LOUP POWER DISTRICT
"SERVING YOU ELECTRICALLY"
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Via Electronic Filing

November 1, 2013

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Subject: Loup River Hydroelectric Project
FERC Project No. 1256
Supplemental Information
Docket 1256-031

Dear Secretary Bose,

Loup River Public Power District (Loup Power District or District) herein electronically files supplemental information related to relicensing the Loup River Hydroelectric Project, FERC Project No. 1256 (Project). The District is the owner, operator, and original licensee of the Project, and the District filed its Final License Application (FLA) with the Commission on April 13, 2012. This filing is in response to the August 27, 2013 request from Commission staff for additional information related to the impact of the U.S. Fish and Wildlife Service's Section 10(j) Recommendations on Project power generation, revenue, and dependable capacity.

If you have any questions regarding the District's responses, or any information provided by the District, please contact me at (402) 564-3171 ext. 268.

Respectfully Submitted,

Neal D. Suess
President/CEO
Loup Power District

Attachments

DEPENDABLE CAPACITY CALCULATIONS

The District has prepared the following supplemental information in response to the Commission's August 27, 2013, request for additional information. The Commission requested information regarding the calculations used to determine the Project dependable capacity of 45 megawatts (MW). As noted in the District's Final License Application (FLA) (Volume 1, Exhibit B, Section B.2.1, pg. B-14), the dependable capacity of the Project is defined as 45 megawatts (MW) based on the Nebraska Public Power District (NPPD) Columbus hydro accreditation. However, the FLA noted that this dependable capacity value included all generating units at the Monroe and Columbus powerhouses. This statement was incorrect; the dependable capacity of 45 MW is for the Columbus Powerhouse units only and does NOT include units at Monroe Powerhouse because it operates in run-of-river mode. NPPD credits Monroe Powerhouse with an additional 3 MW of dependable capacity.

The dependable capacity of 45 MW for Columbus Powerhouse is based on a straightforward, periodic, demonstration testing protocol consistent with the following Southwest Power Pool (SPP) criteria:

- "Capability Tests are required to demonstrate the claimed capability of all generating units, excluding run-of-the-river hydroelectric plants and wind plants. During a Capability Test, a unit shall generate its rated net capability for a specified Test Period" (SPP, July 30, 2013). [The length of these periods is determined by the type and size of the units. The test period for non-steam units is 1.0 hour.]
- "The total seasonal [June, July, August, and September] net capability rating shall be that available regularly to satisfy the daily load patterns of the member and shall be available for a minimum of four continuous hours taking into account possible fuel curtailments and thermal limits" (SPP, July 30, 2013).
- "The seasonal net capability established for hydro electric plants, including pumped storage projects, shall be determined taking into consideration the reservoir storage program and any restrictions imposed by governmental agencies and shall be based on median hydro conditions" (SPP, July 30, 2013).

The results of the tests performed, including any agreed upon re-testing, are considered complete as demonstrated. There are no additional computations involved in the final determination of unit or plant capability. The District's most recent capability test was performed on August 11, 2013, and confirmed the dependable capacity of 45 MW (test results are included as Attachment A).

ANALYSIS OF U.S. FISH AND WILDLIFE SERVICE FLOW RECOMMENDATIONS

The District has prepared the following supplemental information in response to the Commission's August 27, 2013, request for additional information. The Commission requested information regarding the impact of the U.S. Fish and Wildlife Service's (USFWS's) recommended Project flow modifications submitted on October 19, 2012, pursuant to Section 10(j) of the Federal Power Act. The District provided responses to USFWS's recommendations and corresponding rationale via electronic filing on December 6, 2012. The following information responds to the Commission's August 2013 request and hereby supplements the District's December 2012 filing, further demonstrating why USFWS's recommendations should not be adopted in the new license for the Project.

