

<b>DOCKETED</b>	
<b>Docket Number:</b>	23-AFC-01
<b>Project Title:</b>	Morton Bay Geothermal Project (MBGP)
<b>TN #:</b>	256701
<b>Document Title:</b>	Morton Bay Geothermal LLC Responses the United Auto Workers Comments on the ICAPCD PDOC
<b>Description:</b>	N/A
<b>Filer:</b>	Lindsey Xayachack
<b>Organization:</b>	Jacobs
<b>Submitter Role:</b>	Applicant Consultant
<b>Submission Date:</b>	6/5/2024 1:08:36 PM
<b>Docketed Date:</b>	6/5/2024



Morton Bay Geothermal LLC  
4124 NW Urbandale Drive  
Urbandale, IA 50322

Jon Trujillo  
General Manager, Geothermal Development

May 31, 2024

Mr. Jesus Ramirez  
APC Division Manager  
Imperial County Air Pollution Control District  
150 South Ninth Street  
El Centro, California 92243

RE: **Selected Responses to the United Auto Workers Comments on the ICAPCD Preliminary Determinations of Compliance of BHER Geothermal Projects**

Dear Mr. Ramirez:

Black Rock Geothermal LLC, Elmore North Geothermal LLC, and Morton Bay Geothermal LLC (the Applicants) appreciate the work of the Imperial County Air Pollution Control District (ICAPCD) to produce comprehensive Preliminary Determinations of Compliance (PDOC) for the Black Rock Geothermal Project (BRGP or Black Rock), Elmore North Geothermal Project (ENGP or Elmore North), and Morton Bay Geothermal Project (MBGP or Morton Bay).

The Applicants welcome this opportunity to submit selected responses to certain comments submitted by the United Auto Workers (UAW) on the PDOCs for Black Rock, Elmore North, and Morton Bay. UAW's comments on the PDOCs were submitted to the ICAPCD on March 8, 2024. The Applicants remain available to provide additional information in furtherance of issuance of the Final Determinations of Compliance (FDOCs) for the Black Rock, Elmore North, and Morton Bay Projects.

- I. First, ICAPCD does not have sufficient guidelines for making determinations regarding the aggregate number of geothermal projects it is facing. It lacks its own established health risk thresholds, and preliminarily approved these applications using risk thresholds from the neighboring SCAQMD. The density of proposed geothermal developments is unique to the Imperial Valley and brings potential hazards that SCAQMD does not face and has not had to regulate. ICAPCD should develop appropriate risk thresholds that consider the full scope of proposed development; consistently approving projects on a piecemeal basis could result in an unacceptable level of health risks on absolute terms, even if individual projects fall within acceptable limits.*

**Response:** The methodology used to assess project-specific health risk impacts is consistent with the Office of Environmental Health Hazard Assessment's (OEHHA) *Air Toxics Hot Spots Program Risk Assessment Guidelines, Guidance Manual for Preparation of Health Risk Assessments*.<sup>1</sup> Reference to the South Coast Air Quality Management District's (SCAQMD) health risk thresholds was provided for convenience, in the absence of ICAPCD-specific health risk thresholds, and is considered appropriate because they align with those recommended by the California Air Resources Board (CARB) and the California Air Pollution Control Officers

---

<sup>1</sup> <https://oehha.ca.gov/media/downloads/crn/2015guidancemanual.pdf>



Jon Trujillo  
General Manager, Geothermal Development

Association (CAPCOA).<sup>2</sup>

Although ICAPCD does consider projects on an individual basis, the Applicants conducted a cumulative impacts analysis for each project consistent with U.S. Environmental Protection Agency (EPA) guidance to consider the potential, cumulative impacts of all existing and proposed facilities within six miles of the MBGP, BRGP, and ENGP. The results of these analyses<sup>3</sup> demonstrate that maximum modeled cumulative impacts are less than the California and National Ambient Air Quality Standards (CAAQS and NAAQS, respectively), such that concurrent operation of the MBGP, BRGP, and ENGP would not cause or contribute to a violation of an air quality standard.

