



**United States Department of the Interior  
California Department of Toxic Substances Control**



**ELECTRONIC SUBMISSION**

October 4, 2016

Ms. Yvonne Meeks  
Portfolio Manager – Site Remediation  
Pacific Gas and Electric Company  
4325 South Higuera Street  
San Luis Obispo, CA 93401

Subject: Agency Directives on Topock Groundwater Remediation Project Model Revisions

Dear Ms. Meeks,

The United States Department of the Interior (DOI) and the California Department of Toxic Substances Control (DTSC), collectively “the Agencies”, provided direction to Pacific Gas and Electric Company (PG&E) in a letter dated October 19, 2015 regarding the Topock Groundwater Remediation Project. Included within this letter were details regarding nine updates to the groundwater model necessary to improve the reliability of the model projections.

In November 2015, the Agencies received letters from Hargis and Associates on behalf of their client, the Fort Mojave Indian Tribe, from the Chemehuevi Indian Tribe, and from the Cocopah Tribe submitting comments regarding the agencies directives to PG&E on the groundwater remedy design specific to the groundwater model updates.

The revised model report was submitted by PG&E on March 2, 2016. A Technical Working Group (TWG) meeting was held on March 16 to allow PG&E and their consultants to describe the groundwater model updates that were completed to address the agencies directions. These updates included:

- Expanding the regional groundwater flow model, and conversion of the regional groundwater flow model from MicroFEM to MODFLOW;
- Restructuring and refinement of the model grid to eliminate very thin layers along the bedrock contact and more accurately simulate the interaction between the alluvial aquifer and bedrock with respect to groundwater flow and solute transport;

- Refining Colorado River and Topock Marsh areas and associated parameters through model recalibration;
- Completing steady state and transient groundwater flow model calibrations to refine hydraulic parameter values;
- Conducting a sensitivity analysis on hydraulic conductivity, river bed conductivity, leakance and evapotranspiration to identify parameters that have the greatest influence on remedy design and operation; and
- Evaluating the remedial design from the 100% basis of design with the updated groundwater flow and solute transport model with respect to transport of hexavalent chromium, byproduct manganese, byproduct arsenic, and arsenic associated with freshwater injection in the uplands.

PG&E submitted documentation for the revised model in February 2016. The Agencies believe that PG&E addressed the intent of the model directives.

At the request of the Tribes, an April 5, 2016 meeting was held with DTSC and DOI. Dr. Robert Prucha, a Technical Review Committee (TRC) member, provided a presentation of the TRC evaluation of the model. Key issues discussed with the Tribes during the meeting were:

#### Model Boundary Conditions

- Eastern/Southeastern model boundaries are not representative of conceptual model
- Evapotranspiration (ET) rates are still too low
- Evapotranspiration and River cells are incorrectly specified for Topock Bay.
- Groundwater pumping from many surrounding wells is not considered.

#### Water Budgets and Mass Balance

- Significant mass balance errors reported

#### Model Analyses

- Uncertainty analysis not conducted or discussed
- Sensitivity analysis was not worthwhile; PG&E should have completed a predictive analysis.
- Calibration of new model did not simulate plume development
- Steady state flow model is unrealistic for fate and transport modeling.

Dr. Prucha also noted that an updated evaluation for siting MW-X/MW-Y is still missing. He did indicate, however, that his major concerns would not significantly impact the remedial design and operation since the model predictions within that area are based on substantially more data.

In May 2016, additional letters providing comments on the model were received from the Fort Mojave Indian Tribe, Hualapai Tribe and Cocopah Tribe. The letters included a memorandum of the TRC review of the updated Arcadis model as well as the TRC presentation material.

An additional Technical Working Group meeting was held on June 22, 2016. This meeting included opening remarks regarding the Tribal perspective of the Colorado River and a presentation of Tribal/TRC concerns and stakeholder concerns with the updated groundwater model. In the afternoon, the group held open discussions of groundwater modeling issues. In addition to issues raised during the April 5<sup>th</sup> meeting, the following major concerns were raised:

- Little physical basis for southwestern constant flux boundary.
- Potential unrealistic nature of the potentiometric surface for the lowest model layer due to low anisotropy (1:1000).
- Large scale conceptual uncertainties unaccounted for.
- The hydraulic conductivities need to be representative of actual lithologies and/or published values (e.g., hydraulic conductivity of the Bouse Formation appears too high in the model).

The Agencies have considered the comments provided by the Cocopah Tribe, the Fort Mojave Indian Tribe, the Hualapai Tribe and the Metropolitan Water District, the presentations provided by the TRC, as well as the discussions held between the Agencies and Tribes, as well as discussions at the TWG meetings. Based on this information, the Agencies believe that several revisions to the model, including recalibration, should be completed in the near term, before remedy design approval. Agencies hereby direct PGE to complete the following:

Tribal and Stakeholder Comments (bulleted) and Required Revisions (numbered)

- Eastern and southern model boundaries are not representative of the conceptual model
  - Show flow paths through regional model
1. Adjust eastern and southeastern model boundaries to be consistent with the site conceptual model.

The previous CH2Hill modeling allowed about 100 acre-feet per year (ac-ft/yr) to enter the model domain from Sacramento Wash. Furthermore, Dr. Prucha noted during the June 22 TWG meeting that USGS estimates westward groundwater flow through Sacramento Wash at between 2,400 and 4,000 ac-ft/yr.