In its October 2012 submittal, USFWS made the following flow recommendations[1]:

- USFWS Recommendation 1 – "The Loup River Hydroelectric Project shall maintain a continuous minimum flow of 350 cubic feet per second (cfs) from April 1 through September 30 in the Loup River passing the Project diversion."
- USFWS Recommendation 2 – "The Project shall maintain a continuous minimum flow of 175 cfs from October 1 through March 31 in the Loup River passing the Project diversion."
- USFWS Recommendation 3 – "The maximum diversion of the Project at the Loup River diversion shall not exceed an instantaneous flow of 2,000 cfs, from March 1 through August 31."
- USFWS Recommendation 5 – "The Project shall be operated to maintain a minimum return flow of 1,000 cfs from March 1 to August 31 in the Project tailrace return (i.e., return to the Platte River). Operational deviations from the minimum base flow shall be reported to the Commission within 30 days of the event."

Specifically, in its August 2013 communication, the Commission requested the following information for each USFWS flow recommendation:

- Amount of lost generation
- Loss in value of Project power
- Impact on Project's dependable capacity and corresponding effect on the value of Project power

In the District's December 2012 filing, revenue impacts were analyzed for 3 years of hydrologic data representing wet, dry, and normal hydrologic conditions. This time frame of analysis was used due to the condensed time frame available to prepare a

[1] USFWS Recommendation 4 is not included here because it does not pertain to flow; instead, that recommendation involves a proposal to modify sandbars within the Loup River bypass reach.

response. In response to the Commission's August 2013 request, the District has analyzed the 20 most recent years of hydrologic data, 1990 to 2012, excluding the years 2004, 2005, and 2006. These years were excluded because they are not considered representative of typical system operations due to extensive outages associated with the refurbishment of the Monroe and Columbus powerhouse turbines and generators. The use of a 20-year period provides a more representative analysis based on a longer historical period.

Based on that historic data, the District analyzed the following to determine the impact of USFWS's flow recommendations on Project generation, revenue, peaking ability, and dependable capacity:

- Current operations (baseline)[2]
- USFWS Recommendations 1 and 2, Minimum Bypass Flows Year-Round – minimum bypass flow of 350 cfs from April through September and 175 cfs from October through March.
- USFWS Recommendation 3, Limit on Maximum Canal Diversion March through August – maximum flow of 2,000 cfs diverted into the Loup Power Canal from March through August.
- USFWS Recommendation 5, Minimum Tailrace Flow March through August – minimum flow of 1,000 cfs in the Tailrace Canal from March through August
- USFWS Recommendations 1, 2, 3, and 5 combined

Table 1 summarizes the following information for the 20-year analysis (1990 to 2012) of the impacts on generation and revenue:

- Power generated under current operations and each USFWS recommendation
- Lost generation that would result under each USFWS recommendation compared to current operations
- Revenues from power generated under current operations based on the District's 2010 PPA contract price of $44.16/MWh[3]
- Lost revenue that would result under each USFWS recommendation
- Number of days a continuous minimum flow of 1,000 cfs could not be maintained in the Tailrace Canal under each USFWS recommendation.

Discussion of the methodology used to calculate each of these values is provided in Attachment B.

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[2] As stated in the District's FLA (Volume 1, Exhibit D, Section D.9), the District is not proposing any substantive changes to Project operations; therefore, current operations are the same as operations proposed in the FLA.

[3] The District's 2010 PPA contract price was used for various analyses in the FLA and is used here for consistency.

Table 1. Impact of USFWS's Operational Recommendations on Project Generation and Revenue (1990 – 2012 data [excluding 2004, 2005, 2006])

	Current Operations	R 1 & 2	R 3	R 5	R 1, 2, 3 & 5 Combined
Power Generated (MWh)	170,083	161,707	159,563	167,579	150,493
Lost Generation (MWh)	N/A	(8,376)	(10,520)	(2,504)	(19,590)
Revenue ($44.16 per MWh)	$7,510,865	$7,140,981	$7,046,302	$7,400,289	$6,645,771
Lost Revenue ($44.16 per MWh)	N/A	($369,884)	($464,563)	($110,577)[1]	($865,094)
# of Days 1000 cfs cannot be maintained in the Tailrace	N/A	N/A	N/A	20	28

Notes:

[1] Lost revenue associated with USFWS Recommendation 5 is based on the District's current levelized PPA price, which does not differentiate the value of on- and off-peak generation.

