Ice House Partners, Inc. Bypass Flow Requirements A Retrospective Study

Respectfully Submitted:

Ice House Partners P-12769 March 26, 2014

Bypass Flow Requirements: A Retrospective Study

Goals and Objectives:

The objective of this retrospective study will be to analyze the collected water height data during the 24-month period, commencing on March 8, 2012 through March 8, 2014 to help characterize the available aquatic habitat in the Ice House Partners bypass reach. This establishes that the temporary bypass flow (1 mgd)¹ is adequate and should be considered as the permanent bypass reach flow requirement. This retrospective study is being submitted, in order to fulfill requirements included in the Ice House Partners Exemption Order². Our plan previously submitted and accepted by FERC and the resource agencies, proposed to "monitor the impoundment level" and "control operations and bypass mechanisms in accordance with changes in this elevation."³

As described in the November 21, 2011 Order, a notched opening in the dam's flashboards (weir) was provided to maintain the temporary minimum flow to the bypass reach. As long as the water height is equal to or greater than the main weir height, the downstream bypass spillway flow is known to be maintained at the required amount.

This is assured by having the special aperture (5" x 24") designed for this bypass flow set below the normal weir height by approximately 4". This operation is inherently automatic and delivers 0ver 1 mgd at a water level equal to the weir height. For water heights above this, bypass flow is obviously higher, both due to flow over the weir and increased flow at the aperture due to a higher head. This notched weir is used to provide at least the minimum flow of 1 mgd to the bypass reach in accordance with article 18. See calculations attached; about 1,158,000 gallons per day passes through this rectangular opening.

The photo (next page) was taken on the downstream side, looking back up towards the dam; the rectangular aperture; 4" below the dam crest is passing the >1 mgd. (*The wooden structure to the left is the upstream eel passage.*)

¹ See Appendix A, March 14, 2014, Letter to Mr. Fayyad, FERC – which includes calculations and detailed information on the "notched" weir.

² See 122 FERC ¶ 62,262; Order Granting Exemption From Licensing (5 MW or Less) issued March 31, 2008. 20111121-3023 FERC PDF (Unofficial) 11/21/2011 Project No. 12769-002 - 2 -

³ See November 21, 2011 ORDER MODIFYING AND APPROVING RUN-OF-RIVER MAINTENANCE AND MONITORING PLAN PURSUANT TO LICENSE ARTICLE 14



Photo taken March 20, 2014

Requirements:

The following requirement(s) will be addressed in this submission:

Article 14, in part, requires the exemptee to file a bypass reach flow study plan and results within one year. The requirements are specified in the terms and conditions issued by the U.S. Fish and Wildlife Service (FWS) on October 10, 2007 and Massachusetts Division of Fish and Wildlife (MADFW) on October 11, 2007, pursuant to section 30(c) of the Federal Power Act as set forth in Appendices A and B of the project exemption order, respectively.

Article 18 requires the exemptee, in part, to release a continuous one million gallons per day (1 mgd) flow, or its equivalent in cubic feet per second (cfs), into the bypass reach until such time that a permanent flow is established. Article 18 states that this flow should be released in accordance with the MADFW's section 30(c), condition. Article 18 requiring 1 mgd flow into the bypass reach, is included, to ensure that adequate flow is provided to the bypass reach until the results of the bypass reach flow study are evaluated and a permanent bypass flow is established.

Existing Information:

Project Description:

The Project is located on the Nashua River at 323 West Main Street in the Town of Ayer in Middlesex County, Massachusetts. The Ice House Project includes a 190-

foot-long dam and spillway, a head gate structure equipped with four 8-foot-high, 10foot-wide gates, leading to a 50-foot-wide, 109-foot-long power canal. The restored powerhouse, which contains two turbine generating units with a total installed capacity of 280 kilowatts, is located in the canal about 75 feet downstream of the head gate. Water used for generation is discharged from the powerhouse into a 50-foot-wide, 400-footlong tailrace (measured from the head gate to the tailrace outlet). The Nashua River reach that is bypassed by operating the project (measured from the dam to the tailrace outlet) is about 300 feet long. The dam, head gate structure and powerhouse building have all been restored.

