United States Department of the Interior

FISH AND WILDLIFE SERVICE

300 Westgate Center Drive
Hadley, MA 01035-9589

June 12, 2014

MEMORANDUM

To: Supervisor, Chesapeake Bay Field Office, Annapolis, MD
Attention: David Sutherland, Fish and Wildlife Biologist

From: Jesus Morales, Hydraulic Engineer, Fish Passage

Subject: Inspection of Fishways at Conowingo Hydroelectric Project (FERC #405) on May 5, 2014

An inspection of the fish passage facilities at the Conowingo Hydroelectric Project (Project) was performed at 10:00 am on Tuesday, 05/06/2014. The Project is owned and operated by the Exelon Corporation (Exelon). The agency team included David Sutherland (USFWS), Sheila Eyler (USFWS), and Larry Miller (USFWS). The tour was led by licensee's representative and General Manager, Ken Poletti. Consultants from Gomez and Sullivan Engineers, Normandeau Associates, Inc. (NA), and personnel from the Maryland Department of Natural Resources were also present. On the day of the inspection the river flow was around 60,000 cfs.

The Project is currently under re-licensing. Overall fish passage issues have been previously identified by the Service (per the November 2012 MEMO with subject: Inspection of Fishways at Conowingo Hydroelectric Project (FERC #405) on Oct. 15, 2012 in support of re-licensing activities). Negotiations for future fish passage efforts and infrastructures are still on going. This inspection memo focuses solely on existing facilities and their operations. No significant changes have followed after the 2012 and 2013 inspections.

This site review included both upstream passage facilities, the east fish lift (EFL) and the west fish lift (WFL). There are no downstream facilities at the Project; historically, downstream movement has occurred through the turbines. There are no upstream eel passes at this barrier. One cycle for each of the lifts was operated during site visit.

East Fish Lift (Upstream Passage):

- Attraction flows - The EFL attraction water is fed through the western-most spillway bay. A significant fraction of this flow is passed down the ogee crest, through a stilling basin and into the entrance channel. The stilling basin is still not capable of dissipating enough energy to effectively allow the discharge of the original design flow (i.e., 900 cfs). The Service criterion for energy dissipation on attraction water systems (AWS) requires a volume of at least 16 cubic feet for every cfs. The aeration and turbulence observed have been shown to dissuade shad movement. Discussions with Exelon's operators suggest that the current entrance channel design

is incapable of passing more than 300 cfs without significant turbulence and aeration. Delays and ineffective passage due to insufficient attraction water are a concern.

- Water velocities - Velocities within the fishway do not seem to be meeting the Service criterion on fish lifts (see appendix for a reference sheet on appropriate fish lift water velocities). Even though velocity measurements were not taken during the inspection, water velocities in the entrance channels and the crowding area seem to be lower than desired. The Service recognizes that at 300cfs Exelon is providing 1/3 of the original design flow (i.e., 900 cfs) and causing the water to move slower than originally intended. The Service recommends that water velocities be physically measured to ensure that optimum conditions within the fishway are persistent during all operational flows.

- Hydraulic conditions – Large flow eddies (>1-foot) and other undesirable hydraulics could be observed inside the entrance channels. These adverse conditions can potentially impact the migratory cues and orientation of available fish, causing delays and/or fallbacks for those fish that have found the entrance but have yet to be crowded into the hopper.

- Water boil – A water boil was observed in the zone over the floor diffuser located immediately upstream of gate C. The Service criterion requires that point velocities emitting from the floor diffuser do not exceed 1.0 fps. Minimum water depth over the floor diffuser should allow the diffuser flow to make a 90° bend and change from vertical to horizontal orientation before reaching the water surface.

- Operation of entrance gates - The EFL currently does not operate with more than one entrance gate opened at a time. During the day of the inspection gate C (the most downstream gate out of all three available gates) was the only operating gate. Even though gates A and B were supposed to be completely closed, gate B was discharging enough weir flow to allow fallbacks from disoriented or unmotivated fish. During the inspection dozens of fish were observed exiting the fishway through gate B.

- Entrance conditions - During the day of the inspection operating gate C was set at an elevation that resulted in a head differential between the entrance channel and the tailwater larger than the recommended drop by the Service criterion (i.e., 4 to 6 inches). In the day of the inspection the fishway operator indicated that the drop could have been as high as 18 inches. A hydraulic drop larger than 6 inches could result in a velocity barrier for weaker swimmers like river herring. There was no easy way for the Service inspector to read the staff gage on the external side of the fishway. The Service recommends that the head differential between water surface inside the fishway and water surface in the tailrace be continuously collected and recorded.

- Fishway shutdowns - Fishway operators informed the Service that during this year's migration season the EFL was down for one day because of problems with a hoist, and another half a day because of issues with bearings. The Service recommends that the operators run the fish lift prior to the start of the fish migration season to check that all mechanical elements are working properly. It is unfortunate that the pre-run equipment tests and maintenance did not catch those deficiencies such that operation would be continuous.