R 1 & 2 = USFWS Recommendations 1 and 2, Minimum bypass flow of 350 cfs (April - September) and 175 cfs (October - March) in Loup River

R 3 = USFWS Recommendation 3, Maximum flow of 2,000 cfs diverted to Loup Power Canal (March - August)

R 5 = USFWS Recommendation 5, Maintain minimum flow of 1,000 cfs from Columbus Powerhouse (March – August)

Currently and as proposed to be continued as discussed in the District's FLA (Volume 1, Exhibit A, Section A.2.12, pg. A-12), the Project regulating reservoirs allow for hydrocycling of the daily inflow at Columbus Powerhouse, ponding water during off-peak hours of low electrical demand and releasing water during on-peak hours of high electrical demand, all within a 24-hour period. Flows are typically released through Columbus Powerhouse in increments that maximize turbine efficiency (maximum turbine efficiency is obtained at approximately 1,600 cfs) (Volume 1, Exhibit A, Section A.2.12, pg. A-12). USFWS Recommendation 5 would require modification of the way ponded water is used to generate power at Columbus Powerhouse and would shift the production of power from the on-peak period of high electrical demand to the off-peak period of low electrical demand. Furthermore, USFWS Recommendation 5 would result in power production at a less efficient flow rate (generation at 1,000 cfs is approximately 10 percent less efficient than at 1,600 cfs).

Tables 2 and 3 summarize the impacts of USFWS Recommendation 5 and USFWS Recommendations 1, 2, 3, and 5 combined on on-peak and off-peak generation at Columbus Powerhouse for the 20-year analysis (1990 to 2012).

Discussion of the methodology used to calculate each of these values is provided in Attachment B.

Table 2. Columbus Powerhouse On- and Off-Peak Generation for Current Operations and under USFWS Recommendation 5 (1990 – 2012 data [excluding 2004, 2005, 2006])

	Columbus Powerhouse Generation						
	On-Peak (MWH)			Off-Peak (MWH)			On & Off-Peak
	1000 cfs	*1600 cfs*	*Total*	*1000 cfs*	*1600 cfs*	*Total*	
March to August Total							
Current Operations	0	76,512	76,512	0	69	69	76,581
Recommendation 5	3,076	58,823	61,899	12,177	0	12,177	74,076
Change in Generation	3,076	(17,689)	(14,613)	12,177	(69)	12,108	(2,505)
January to December Total							
Current Ops	0	138,364	138,364	0	80	80	138,444
Recommendation 5	3,076	120,675	123,751	12,177	11	12,188	135,939
Change in Generation	3,076	(17,689)	(14,613)	12,177	(69)	12,108	(2,505)

Table 3. Columbus Powerhouse On- and Off-Peak Generation for Current Operations and under USFWS Recommendations 1, 2, 3, and 5 Combined (1990 – 2012 data [excluding 2004, 2005, 2006])

	Columbus Powerhouse Generation						
	On-Peak (MWH)			Off-Peak (MWH)			On & Off-Peak
	1000 cfs	*1600 cfs*	*Total*	*1000 cfs*	*1600 cfs*	*Total*	
March to August Total							
Current Operations	0	76,512	76,512	0	69	69	76,581
Recommendations 1, 2, 3, 5	4,311	46,586	50,897	11,432	0	11,432	62,329
Change in Generation	4,311	(29,926)	(25,615)	11,432	(69)	11,363	(14,252)
January to December Total							
Current Ops	0	138,364	138,364	0	80	80	138,444
Recommendations 1, 2, 3, 5	4,311	106,358	110,669	11,432	9	11,441	122,110
Change in Generation	4,311	(32,006)	(27,695)	11,432	(71)	11,361	(16,334)