Historical Narrative:

The project's two turbines each require 170 cfs of flow to operate and the turbines are an "open top, vacuum flume design." By design, this does not allow turbine operation if the impoundment level is less than full pool. The band of tolerance in the system is about 3" – where the vacuum will break, the turbines will shut down and the water will build back up in the pool. It is important to note that the notch in the weir <u>does not start</u> until 4" below the top of the dam (see photo above). This ensures that the bypass flow notch is always passing water, even if the pool height were to drop below the top of the dam.

This is assured by having the special aperture designed for this bypass flow set below the normal weir height by a calculated amount. This operation is inherently automatic and delivers 1,158,000 gallons per day at a water level equal to the weir height. For water heights above this, bypass flow is obviously higher, both due to flow over the weir and increased flow at the aperture due to a higher head.

Ice House Partner's began operation on March 8, 2012.

The November 21, 2011, the Commission ordered the following:

(B) The exemptee shall conduct a study of the bypass reach flows within one year of the commencement of project operation. This study shall be conducted to determine a suitable bypass discharge to maintain water quality and habitat in the bypass reach. In addition, the exemptee shall file a bypass reach study plan with the Federal Energy Regulatory Commission (Commission) at least two months prior to implementation of the study and then, within six months after completing the study, file the results of the study and a plan for maintaining and monitoring the bypass reach flow.

And, pursuant to Appendix (A)(2) the "flow shall be determined after additional consultation with the MA Division of Fisheries and Wildlife and the U.S. Fish and Wildlife Service. A series of demonstration flows may be needed."

The bypass flow study was ordered to have been conducted during the first field season following "commencement of project operation."

We have been in contact with MA DFW including site visits under minimum river flow conditions during these past years of operation, with regard to determining bypass flow adequacy. As noted in Appendix (A)(2) above, a series of demonstration flows "may be needed". It was during the agency's most recent visit in November 2014 that we received documentation from them to confirm that the temporary bypass flow regime we have been operating under, since project commencement – is, in fact, adequate as a permanent flow requirement.⁴

As noted in Dr. Slater's e-mail, our specific site conditions are such that "the river backwaters to within <100 feet of the dam". Actually, even under minimum river flow, there is always a pool of water at the dam toe, due to backflow. The topography does not slope away from the dam enough to drain this pool.

The photo below, taken on March 20, 2014 shows the area just below the dam.



The second photo (next page, also taken on March 20, 2014) shows the bypass reach. The photo of the notched weir (above) shows water passing through the opening, yet not spilling over the top of the dam. These photos of the bypass reach/downstream of the dam the same day document a typical bypass reach (backwater) condition, given the very flat and shallow river bathymetry.

⁴ Reference 11-26-2013 e-mail from MA DFW, included in Appendix B of this submission.



Current Regulatory Status:

Article 18 of the Ice House Partners Exemption requires the discharge of a minimum of 1 mgd (or its equivalent in cubic feet per second) into the bypass reach area downstream of the dam. This interim conservation flow was established by MA DFW and documented in Appendix B(5) of the Exemption. There have been no violations of this minimum flow requirement in the operational history of the site.⁵ There have, however, been approved deviations, during annual inspection and maintenance activities. All such deviations have been documented and the Commission, resource agencies and local conservation commissions have all been notified, prior to any such dewatering plan, as required by the Exemption. Even in these conditions the backflow keeps the bypass reach submerged.

Ice House Partners failed to file for an extension of time, requesting another field season for data collection and observational activities, as it had been deemed were required to fulfill the part of Article 14 related to bypass flow study and establishing a permanent flow requirement. An extension request will be filed with this report to allow additional time for the Commission to review and obtain agency concurrence.

