ATTACHMENT 2

Thermal Discharge Studies

Under the direction of the Executive Officer, a technical workgroup was formed to oversee thermal effects studies (and entrainment and impingement studies) at MBPP for this NPDES permit. Workgroup members included Regional Board staff and independent scientists, the Discharger's staff and consultants, California Department of Fish and Game staff, and Energy Commission staff and Energy Commission independent scientists. The technical workgroup directed three biological studies related to the discharge and a study to physically map the distribution of the thermal plume. The biological studies are not long-term monitoring efforts capable of distinguishing the amount of change caused by the discharge relative to natural temporal changes in community structure and abundance.

Long-term biological studies were not required for the thermal discharge at this site in previous NPDES permits. The discharge began in the early 1950's, while the Porter Cologne Water Quality Control Act was created in 1969, the Clean Water Act was adopted in 1972, and the current State Thermal Plan was adopted in 1975. A few biological surveys were done by PG&E and others; however, these studies were short term and used different methodologies. The results do not form a biological baseline. [Note: Long-term biological monitoring was conducted at Diablo Canyon, but the cooling water volume at that facility is four times greater than the volume used at Morro Bay. The baseline studies at Diablo Canyon began in 1975, and the plant began operation in 1984. The Morro Bay Power Plant began operation in the early 1950's, and no pre-operation biological baseline data were collected. In this respect, the Morro Bay Power Plant is similar to the Moss Landing Power Plant.] Since comprehensive long-term monitoring specifically designed to quantify changes in species composition and abundance near the outfall at Morro Rock was not done, the technical workgroup directed biological surveys to estimate the extent of discharge effects. The three biological surveys include: 1) An evaluation of the sand beach environment to the north of the discharge; 2) an evaluation of the benthic (sand bottom) community in the vicinity of the discharge; and 3) an evaluation of the rocky intertidal zone along the base of Morro Rock. The information presented below is taken directly from Duke Energy's *Thermal Discharge Assessment Report* (TDAR), dated May 2001.

Sand Beach Habitat: Sand beaches in central California support biological communities comprised of benthic invertebrates such as sand crabs, beach hoppers, clams, and worms. The dynamic nature of the sand beach habitat results in large degree spatial and temporal fluctuations in species composition and abundance. The thermal discharge could potentially change the composition and abundance of benthic populations in the vicinity of the discharge. Two surveys were completed in August and November 2000. Beach fauna was sampled at fixed intervals along vertical transects located at increasing distances from the discharge. Ten vertical transects were sampled, out to a distance of about 1000 feet north of the discharge. Four replicate samples were also collected along horizontal transects to allow an estimate of within-area variation. Changes associated with the discharge would be reflected as a gradient in the abundance of organisms across these stations. The results indicate that the thermal discharge is not having a measurable effect on taxa abundance along the sand beach north of the discharge. The thermal discharge may cause changes very close to the outfall, but these changes would be obscured by the high degree of large natural spatial variation that occurs in sand beach populations.

Subtidal Benthic Habitat: The predominant benthic (bottom) habitat in Estero Bay near the discharge is fine sand. This type of habitat can support a diverse and productive assemblage of fish and invertebrates. Invertebrates live both on the benthic surface and beneath the surface. The thermal discharge could potentially change the composition and abundance of benthic populations due to plume contact. Seven benthic sampling stations were established along the 5 meter (~16 foot) depth

contour, as shown on Attachment 4. Two surveys were completed during September and December, 2000. Water temperatures at the stations did not vary substantially. Cooler temperatures were measured closer to the discharge, which indicates possible local upwelling of cooler water as a result of the discharge. Taxa abundances did not show a strong change in gradient relative to distance from the discharge, and no elevated temperatures were measured at the benthic stations. The survey results indicate that the buoyant thermal plume does not affect benthic habitat beyond the immediate vicinity of the discharge. Only the benthic habitat immediately in front of the discharge, in the shallow surf zone, could be affected by the thermal discharge. This area is probably less than an acre in size.