An additional analysis was performed to determine how the District's ability to operate Columbus Powerhouse as a peaking facility would be impacted by implementation of USFWS's recommendations. For the purposes of this analysis, peaking is defined as the ability to operate a second or third turbine at Columbus Powerhouse during the daily peak period (7:00 a.m. to 10:00 p.m.). Table 4 presents the average number of hours of generation per year with a second or third turbine at Columbus Powerhouse and percent change in generation for Current Operations and for each USFWS recommendation.

Table 4. Columbus Powerhouse Peaking Hours using 2 or 3 Turbines (1990 – 2012 data [excluding 2004, 2005, 2006])

	Hours of On-Peak Generation with 2 Turbines	Percent Change	Hours of On-Peak Generation with 3 Turbines	Percent Change
Current Operations	3,649	--	1,025	--
Recommendations 1 and 2	3,394	-7%	891	-13%
Recommendation 3	3,518	-4%	387	-62%
Recommendation 5	2,008	-45%	490	-52%
Recommendations 1, 2, 3, and 5	1,824	-50%	381	-63%

This analysis revealed that operation under USFWS Recommendations 3 and 5 would severely restrict the District's ability to generate on-peak power using two or three turbines. When the average availability of a second unit is reduced by 50 percent, and that of a third unit is reduced by 63 percent, the relative value for peaking service at Columbus Powerhouse is diminished to a level comparable with the run-of-river operation of the Monroe Powerhouse where the historical mean daily flow rate is 1,630 cfs.

Impacts on dependable capacity at Columbus Powerhouse were analyzed based on NPPD's expectation (and SPP criteria [SPP, July 30, 2013]) that the Project be able to provide 4 hours of maximum capacity (45 MW) daily during the summer season. Table 5 summarizes the following information for the 20-year analysis (1990 to 2012, excluding 2004, 2005, and 2006) of impacts on dependable capacity:

- Total annual hours of generation available at 45 MW under current operations and each USFWS recommendation
- Percent reduction in total 45 MW generation under USFWS's recommendations
- Total days when 45 MW can be produced for 4 continuous hours under current operations and each USFWS recommendation
- Percent reduction in total days of 45 MW generation for 4 hours under USFWS's recommendations

Discussion of the methodology used to calculate each of these values is provided in Attachment C.

Table 5. Impact of USFWS's Operational Recommendations on Project Dependable Capacity (Summer [June, July, August, September] 1990 – 2012 data [excluding 2004, 2005, 2006])

	Current Operations	R 1&2	R3	R5	R 1, 2, 3, 5
Total Annual Hours of Generation available at 45 MW	982	884	914	656	496
Percent reduction in total 45MW generation		-10%	-7%	-33%	-49%
Total days when 45 MW can be produced for 4 continuous hours	107	97	107	76	66
Percent reduction in total days of 45 MW generation for 4 hours		-9%	0%	-29%	-38%

In addition to the significant loss of total MWhs and the shift to generation during non-peak periods associated with USFWS Recommendation 5 and USFWS Recommendations 1, 2, 3, and 5 combined, there is the accompanying loss of dependability—meaning the likelihood that the capacity will be available when it is needed. Peaking facilities are generally expected to be available a high percentage of the time. As such, USFWS's proposed substantial curtailment of the District's ability to produce power on demand as needed by NPPD would reduce NPPD's ability to rely on the Project as a dependable source of peaking power and may require NPPD to seek a replacement source of peaking power.

As discussed above, USFWS's recommendations substantially reduce the District's ability to provide peaking capacity with the second and third turbines at Columbus Powerhouse to a point that Columbus Powerhouse would essentially function as a run-of-river plant, similar to Monroe Powerhouse. NPPD and the SPP currently credit the Monroe Powerhouse with a peaking capacity of 3 MW or 38 percent of installed capacity. Applying this same percentage to Columbus Powerhouse would result in a peaking capacity of 17 MW with operations under USFWS's recommendations.