- Operations and maintenance - Any changes to current operations and hydraulic conditions in the fishways need to be discussed and agreed upon with representatives from the Service. The Service recommends setting up annual postmortem meetings at the end of each migration season to discuss lessons learned or alternative approaches on the operations of all fish passage facilities at the Project.

West Fish Lift (Upstream Passage):

- Insufficient water inside the hopper - As soon as the hopper starts lifting, water spills out of the bucket, leaving the bucket with what appears to be less than the USFWS criteria of 0.1 cubic feet per pound of fish. High levels of stressed to the fish are a concerned.

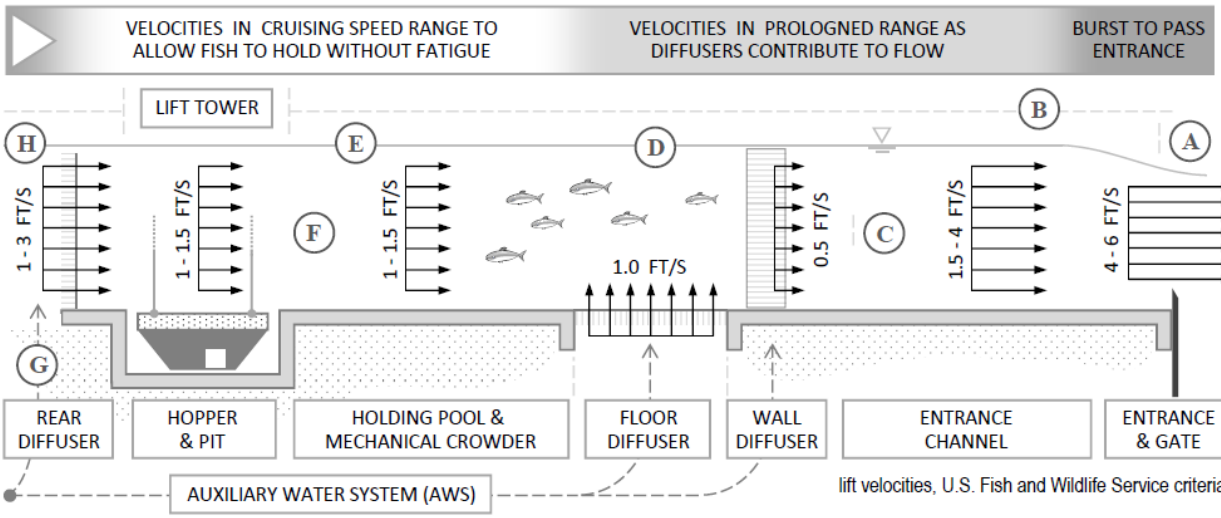
- Risk for injury - Because of the way the fish are being transferred from the bucket into the holding tank, the Service is concern about potential injuries caused by the rusty square-shaped gate at the bottom of the bucket.

- Hydraulic conditions - Undesirable hydraulics at the 90-degrees turn upstream from the entrance gate are causing the fish that enter the fishway to be delayed by having them face the wrong direction for extended periods of time.

Thank you for the opportunity to participate in this review. For questions please contact Jesus at 413-253-8206.

cc. Curt Orvis, USFWS

APPENDIX



lift velocities, U.S. Fish and Wildlife Service criteria

BIOLOGICAL LIFT CAPACITY

$$n_H = V\left(\frac{60\ min}{1\ hr}\right)\frac{r}{w_f \forall_c [1 + C_n]}$$

n_H is the lift biological capacity in fish per hour
V is the volume of the component in ft^3
r is the cycle time in lifts per minute
w_f is the nominal weight of the target species in lbs
C_n is the non-target species allowance
$\forall_c$ is the crowding limit: hopper = 0.10 ft^3/lb †
holding pool = 0.25 ft^3/lb

† crowding limit is valid for lift cycle times of 15 m or less

A. Attraction jet is created by acceleration due to entrance (lift) gate operations; jet typically results in 0.5 – 2.0 foot hydraulic drop into TW.
B. Flood walls and other lift components should be designed to protect against a 50-year flood event.
C. Flow in the entrance channel, downstream of the diffusers, should be streamlined and free of eddies and aeration.
D. Diffuser velocities are maximum point velocities; upwelling and aeration from the AWS should be minimal.
E. Depth in lower flume should be greater than 4 feet at all times.
F. Flow above hopper and in holding pool should be free of aeration.
G. As much AWS flow as possible should be discharged behind the hopper.
H. AWS dissipators should be designed to remove excess energy from flow.

USFWS Northeast Region (R5)
Fisheries, Fish Passage Engineering
B. Towler, 07/29/2014

FISH LIFT