- II. Second, we have not been able to review enough information to have confidence that the applicants' emissions will be acceptable. The projected emissions of non-condensable gasses (NCG) that have been preliminarily approved, including the carcinogen Radon, are based upon data that has been withheld from the public. The three BHER applicants have obtained confidential designation from the CEC for its analysis of the contents of geothermal brines in the area.<sup>1,2,3</sup> Radon is the second leading cause of lung cancer in the United States behind cigarette smoke,<sup>4</sup> and these emissions could have serious consequences for public health. Additionally, Elmore North obtained a confidential designation for the BHE Cluster Impact Study first from the Imperial Irrigation District, and then from CEC. The public cannot trust the applicants or the agencies responsible for regulating them if the data used for crucial calculations, and the conclusions drawn about area impacts, are opaque.*

**Response:** Criteria and toxic air contaminant emission estimates for the MBGP, BRGP, and ENGP were presented in the Applicants' Applications for Certification (AFCs) and subsequent data request responses, all of which are publicly available through the California Energy Commission (CEC) docket.<sup>4</sup> These submittals include the expected composition and flow rates of the projects' non-condensable gases (NCGs) with sufficient back-up data to allow for recreation of these emission estimates based on primary data (brine flows and chemical composition).

It is also important to note that the BHE Cluster Impact Study is a study prepared by the Imperial Irrigation District (IID) that evaluates whether the interconnection of the project will affect IID's transmission network and is unrelated to emissions, including projected emissions of NCGs, from the project. IID has designated the BHE Cluster Impact Study as confidential because it contains critical energy/electricity infrastructure information (CEII). CEII is typically maintained as confidential so as to not publicly disclose potential vulnerabilities or other information regarding critical infrastructure.

- III. While the proportions of NCG in the brines has not been divulged publicly by BHER, the fact that the brines contain radionuclides is not in question. Researchers have known about Uranium-Thorium radionuclides in the geothermal brines beneath Salton Sea since at least as early as the*

---

<sup>2</sup> <https://ww2.arb.ca.gov/sites/default/files/classic/toxics/rma/rmgssat.pdf>

<sup>3</sup> Refer to Attachment DRR 12-1 of the Morton Bay Geothermal Project Data Request Response Set 1 (Revised Responses to Data Requests 3, 4, 7, 10 to 13, and 73 to 77) (Transaction Number [TN] #253082).

<sup>4</sup> MBGP Docket - <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-AFC-01>; BRGP Docket - <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-AFC-03>; ENGP Docket - <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-AFC-02>



Jon Trujillo  
General Manager, Geothermal Development

1980's.<sup>5</sup> Geothermal fields are significant sources of Radon,<sup>6</sup> and alongside active faults Radon can occur at concentrations significantly higher than background levels.<sup>7</sup>

**Response:** The expected percentages by weight of NCG in the production fluids at reservoir conditions were provided in the AFC for each project, and are as follows: 0.11% for the MBGP, 0.14% for the BRGP; and 0.053% for the ENGP.

Radon anomalies or localized areas with high naturally-occurring radon are an indicator of geothermal activity and have been considered as a geophysical tool for identifying sites for energy production.<sup>5</sup> As discussed in Section 2.3.2.1 of the ENGP AFC (Transaction Number [TN] #249737), geothermal anomalies are distributed throughout the Salton Trough, where hotter fluids suitable for electrical generation are accessible.