RESULTS SUMMARY

Implementation of USFWS's proposed recommendations would result in substantial reduction of the District's ability to generate power, particularly during peak demand periods, and corresponding reductions in generation (Table 1), revenue (Table 1), peaking ability (Tables 2, 3 & 4), and dependable capacity (Table 5):

- USFWS Recommendations 1 and 2 (Minimum Bypass Flows Year-Round) would reduce average annual generation by 8,376 megawatt hours (MWh). Based on the District's 2010 power purchase agreement (PPA) contract price of $44.16/MWh, this USFWS recommendation would result in lost revenue of $369,884 per year. The average number of summer (June through September) peaking hours at the 45 MW dependable capacity rating would be reduced by

10 percent. The ability to produce 4 continuous hours of dependable capacity at 45 MW would also be reduced by 10 percent.

- USFWS Recommendation 3 (Limit on Maximum Canal Diversion March through August) would reduce average annual generation by 10,520 MWh. Based on the District's 2010 PPA contract price of $44.16/MWh, this USFWS recommendation would result in lost revenue of $464,563 per year. Under USFWS Recommendation 3, the District's ability to operate Columbus Powerhouse as a peaking unit, i.e., generate with three turbines, would be reduced by 62 percent. The average number of summer peaking hours at the 45 MW dependable capacity rating would be reduced by 7 percent. The ability to produce 4 continuous hours of dependable capacity at 45 MW would not be affected.
- USFWS Recommendation 5 (Minimum Tailrace Flow March through August) would reduce average annual generation by 2,504 MWh. Based on the District's 2010 PPA contract price of $44.16/MWh, this USFWS recommendation would result in lost revenue of $110,577 per year. USFWS Recommendation 5 would reduce the District's ability to operate Columbus Powerhouse as a peaking unit and generate with either two or three turbines by 45 and 50 percent, respectively. Additionally, this USFWS recommendation would reduce the ability to produce power at Columbus Powerhouse during the critical spring and summer peak periods by approximately 19 percent. The average number of summer peaking hours at the 45 MW dependable capacity rating would be reduced by 33 percent. The ability to produce 4 continuous hours of dependable capacity at 45 MW would be reduced by 29 percent. Furthermore, on average, there would be 20 days per year between March and August when USFWS Recommendation 5 does not provide enough water in the Loup Power Canal to provide continuous flow of 1,000 cfs in the Tailrace Canal.
- USFWS Recommendations 1, 2, 3, and 5 combined would reduce average annual generation by 19,590 MWh. Based on the District's 2010 PPA contract price of $44.16/MWh, USFWS Recommendations 1, 2, 3, and 5 combined would result in lost revenue of $865,094 per year. These USFWS recommendations would reduce the District's ability to operate Columbus Powerhouse as a peaking unit and generate with either two or three turbines by 50 and 63 percent, respectively. Additionally, these combined USFWS recommendations would reduce the ability to produce power at Columbus Powerhouse during the critical spring and summer peak periods by approximately 34 percent. The average number of summer peaking hours at the 45 MW dependable capacity rating would be reduced by 50 percent. The ability to produce 4 continuous hours of dependable capacity at 45 MW would be reduced by 38 percent. Furthermore, on average, there would be 28 days per year between March and August when the combination of USFWS

Recommendations 1, 2, 3, and 5 does not provide enough water in the Loup Power Canal to provide continuous flow of 1,000 cfs in the Tailrace Canal.

As discussed in the District's FLA (Volume 1, Initial Statement, Section 6, pg. 12), the District essentially operates as a non-profit entity. Therefore, any reduction in energy production, and thus revenue, must be made up with revenue from customers and would directly translate to higher electric rates for the District's wholesale and retail electric customers. USFWS's aggregate recommendation (1, 2, 3, and 5 combined) would result in the greatest annual lost revenue for the District. This annual lost revenue of $865,094 would represent a significant cost to the District and its ratepayers when compared to the average annual value of Project power since 1938 of $6.0 million (FLA Volume 1, Exhibit D, Section D.5, pg. D-3).

