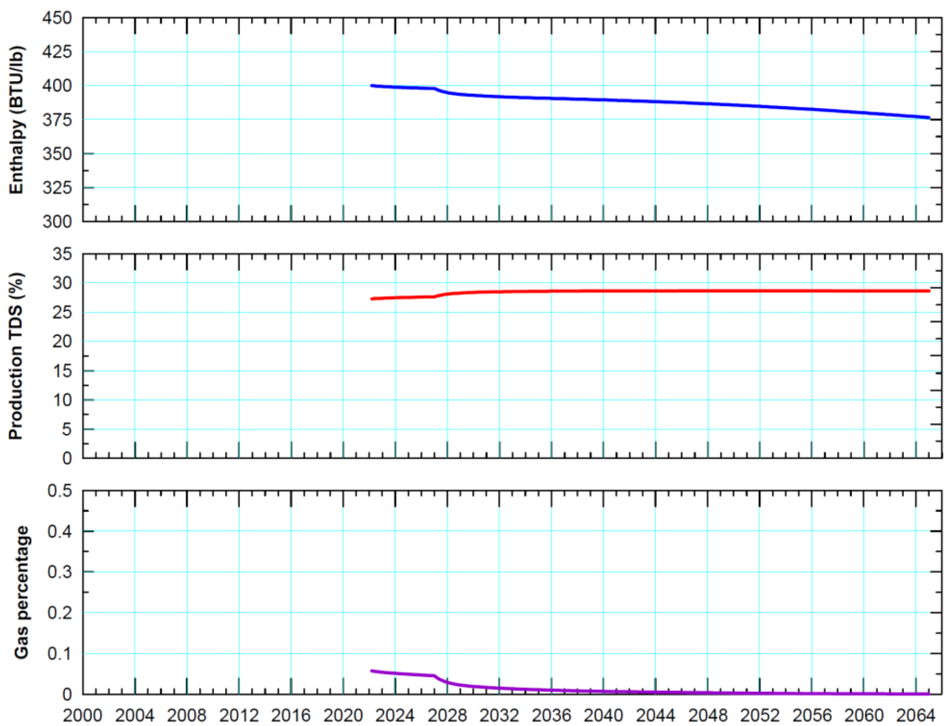

Figure IDR3.c-3. Elmore geothermal facility forecasts for enthalpy, production total dissolved solids, and non-condensable gases

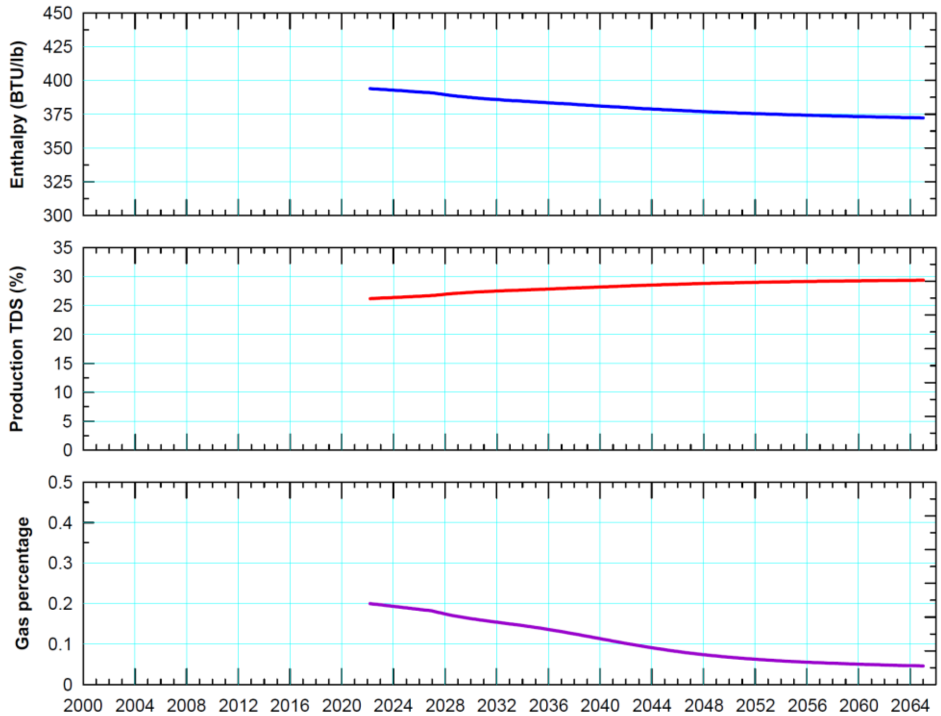

Figure IDR3.c-4. Leathers geothermal facility forecasts for enthalpy, production total dissolved solids, and non-condensable gases