Static ground surface fluxes of radon emissions were estimated in geothermally active and background locations in western Turkey.<sup>6</sup> The highest radon surface flux reported was 484 becquerels per square meter per hour (Bq/m<sup>2</sup>-hr; 3.6 picocuries per square meter per hour [pCi/m<sup>2</sup>-s]), in a sample from a geothermally active location. This highest flux estimate was lower than the guideline value for radon surface flux of 20 pCi/m<sup>2</sup>-s. Note that this surface flux guideline value was calculated through a risk assessment conducted by the EPA<sup>7</sup> and published as a standard in the Uranium Mine Tailings Radiation Control Act (UMTRCA) under Title 10 of the Code of Federal Regulations (CFR), Part 40 (10 CFR 40). This surface flux limit is also a standard under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) for radon emissions from phosphogypsum stacks (40 CFR 61, Subpart R), Department of Energy (DOE) facilities (40 CFR 61, Subpart Q) and uranium mill tailings (40 CFR 61, Subpart W). The results from this comparison suggest that while radon concentrations in shallow soil are higher in locations that are highly active geothermally, they do not seem to produce fluxes to ambient air that pose an increased radon risk to human health.

**IV.** *The act of drilling could create Radon dispersal risks; drilling at the scale and density planned for Lithium Valley could compound these risks. As early as 1975, researchers theorized that there is a possibility of locally increased Radon concentrations near geothermal plants.<sup>8</sup> Geothermal drilling may increase ambient Radon levels by transporting it from lower depths to the surface, and researchers recommended curtailing new geothermal development in Turkey until a broader research and Radon survey program could be implemented in that area.<sup>9</sup>*

**Response:** A study of radon exposure in rural residences in Canada<sup>8</sup> identified groundwater wells

---

<sup>5</sup> Balcazar, M, A. Lopez, M. Flores, and M. Huerta. 2014. Natural radiation contribution to renewable energy searching. 14th International Symposium on Solid State Dosimetry, Cusco, Peru, April 2014.

<https://www.osti.gov/etdeweb/biblio/22289147>. PDF available from [https://inis.iaea.org/collection/NCLCollectionStore/\\_Public/45/110/45110591.pdf](https://inis.iaea.org/collection/NCLCollectionStore/_Public/45/110/45110591.pdf).

<sup>6</sup> Aydar, E and C. Dikar. 2021. Carcinogen soil radon enrichment in a geothermal area: case of Guzelcamli-Davutlar district of Aydin city, western Turkey. Ecotoxicology and Environmental Safety. 208:111466. <https://www.sciencedirect.com/science/article/pii/S0147651320313038>.

<sup>7</sup> U.S. Environmental Protection Agency (EPA). 1982. Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites (40 CFR 192), Volume 1. EPA 520/4-82-013-1. <https://semsub.epa.gov/work/05/145482.pdf>.

<sup>8</sup> Khan, S.M., D.D. Pearson, E.L. Eldridge, T.A. Morais, M.I.C Ahanonu, M.C. Ryan, J.M. Taron and A.A. Goodarzi. 2024. Rural communities experience higher radon exposure versus urban areas, possibly due to drilled



Jon Trujillo  
General Manager, Geothermal Development

acting as unintended conduits for radon migration to indoor air. Factors associated with increased radon emissions and indoor air concentrations included smaller distances between wells and residences and higher density of groundwater wells (i.e., number of wells) in proximity to residences. Indoor radon concentrations were significantly higher than background (17 becquerels per cubic meter [Bq/m<sup>3</sup>] or 0.46 picocuries per liter [pCi/L]) in rural residences when these factors were present, though the typical concentrations measured were lower than 123.8 Bq/m<sup>3</sup> or 3.3 pCi/L. The highest concentration reported in this study fell in the range of concentrations (2 to 4 pCi/L) where EPA recommends indoor mitigation to reduce radon risks.<sup>9</sup> Indoor radon concentrations were not significantly elevated in residences greater than 600 meters from a groundwater well.

The land uses surrounding the proposed geothermal projects include agricultural, open space, recreational, geothermal energy production, and equipment staging. Industrial land uses are located within 1.5 miles (2.5 kilometers) of each of the three project sites. The nearest permanent private residence is located approximately three miles (five kilometers) from each of the project sites, whereas the closest residence is employee housing at the Sonny Bono Salton Sea National Wildlife Refuge, located approximately 0.6 miles (one kilometer) from the ENGP location.<sup>10, 11, 12</sup> The nearest indoor spaces are also located more than 600 meters from each project's production well locations. Based on these distances, there are no human receptors in proximity to the proposed geothermal facilities beyond workers at the facilities who will be protected by adherence to health and safety plans. As there are no residential or indoor receptors in proximity to geothermal well bores, the radon risks to human health will not be increased from the geothermal drilling required for these projects.