Other Considerations

In addition to generation and direct revenue impacts, there are several operational factors to be considered with respect to the Commission's analysis of the potential impact of USFWS's recommendations on the Project. As detailed in the District's FLA (Volume 1, Exhibit B, Section B.1.3, pg. B-10) and explained in the District's December 6, 2012, initial response, the Project was specifically licensed, designed, and constructed to operate in a daily hydrocycling mode in order to economically maximize power generation during peak demand periods of the day. During off-peak periods, water is ponded in the reservoirs for release during the peak demand period the following day. There is no spillway or other means to release water from the Columbus Powerhouse other than through the three identical Francis turbines, which are designed to operate most efficiently and safely at flows in the range of 1,300 to 1,800 cfs. Furthermore, the District invested $18 million between 2004 and 2007 to refurbish the Project's six turbine-generator units (three units at Monroe Powerhouse and three units at Columbus Powerhouse) to optimize performance according to historical operating parameters (that is, daily hydrocycling at Columbus Powerhouse) (FLA Volume 1, Exhibit C, Section C.1, pg. C-1).

Operating the Columbus Powerhouse turbine units at maximum efficiency (that is, 1,600 cfs) involves a wicket gate position (opening) of about 70 percent and results in smooth, efficient operation. Operating at 1,000 cfs is possible but results in noticeably rough operation with audible internal popping sounds and perceptible machine vibrations. District engineering and operating personnel caution that the turbines should not be operated for extended periods at discharges below 1,200 cfs because such flows result in rough, unsafe operation as damaging mechanical vibrations and cavitation are induced that will erode runner blades. Over time, these low-flow phenomena would reduce unit performance, substantially increase maintenance costs, and ultimately shorten the economic life of the machines. The incremental cost of this maintenance cannot be determined at this time without extended operating experience at the proposed continuous flow.

As discussed in greater detail in the District's response to USFWS's Section 10(j) recommendations dated December 6, 2012, and particularly in view of the substantial adverse economic impact on the Project as demonstrated above, the District believes the proposed USFWS recommendations are not necessary or appropriate for inclusion in the new license based on the following:

USFWS Recommendations 1, 2 and 3:

- Limiting diverted flow would prevent the District from exercising its existing water right and could be construed as an unlawful taking by the Federal government (Loup Power District, December 6, 2012, pg. 9).
- The Loup River bypass reach supports a diverse and viable fishery under current operations (FLA Volume 2, Exhibit E, Section E.6.3.2, pg. E-181; FLA Volume 3, Appendix D, Section 5.7.1, pgs. 91-94).
- There is not a sediment deficit in the lower Platte River; therefore, additional sediment transport by additional flow is unnecessary (FLA Volume 3, Appendix A, Section 5.1, pg. 67; Loup Power District, December 6, 2012, Attachment B).
- There is no link between water diversion and temperature excursions in the Project bypass reach; therefore, no additional minimum flow requirements are necessary for temperature regulation (FLA Volume 3, Appendix C, pgs. 17, 57, and 62).
- The minimum flow proposed by USFWS would result in a depletion of water in the lower Platte River, and therefore, this would conflict with USFWS guidance and could actually be detrimental to the fisheries, including the endangered pallid sturgeon (Loup Power District, December 6, 2012, Attachment A).
- Limiting diverted flow into the Loup Power Canal would not substantively improve interior least tern and piping plover habitat in the Loup River bypass reach (FLA Volume 3, Appendix J, Section 5.2.2 and Table 5-4, pgs. 47-48; Table 5-5, pg. 50; and Section 5.2.4, pg. 51).
- Water diverted into the Loup Power Canal maintains aquatic habitat and supports an excellent fishery; reduced flow diversion could be detrimental to this fishery (FLA Volume 2, Exhibit E, Section E.6.3.2, pg. E-178; and Section E.6.3.1, pgs. E-172 to E-173).