Background: *Morton Bay Geothermal Project Resource Adequacy Report* (Resource Adequacy Report) (TN#: 250042) (IDR 3.d)

Informal Data Request:

3. *GeothermEx prepared a model to evaluate the geothermal resource of the Salton Sea Geothermal Field (SSGF). The results of this model were presented in the Morton Bay Geothermal Project Resource Adequacy Report (Resource Adequacy Report) (TN250042).*
    d. *Please directly speak to what assumptions regarding well proximity undergird the GeothermEx resource adequacy analysis for the proposed Morton Bay Geothermal project, including the feasibility and potential impacts (cost, design, long-term viability, etc.) of changing said locations by an assumed distance. If well spacing data was not included in the model, please explain why.*

Response: Well locations, including the existing well locations for HR1 and preliminary well locations for the MBGP, were incorporated into the field-wide reservoir model to examine the adequacy and ability to sustain the geothermal resource through the horizon of the study, 2065. The well locations are shown in Figure 1.1 of SSGR Numerical Resource Simulation. The planned well locations for MBGP have changed slightly from those presented in the SSGR Numerical Resource Simulation; however, these changes do not alter the conclusion of SSGR Numerical Resource Simulation regarding the adequacy of SSGF to support both existing projects and the MBGP, BRGP, and ENGP. This is because (a) the total production and injection flow rates for MBGP (shown in Table 3.1 of SSGR Numerical Resource Simulation) remain unchanged, and (b) the overall production and injection areas for MBGP are also unchanged.

Well spacing is only one factor considered in the siting of the MBGP production and injection wells. As further described in Section 2.3.2.2 of the AFC, the guiding principles used in locating the wells for the MBGP were as follows:

- Production wells would be located near known production areas.
- Sufficient spacing between production and injection wells is maintained to prevent thermal breakthrough of injection fluid.
- Production wells are located to minimize production impacts to existing geothermal projects.
- Well spacing to ensure adequate resource and injection to support generation for the Project life.

Wellhead locations were also sited based on environmental and cultural resources considerations, while still allowing access to geothermal resources within the geothermal leasehold for the MBGP. Proposed well locations, resource area, power plant site, production supply, and injection capacity were all sited to maintain sufficient spacing between wells to minimize and avoid possible thermal and pressure impacts without undue interference between wells. (AFC, pp. 2-6.) Spacing between the proposed wells is consistent with historical spacing in the SSGF, which has shown to be sustainable, and with statutory requirements regarding spacing from property boundaries, streets, roads, and highways. Sufficient distance between production and injection areas ensures that production fluid is not quenched by injection fluid and the reservoir receives adequate pressure support from the returned injection fluid. (AFC, pp. 2-9) Additionally, injection and production must be planned so that spent geothermal fluid is placed slightly deeper than production to allow gravity to support the migration of denser injection fluid towards the heat source for reheating, while hotter, less dense fluid upwell towards the production area. (AFC, pp. 2-9) Well pads, when possible, will support multiple directionally drilled wells to limit the impact on surface lands.

Due to the complex and myriad factors that go into the determination of where to locate a well, changing significantly the location of a well is not a simple matter and potentially infeasible due to cost or site constraints following an examination of the factors above.

Background: Cooperative Measures Relating to the SSGF (IDR 4)

Informal Data Request:

4. *Please provide any correspondence or describe any cooperative measures the applicant has taken in partnership with other existing plant operators showing that the long-term viability of SSGF is provided for.*

Response: The Applicant is an indirect, wholly owned subsidiary of BHE Renewables, LLC (BHER). BHER and its affiliates work extensively with a myriad of entities relating to geothermal operations in the SSGF, including existing plant operators, the County of Imperial, the California Energy Commission, and other local, regional, state, and federal stakeholders. For example, BHER has worked with Cyrq Energy on issues as routine as providing general well maintenance techniques to proactively contacting Cyrq Energy to discuss the proposed MBGP prior to and after the resource adequacy determination. The Applicant also expects that it will be part of the Geothermal Industrial Committee as a requirement of any conditional use permit issued by the County for the wells and well field.