The Turkish radon study described in UAW's comment<sup>13</sup> has been reviewed in a previous response. The authors recommended a highly precautionary approach. However, a review of their data (presented above) indicates that outdoor radon surface flux, even from geothermally active areas, was low when compared with the surface flux standard used widely by U.S. regulatory agencies. This suggests that the study's results would not be justification for curtailing geothermal development in favor of further research.

- V. *A similar research program is needed in the Salton Sea area before further development is authorized. Despite long-standing awareness of potential risks specific to this industry in this location, in-depth publicly available research on the topic is scant. The California Department of Conservation Radon Program assessed indoor Radon levels throughout the state in 2016, but zip codes 92233 (Calipatria), 92281 (Westmorland), and 92257 (Niland) are not in the 2016 CDPH California Indoor Radon Test Results.<sup>10</sup> Indoor Radon surveys should be conducted now, in*

---

groundwater well annuli acting as unintended radon gas migration conduits. Scientific Reports.14:3640.  
<https://www.nature.com/articles/s41598-024-53458-6>.

<sup>9</sup> Agency for Toxic Substances and Disease Registry (ATSDR). 2024. What are the Standards and Regulations for Environmental Radon Levels? Accessed March 2024. <https://www.atsdr.cdc.gov/csem/radon/standards.html>.

<sup>10</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249737&DocumentContentId=84377>

<sup>11</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249752&DocumentContentId=84391>

<sup>12</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249723&DocumentContentId=84361>

<sup>13</sup> Aydar, E. and C. Dikar. 2021. Carcinogen soil radon enrichment in a geothermal area: case of Guzelcamli-Davutlar district of Aydin city, western Turkey. Ecotoxicology and Environmental Safety. 208:111466.  
<https://www.sciencedirect.com/science/article/pii/S0147651320313038>.



Jon Trujillo  
General Manager, Geothermal Development

*combination with atmospheric tests in the vicinity of active geothermal operations. Much depends on the profile of geothermal brines in the area, and the exact data which could prove illuminating is that which has been deemed confidential.*

**Response:** The California Department of Public Health performs radon testing in buildings throughout the state, including studies focused on counties identified as higher radon risk areas, with results published by the California Department of Conservation (DOC).<sup>14</sup> Currently, Imperial County is judged low-risk based on EPA's radon map for California.<sup>15</sup> As stated previously, the nearest indoor spaces are located more than 600 meters from each project's production well locations. The nearest permanent private residence is located approximately three miles (five kilometers) from each project site, whereas the closest residence is employee housing at the Sonny Bono Salton Sea National Wildlife Refuge, located approximately 0.6 miles (one kilometer) from the ENGP location. At these distances, the indoor radon risks to human health will not be increased from the geothermal drilling required for these projects.

**VI.** *Radioactive waste and emissions generated by oil and gas drilling is an instructive comparison. OSHA lists both petroleum drilling and geothermal energy facilities as locations that may require special protections for workers because they can produce technologically enhanced naturally occurring radioactive material (TENORM), a substance with artificially elevated concentrations of radioactivity above naturally occurring radioactive material (NORM).<sup>11</sup> TENORM wastes associated with geothermal energy production are similar to those produced by petroleum operations.<sup>12</sup>*