USFWS Recommendation 5:

- There is not enough continuous flow in the Loup River, nor available to the Loup Power Canal, to provide a constant flow of 1,000 cfs through the Columbus Powerhouse turbines (Loup Power District, December 6, 2012, pg. 19).
- The lower Platte River is a thriving and vibrant river ecosystem that supports an abundance of aquatic and wildlife species under current conditions (FLA Volume 2, Exhibit E, Section E.6.3.1, pg. E-173).

- Flow fluctuations due to hydrocycling are similar in magnitude to the natural flow fluctuations that already occur in the lower Platte River, as illustrated by the hydrograph near North Bend during a period when the Project was not in operation (FLA Volume 3, Appendix B, Figure 5-3, pg. 57).
- Alterations of established discharge patterns or channel features might irreparably alter pallid sturgeon habitat (National Research Council, 2005, pg.248).

REFERENCES

Loup Power District. December 6, 2012. Letter from Neal D. Suess, President/CEO, Loup Power District, to Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, regarding Loup River Hydroelectric Project, Reply Comments – U.S. Department of Interior Comments, FERC Project No. 1256, Docket 1256-031.

National Research Council. 2005. *Endangered and Threatened Species of the Platte River*. Washington, D.C.: The National Academies Press.

Southwest Power Pool (SPP). July 30, 2013. "Southwest Power Pool Criteria." Available online at http://www.spp.org/publications/SPP%20Criteria%20and%20Appendices%20July%202013.pdf.

ATTACHMENT A

COLUMBUS POWERHOUSE CAPABILITY TEST

Real Power Report Form

COMPLETED

Pumped Storage & Reservoir Hydro Units

Company	LOUP
Reported by	Brad Morton
Station Name & Unit Number	Columbus Hydro Units 1

Month & Date of Test	8/11/2013
Average Ambient Dry Bulb Temperature during test	86
Ambient Dry Bulb Temp. during test to be >= this value (refer to Attachment 1)	83.1
Gross MWh/hr Generated during test	15.07
MWh/hr Station Service during test	0.03
Net MWh/hr Generated during test	15.04
Average Head Condition (in ft) during test	115.7
Average Head Condition (in ft) Rating Condition	115.7
Average MWh/hr Net Adjustment due Rating Conditions	0
Fuel (Coal / Gas / Oil / Nuclear / other) Approx. Percent	Other/Water
Average MWh/hr Net Adjustment due to Fuel (if applicable)	0
Other Adjustements	
Reason for adjustment	NA
Average MWh/hr Net Adjustment	0
Reason for adjustment	N/A
Average MWh/hr Net Adjustment	0
Total Adjustments	0
Rated Net Capability (MWh/hr)	**15.04**

Notes: Capacity test of individual generator 8/11/13 @ 1700

8/11/13 @17:00HRS
Temp @CPH 86
Temp @84 Columbus METAR
Temp @88 Grand Island METAR
Temp @84 Norfolk METAR

Wet Bulb = 75.5
Barometer = 30.0

Real Power Report Form

COMPLETED

Pumped Storage & Reservoir Hydro Units

Company	LOUP
Reported by	Brad Morton
Station Name & Unit Number	Columbus Hydro Units 2

Month & Date of Test	8/11/2013
Average Ambient Dry Bulb Temperature during test	86
Ambient Dry Bulb Temp. during test to be >= this value (refer to Attachment 1)	83.1
Gross MWh/hr Generated during test	15.07
MWh/hr Station Service during test	0.03
Net MWh/hr Generated during test	15.04
Average Head Condition (in ft) during test	115.7
Average Head Condition (in ft) Rating Condition	115.7
Average MWh/hr Net Adjustment due Rating Conditions	0
Fuel (Coal / Gas / Oil / Nuclear / other) Approx. Percent	Other/Water
Average MWh/hr Net Adjustment due to Fuel (if applicable)	0
Other Adjustements	
Reason for adjustment	NA
Average MWh/hr Net Adjustment	0
Reason for adjustment	N/A
Average MWh/hr Net Adjustment	0
Total Adjustments	0
Rated Net Capability (MWh/hr)	**15.04**