In the current model, the eastern and southern boundaries across Sacramento and Warm Spring Washes are specified as “no-flow” boundaries. This assumption, however, is inconsistent with the conceptualization that groundwater should be flowing within and at the approximate orientation of the alluvial wash. Although the current model is inconsistent with the conceptual model, it was designed to compensate for this inflow by allowing a significant volume of water to enter from the northeastern boundary, flow south across Sacramento and Warm Spring Washes before taking a more westerly path towards the Colorado River. In addition to the changes to the eastern and southern boundaries, the northeastern boundary conditions (immediately east of the Colorado River) may require revisions to decrease the flow entering the model in order to compensate for the increased inflow from Sacramento and Warm Springs Washes. Finally, particle tracking needs to be performed to demonstrate the agreement between the numerical and conceptual models.

### Tribal and Stakeholder Comments

- Evapotranspiration (ET) rates are still too low
  - Evapotranspiration and River cells are incorrectly specified for Topock Bay.
2. Review available data and computational methods for determining evapotranspiration rates, and with the assistance of Tribal representatives redefine the river cells and most likely areas for evapotranspiration as well as evapotranspiration rates and root extinction depths.

### Tribal and Stakeholder Comments

- Significant mass balance errors reported
  - Independently estimate of groundwater fluxes into and out of the model and compare against model values.
  - Calculate fluxes into and out of the model domain based on current best scientific understanding in order to develop a reasonable water budget for the model domain.
  - Show magnitude and location of flows in/out of river, subsurface flows out of basin and ET.
3. Ensure that mass balance is properly reported, illustrate inflows and outflows and compare against independent estimates.

Although the mass balance reported for the model was in error, the actual model-wide mass balance error is 0.06%, which is very good. For the next model calibration, ensure that the model mass balance is properly recorded. Furthermore, provide a map showing the major model inflows and outflows as well as volumes, and to the extent practicable, compare against independently measured values.

### Tribal and Stakeholder Comments

- The hydraulic conductivities need to be representative of actual lithologies and/or published values (e.g., hydraulic conductivity of the Bouse Formation appears too high in model).
- The calibrated hydraulic conductivities for the hydrostratigraphic units assigned in the model need to better represent these deposits. The assigned hydraulic conductivity values for each unit should be consistent with results derived from past hydraulic testing or with the nature of the deposit for those units that have not been tested directly.
- In addition to vertical anisotropy, horizontal anisotropy should be built into the hydraulic conductivity distribution such that preferential flow through the various deposits is consistent with the nature with which the various fluvial and alluvial units are deposited.

4. Provide a hydraulic conductivity frequency histogram for each hydrostratigraphic unit and discuss appropriateness of the distribution and assumed anisotropies with respect to measured values, depositional environments and diagenesis.

The Agencies have determined that other comments raised by Tribal representatives do not currently require changes to the model, but do need additional explanation and justification. These issues are listed below.

#### Tribal and Stakeholder Comments

- Groundwater pumping from many surrounding wells is not considered. [Groundwater simulating pumping from multiple wells is grouped into pumping centers rather than as individual wells.]
5. Describe the sources of data, data collection approach, available data, uncertainty, potential impacts on modeling results versus alternative conceptualizations, and justification for this approach.

#### Tribal and Stakeholder Comments

- Little physical basis for southwestern constant flux boundary.
6. Provide additional basis, associated uncertainty, potential impacts on modeling results versus alternative conceptualizations, and justification for the approach.

#### Tribal and Stakeholder Comments

- Potential unrealistic nature of the potentiometric surface for the lowest model layer due to low anisotropy (1:1000).
7. Provide addition basis, associated uncertainty, potential impacts on modeling results versus different anisotropies (1:100), and justification for the approach.

Future model updates are anticipated (per the model update procedure outlined in the 100% Basis of Design Report) which will allow for additional feedback to be incorporated into the model revisions. During installation and startup of the remedial system, additional hydrogeologic and groundwater quality data will be generated. Once this information is incorporated into the model, and prior to model re-calibration, additional discussions should be held between the Agencies, Tribal representatives, stakeholders and PG&E to determine the value of performing; uncertainty, predictive and sensitivity analysis, and calibration to steady-state and/or transient data.

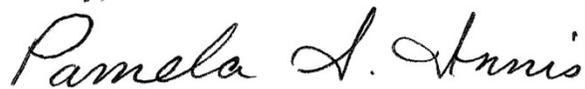
The Agencies expect that a technical meeting will be held in the near future to discuss the revisions identified in this letter. Attendees at this meeting would include a limited number of Agency representatives, Tribal representatives, stakeholders and the PG&E modeling team members. The purpose of the meeting is to provide a forum for collaborative discussion of the

proposed revisions to the model. We believe this can be accomplished through a web-based meeting/conference call.

The Agencies would like to reaffirm that the overall purpose of the groundwater model continues to be the evaluation of the subsurface flow conditions in support of remedy design and operation. PG&E has stated that the current revised model continues to indicate that the planned remedy will be effective in remediating the current chromium plume distribution while minimizing the potential adverse impacts from byproduct generation. We appreciate PG&E's continued cooperation in revising the model.

If PG&E needs any additional clarifications on any issues discussed within this letter or believe that additional direction on model revisions is necessary, please feel free to contact us.

Sincerely,



Pamela S. Innis  
DOI Topock Remedial Project Manager



Aaron Yue  
Project Manager  
Department of Toxic Substances Control

cc: PG&E Topock Consultative Workgroup Members – Via e-mail  
PG&E Topock Geo/Hydro Technical Workgroup Members – Via e-mail  
Tribal Representatives in PG&E Contact List – Via e-mail  
Technical Review Committee – Via e-mail