**Response:** A recent review of naturally occurring radioactive material (NORM) and radiation protection in geothermal plants noted that the maximum concentrations of Radium-226 (about 100 becquerels per liter [Bq/L] or 2,700 pCi/L) found in brines and production waters from wells of oil and gas plants have the same magnitude of geothermal fluids.<sup>16</sup> Protection of human populations, including workers from hazardous substances, involves adherence to laws, ordinances, regulations, and standards (LORS), as described in the projects' AFCs.<sup>17, 18, 19</sup> The U.S. Occupational Safety and Health Administration's (OSHA) Ionizing Radiation Standard (29 CFR 1910.1096) requires employees to be protected from ionizing radiation sources not regulated by other agencies, such as the U.S. Nuclear Regulatory Commission (NRC), including NORM in certain industries.<sup>20</sup> Geothermal brine residuals is one example cited by OSHA of an industry where technologically enhanced naturally occurring radioactive material (TENORM) might be present. The Applicants take the health and safety of all employees and contractors seriously, and as part of the BRGP, ENGP, and MBGP will prepare and submit construction and operational

---

<sup>14</sup> California Department of Conservation (DOC). 2024. Indoor Radon. Accessed April 2024. <https://www.conservation.ca.gov/cgs/minerals/mineral-hazards/radon>.

<sup>15</sup> U.S. Environmental Protection Agency (EPA). 2024. California – EPA Map of Radon Zones. Accessed April 2024. <https://www.epa.gov/sites/default/files/2014-08/documents/california.pdf>.

<sup>16</sup> Leonardi, F., G. Venoso, A. Bogi, et al. 2024. Review of NORM occurrence and application of a tailored graded approach for the radiation protection in geothermal plants. European Physics Journal Plus. 139: 195. <https://link.springer.com/article/10.1140/epjp/s13360-024-04917-6>.

<sup>17</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249737&DocumentContentId=84377>

<sup>18</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249752&DocumentContentId=84391>

<sup>19</sup> <https://efiling.energy.ca.gov/GetDocument.aspx?tn=249723&DocumentContentId=84361>

<sup>20</sup> U.S. Occupational Safety and Health Administration (OSHA). 2024. Ionizing Radiation. Accessed April 2024. <https://www.osha.gov/ionizing-radiation/hazards>.





Jon Trujillo  
General Manager, Geothermal Development

health and safety plans to the CEC that incorporate all applicable LORS, including OSHA requirements, that will provide the foundation for protecting and reducing potential physical, environmental, and chemical impacts to employees/contractors.

- VII.** *An estimated 30 percent of domestic oil and gas wells produced some TENORM when studied in 1988.<sup>13</sup> The EPA states that oil and gas maintenance workers can be exposed to gamma radiation and inhale radioactive dust and Radon gas, increasing their risk of lung cancer.<sup>14</sup>*

**Response:** A recent study measured the internal doses of workers exposed to TENORM during cleaning and scale-removal activities at a geothermal plant in Germany.<sup>21</sup> Doses to workers were calculated while wearing personal protective equipment, assuming workers performed cleaning activities 170 hours (i.e., approximately 1 month) per year. The dose from ingestion pathways and inhalation of radon was calculated to be 323 microsievert per year ( $\mu\text{Sv}/\text{y}$ ; 32.3 millirem per year [mrem/y]), which is less than German radiation worker limits of 20,000  $\mu\text{Sv}/\text{y}$  (2,000 mrem/y) and less than the limit for the general public of 1,000  $\mu\text{Sv}/\text{y}$  (100 mrem/y), as recommended by the International Commission on Radiological Protection (ICRP). For comparison, the OSHA Ionizing Radiation Standard (29 CFR 1910.1096(b)(1)) is 5,000 mrem/y and the NRC uses 100 mrem/y as a limit for protection of the general public. While the study of this one geothermal facility suggests that doses were relatively low, workers used personal protective equipment for potential chemical and radiation hazards associated with scale. While ionizing radiation both from internal and external exposures is one potential hazard associated with cleaning activities at a geothermal facility, it is one that will be addressed as part of the operational health and safety plan.