Rocky Intertidal Habitat: Morro Rock and the adjacent riprap represent the only rocky habitat in the vicinity of the discharge. This rocky habitat is isolated from similar habitats by sand beaches. The closest similar rocky habitat is found six miles to the north near Cayucos and six miles to the south at Montana De Oro State Park. The populations found at Morro Rock are probably sustained by self-recruitment from parent populations. The rocky subtidal and intertidal areas around the discharge were surveyed during September 2000. Elevated temperatures can adversely affect invertebrate and algal communities in these habitats. Counts of invertebrates, kelp plants, algal cover, and sessile invertebrates were made in $1m^2$ quadrats. The quadrats were placed every five meters along horizontal transects located about 1 meter below "mean lower low water" (MLLW). Transect RT-1 extended about 180 meters (about 600 feet) along the north side of Morro Rock. A transect was also placed along the west face of Morro Rock. The north Morro Rock sampling area is shown in Attachment 5. Intertidal sampling along Morro Rock was limited due to constantly hazardous wave conditions. The results show that the thermal plume is obviously impacting the invertebrate and algal community along the north side of Morro Rock for a distance of about 600 feet (0.1 miles). The survey illustrates a definite gradient of change in species composition and abundance in this area. Foliose algal taxa such as iridescent seaweed is absent in this area due to the thermal plume. For comparison, the Diablo Canyon Power Plant discharge is causing thermal effects over a shoreline distance of about 2.3 miles (1.4 miles of major changes and an additional 0.9 miles of minor changes). Also, in the 1982 Diablo Canyon Power Plant NPDES Permit, the State Water Resources Control Board allowed some degree of thermal impact along about ½ mile of shoreline (~2600 feet). The impacted distance at Morro Rock (600 feet) is therefore several times less than the amount of degradation originally allowed at Diablo Canyon[1]. The discharge volume at Morro Bay Power Plant (668 MGD maximum) is also much less than the cooling water flow at Diablo Canyon (2,500 MGD).

Thermal Plume Dispersion Surveys: Duke Energy's May 2001 TDAR also includes the results of several thermal plume surveys. These surveys include aerial over-flights using infrared imaging equipment, direct temperature measurements from boat surveys, and direct temperature measurements from fixed stations in the receiving waters. The distribution of the thermal plume is important to help determine the spatial extent of biological effects and to determine compliance with the Thermal Plan.

Black and white aerial images of the thermal plume are not presented here because they do not reproduce well when copied. The entire report is available for review at the Regional Board office, and infrared thermal images will be presented at the July 12th workshop. Estimated percent frequency distribution maps for the thermal plume are shown in Attachments 6 and 7. Attachment 6 shows the frequency of occurrence for the 4°F isotherm under existing operating conditions. Attachment 7 shows the predicted frequency of occurrence for the 4°F isotherm under future operating conditions. The thermal plume is clearly affected by wind, waves, and tides. Under the most common conditions the plume is concentrated along the north side of Morro Rock out to about 500 to 600 feet from the point of discharge, until it flows offshore beyond the point of breaking waves. The plume then

[1] The State Water Resources Control Board's Water Quality Order 83-1 regarding the Diablo Canyon Power Plant thermal discharge concluded that PG&E's predicted impacts along one third of Diablo Cove (about ½ mile) constitute reasonable protection of beneficial uses. The Order does not state distances in feet or miles; staff provides these distances here for comparison purposes.

spreads outward concentrically into Estero Bay. The pattern that emerged shows the plume spreading out from the northwest corner of Morro Rock, then advecting southward parallel to the west side of Morro Rock during the falling tide. This was observed on several occasions when the wind was blowing from the northwest (as it usually does). Under very high wave conditions the plume spreads into the surf zone north of the discharge. This also occurs under anomalous conditions when the wind and waves are from the south. During three surveys the wind was from the south, and resulted in the plume dissipating to the north, even on the falling tide. The intensity of the thermal plume distribution is expected to decrease after the power plant is modernized. The 4°F delta temperature contour occurs infrequently along the west side of Morro Rock and along the sand beach to the north (less than 20% of the time).

The results of the thermal plume surveys support the biological surveys, which indicate thermal impacts only along the north side of Morro Rock for a distance of about 600 feet.