An on-site visual assessment with MA DFW⁶ occurred on November 22, 2013 around 9 AM, during a typical period of low seasonal flow and while we were operational, running both turbines in a reduced capacity. It was during this visual assessment that MA DFW noted that the flow was "more than adequate".

⁵ Reference historical water height graph included in this report, on Page 8.

⁶ November 22, 2013 – Caleb Slater, PhD Anadromous Fish Project Leader, MA DFW

TIME	DATE	Water Height in inches Over the Dam
08:29:59	11-22-2013	1.50727474689484
08:45:00	11-22-2013	1.20897448062897
08:59:59	11-22-2013	1.43570411205292
09:14:59	11-22-2013	1.28777289390564
09:30:01	11-22-2013	1.02978873252869

The recorded water height measurements at the time of the visit are shown below:

It was our misunderstanding that the study plan was due eighteen months after project commencement (September 2013) and that we were waiting for seasonal low flow conditions <u>after</u> our first field full field year to conduct our on-site visual inspection with MA DFW. Flow demonstrations under minimum river flow conditions are standard procedures for the determination of flow management in regulated rivers. MA DFW and I corresponded about scheduling a visit, which did not ultimately occur until November 22, 2013⁷ which delayed this filing.

It is our intent, with this submittal to accomplish the following:

- Show that we have successfully maintained the conservation flow of 1 mgd, as required by Article 18 of the Exemption;
- Conclude that based on educated and experienced visual assessment, the conservation flow of 1 mgd is adequate to maintain water quality and healthy aquatic habitat;
- Recommend that the conservation flow of 1 mgd become the permanent minimum flow requirement for the project;
- Solicit concurrence from MA DFW and USFWS on the conclusions set-forth.

Data Collection & Analysis

The graph included on the next page displays the recorded water height over the dam data for the period starting on March 8, 2012 and ending March 8, 2014. This period includes the first and second field year of operation and is included in this study.

As long as the water height is no less than (-) 4", the downstream bypass spillway flow is maintained at the required amount. All recorded levels equal to or greater than zero illustrate when the bypass flow is exceeded by the additional spillage over the entire length of the weir. The (-) 4" below the dam crest is the setting of the top of the rectangular opening.

⁷ See Appendix B for various e-mail interactions about scheduling.



WATER HEIGHT OVER DAM - MARCH 8, 2012 THRU MARCH 8, 2014

During approved periods of inspection, maintenance and repair (typically in early autumn) when the schedule work requires us to drop the water height more than 4" below the dam crest – the removable steel gate (see as-built drawing, in Appendix C) can be removed temporarily, in order to pass additional water, insuring that bypass flow minimums are maintained, in all conditions

Conclusion

Based on the recorded daily data from a two year period, we can demonstrate that the bypass flow requirement has been met. The historical data also shows that the weir typically spills water across its entire length, which is additive flow to the minimum/conservation requirement. There is also normal leakage through the dam of the same order of magnitude as the notch flow, which exits via (3) core drains. The dam has a permeable, loose rock-fill core. The flow demonstration and onsite visual assessment conducted on November 22, 2014 confirmed that the recommended conservation flow is adequate to protect water quality and habitat. The historical data included in this report shows that the typical flow on site regularly exceeds the minimum bypass requirement. It has been noted, that our unique site conditions are such that the river "backwaters" to the base of the dam, thereby maintaining a fully watered bypass reach, even under the lowest of flow conditions.

It is our conclusion that the conservation flow of 1 mgd should be accepted as the permanent flow requirement for our site, and as such this retrospective study, in conjunction with agency consultation and Commission guidance fulfills that part of Article 14 and Article 18, as they may pertain to bypass flow discussions.

Future monitoring, maintenance and recording of this bypass flow will be described in a separate filing, once we receive Commission approval.