January 30, 2009

Kendall Station
Additional Responses to the Modified Permit

Alden Research Laboratory, Inc. (Alden) has prepared the following discussion in response to Mirant's Kendall Station final NPDES permit.

Review of Wedgewire Deployments

The Region challenged Mirant's position that there was no precedent for deployment of a wedgewire system with the design specifications proposed (0.5 mm and 0.5 ft/s through-media velocity) at a facility similar to Kendall's intake. They provided examples of facilities which, in their mind, are similar to Kendall. However, most of the facilities Region 1 cited in their response are dissimilar to Kendall (see below). The closest would be Charles Point which uses 0.5 mm screens. However, the flow rate is approximately two thirds of that used at Kendall. As a point of information, EPA miscalculated the flow rate for Charles Point (55 mgd actual vs. 60 mgd reported by EPA). The Charles Point screens are deployed 800 ft offshore in the Hudson River at a water depth of 22 ft. The hydraulics 800 ft offshore in a large river are very different than what would be expected at Kendall. The Hudson River's mean annual freshwater flow is approximately 33,000 cfs with a tidal flow of 160,000 cfs, while the Charles River has a mean annual flow of 428 cfs. The Hudson River is a dynamic, tidal bi-directional river which provides a sweeping velocity well beyond (1 to 3 ft/sec ambient and 0.5 ft/sec slot) the approach velocity to the screens. Kendall is located on the Broad Canal (a dead end canal) without sweeping river currents and all of the flow into the Broad Canal is generated by the intake. Artificially inducing flow by the screens in a confined area increases the density of debris and probability of debris impinging on the screens. At Charles Point the screens are in deep water and withdraw only a small percentage of the Hudson River (0.1% of tidal flow), which should limit their interaction with debris.

Station	Flow	Slot Size
Eddystone	633 mgd	6.4 mm
J.H. Campbell	489 mgd	9.5 mm
Jeffrey Energy Center	71 mgd	10 mm
Charles Point Recovery	55 mgd	0.5 mm
Logan Generating Station	7 mgd	1.0 mm

In addition to the above listed facilities, the Region has referenced other wedgewire screen installations in support of other points they were making. For example in the Statement-of-Basis (page 54), the Region used the Logan Generating Plant on the Delaware River to support their position that wedgewire screens were a viable option for Kendall. The flow and slot size has been included in the above list for completeness. However, it should be noted that the approach velocity to the screens at Logan is 0.5 ft/sec. In the same discussion, the Region also referenced data from wedgewire screens at Chalk Point. However, it should be noted that this was an *in situ* pilot study; not a CWIS installation. Finally, in their response to comment 4.24.7 the Arbuckle Mountain Hydroelectric Plant was used as an example of why operating costs for a wedgewire system at Kendall should not be an issue. It should be noted that Arbuckle Mountain is located on a remote California stream that is characterized as "flashy". The unit is operated remotely as a run-of-river plant. When the facility is not generating the wedgewire screens do not operate. The wedgewire system consists of (8) 33 in. x 66 in. vertical cylinders; and, the total flow is 115 cfs; the slot width is 2.38 mm; and, the approach velocity is 0.33 ft/sec. This project is not a good example of a Kendall-like operation.

Difficulties in Assuring Equal Flow through an AFB

Alden considers installation of an AFB within the Broad Canal impractical and recommends pilot studies and hydraulic modeling prior to any installation. A hydraulic model study is required to properly design the flow modifications to assure uniform flow distribution through the AFB fabric. The AFB installation would require an approximately 600 ft long AFB deployment. It will be extremely difficult to attain uniform flow distribution through the AFB because of the asymmetric configuration. On the distal end of the AFB, the fabric would be over 400 ft away from the closest intake while the proximal end of the AFB would be only 30 ft away and directly in front of the intakes. Alden expects the flow modifications required to attain uniform flow will result in high headlosses which may be incompatible with the existing circulating water pumps.

Alden anticipates the flow modifications required would be substantial and likely require a pipe with many orifice openings routed the full length of the 600 ft deployment inside the AFB. Proper sizing, geometry, and location of the pipe and orifices under different flow conditions could be determined using hydraulic modeling. The location and angle of a diversion wall would also need to be investigated to assure a constant bypass velocity could be achieved. Hydraulic modeling would consist of detailed numeric model using computational fluid dynamics (CFD). A physical model or in-situ test is not recommended as the effort required to modify and design would be significantly greater than what is required in a computational environment. The model would include the diversion structure, AFB, flow modifiers and intakes. The model would determine and verify velocity conditions along the AFB and provide pertinent engineering data regarding AFB forces and system headlosses for different debris loading conditions. This information is required for the final structural design of the AFB support system and flow modifications and to verify compliance with EPA design criteria. The model would also be used to assess operation and maintenance concerns that could affect the structural integrity of the AFB.

Potential for Multiple Re-impingement

Both the AFB and barrier-net within a bounded flow condition have the potential to result in the multiple re-impingement of eggs and larvae. Assuming that a 0.5 ft/sec sweeping current is present and the air bubbler or backwash system being used can displace and move an impinged organism 1 ft from the screen face and is operated immediately following each impingement event, a non-motile organism would re-impinge every 25 seconds along the fine-mesh net and every minute along the AFB. Under these conditions an organism impinged at the upstream end of the barrier net would be impinged 26 times before entering the bypass and an organism impinged at the upstream end of the AFB would impinge up to 20 times. Re-impingement increases the potential for injury and/or mortality and limits the ability of the bypass system to improve survival.