- VIII.** *Even in the long-established petroleum extraction industry, key research is lacking regarding broader environmental and health impacts of TENORM. A 2019 literature review of TENORM in the oil and gas industry put its conclusions in strong terms: “The review results of obtainable data relating to the incidence of TENORM in the oil and gas industry indicate that an initial conclusion can be strained on the necessity for further study in this field.”<sup>15</sup>*

**Response:** Bearing in mind that petroleum exploration and production is an uncertain model for risks associated with geothermal energy production, the literature review in 2019<sup>22</sup> also notes in Table 12 that the range of exposures to TENORM in petroleum production in the U.S. was from 0.002 to 0.5 millisievert per year (mSv/y) as an effective annual dose rate. This corresponds to 0.2 to 50 mrem/y, which falls below the NRC’s dose limit for protection of the general public of 100 mrem/y. The source cited in the 2019 publication<sup>23</sup> is one of a series of authoritative studies about NORM waste management in petroleum exploration and production performed by the Argonne

---

<sup>21</sup> Shinonaga, T., D. Walther, W.B. Li, J. Tschiersch. 2023. Internal radiation exposure from TENORM for workers conducting cleaning activities on equipment used at geothermal energy plant. *International Journal of Hygiene and Environmental Health*. 248: 114061. <https://www.sciencedirect.com/science/article/abs/pii/S1438463922001444>.

<sup>22</sup> Mohsen, M.M.A., Hongtao, Z., Zhongyu, L. and N.M.M. Maglas. 2019. Concentrations of TENORMS in the petroleum industry and their environmental and health effects. *RSC Advances*. 9: 39201. <https://pubs.rsc.org/en/content/articlelanding/2019/ra/c9ra06086c>.

<sup>23</sup> Smith, K.P., D.L. Blunt, G.P. Williams and C.L. Tebes. 1996. Radiological Dose Assessment Related to Management of Naturally Occurring Radioactive Materials Generated by the Petroleum Industry. Report ANL/EAD-2, Environmental Assessment Division, Argonne National Laboratory. <https://apps.dtic.mil/sti/tr/pdf/ADA335392.pdf>.



Morton Bay Geothermal LLC  
4124 NW Urbandale Drive  
Urbandale, IA 50322

Jon Trujillo  
General Manager, Geothermal Development

National Laboratory.<sup>24</sup> As cited in previous responses, there is continuing research about the risks of geothermal energy production. However, the analysis of radon emissions from the proposed geothermal facilities, developed in response to prior comments from the California Unions for Reliable Energy (CURE),<sup>25</sup> incorporated worst-case assumptions as a means to bound the uncertainties in our understanding of radon emissions and dispersion. Other than radon, TENORM in geothermal energy production primarily represents a potential hazard to workers, which is addressed through adherence to a facility health and safety plan.

*IX. Regulatory approvals should be withheld until adequate research is conducted on whether increased drilling leads to increased ambient TENORM, and that includes public access to the full dataset of brine analyses and system impact studies possessed by the applicant.*

**Response:** As stated in the responses above, existing studies do not justify the curtailment of geothermal development in favor of further research regarding radon exposure and information critical to the development of the projects' emission estimates were made publicly available through the BRGP, ENGP, and MBGP Dockets hosted on CEC's website.

#### **The Applicants Remain Available to Support the Issuance of the FDOCs**

Thank you for the opportunity to address UAW comments. The Applicants look forward to working with the ICAPCD during the finalization of the Determination of Compliance. Please contact Anoop Sukumaran at (760) 348-4275 (email address: [Anoop.Sukumaran@calenergy.com](mailto:Anoop.Sukumaran@calenergy.com)) or Jerry Salamy at (916)769-8919 (email address: [Jerry.Salamy@jacobs.com](mailto:Jerry.Salamy@jacobs.com)) if you have any questions or if you need additional information.

Sincerely,

Jon Trujillo  
General Manager, Geothermal Development

---

<sup>24</sup> Argonne National Laboratory (ANL). 2024. NORM Waste Management. Accessed April 2024. <https://www.anl.gov/evs/norm-waste-management>.

<sup>25</sup> Elmore North Geothermal Project CURE Data Response Set 4 (Responses to Data Requests 255 to 287), February 21, 2024. <https://efiling.energy.ca.gov/GetDocument.aspx?tn=254602&DocumentContentId=90228>.