Notes: Capacity test of individual generator 8/11/13 @ 1700

8/11/13 @17:00HRS
Temp @CPH 86
Temp @84 Columbus METAR
Temp @88 Grand Island METAR
Temp @84 Norfolk METAR

Wet Bulb = 75.5
Barometer = 30.0

Real Power Report Form

COMPLETED

Pumped Storage & Reservoir Hydro Units

Company	LOUP
Reported by	Brad Morton
Station Name & Unit Number	Columbus Hydro Units 3

Month & Date of Test	8/11/2013
Average Ambient Dry Bulb Temperature during test	86
Ambient Dry Bulb Temp. during test to be >= this value (refer to Attachment 1)	83.1
Gross MWh/hr Generated during test	15.1
MWh/hr Station Service during test	0.03
Net MWh/hr Generated during test	15.07
Average Head Condition (in ft) during test	115.7
Average Head Condition (in ft) Rating Condition	115.7
Average MWh/hr Net Adjustment due Rating Conditions	0
Fuel (Coal / Gas / Oil / Nuclear / other) Approx. Percent	Other/Water
Average MWh/hr Net Adjustment due to Fuel (if applicable)	0
Other Adjustements	
Reason for adjustment	NA
Average MWh/hr Net Adjustment	0
Reason for adjustment	N/A
Average MWh/hr Net Adjustment	0
Total Adjustments	0
Rated Net Capability (MWh/hr)	**15.07**

Notes: Capacity test of individual generator 8/11/13 @ 1700

8/11/13 @17:00 HRS
Temp @CPH 86
Temp @84 Columbus METAR
Temp @88 Grand Island METAR
Temp @84 Norfolk METAR

Wet Bulb = 75.5
Barometer = 30.0

ATTACHMENT B

GENERATION AND REVENUE IMPACT ANALYSIS METHODOLOGIES

ATTACHMENT B
GENERATION AND REVENUE IMPACT ANALYSIS METHODOLOGIES

There is a direct correlation between the volume of diverted flow from the Loup River and hydroelectric power generation at the Monroe and Columbus powerhouses. USFWS's proposed flow recommendations 1, 2, and 3 would have a direct effect on the volume of flow entering the Loup Power Canal and, thus, an effect on the generation of hydroelectric power. The following approach was used to evaluate the change in flow volume into the Loup Power Canal and the resulting impact on hydroelectric power generation and revenue. First, the flow volumes for current operations and each USFWS flow recommendation were determined. These volumes are the amount of water available for power generation. Once computed, the available volume was converted to power generation and associated revenue. This was done for the 20 most recent years of hydrologic data, 1990 to 2012, excluding the years 2004 through 2006; these 3 years were excluded due to refurbishment of the Monroe and Columbus powerhouse turbines and generators.

USFWS Recommendation 5 does not have a direct impact on the amount of water available to produce hydroelectric power. However, it would impact the manner in which electricity is produced at Columbus Powerhouse, resulting in less efficiency in power generation. Based on the available flow volume, the hydroelectric power generation for current operations and USFWS Recommendations 1, 2, 3, and 5 was determined at both the Monroe and Columbus powerhouses.

Analysis of Available Water Volume for Hydroelectric Power Generation

The amount of water available for hydroelectric power generation at the Monroe and Columbus powerhouses, based on the reduction in flow volume under each USFWS recommendation, was quantified using average daily flow from the following gages:

- USGS Gage 06793000, Loup River near Genoa, NE (Loup River near Genoa gage) (USGS, September 21, 2013a)
- USGS Gage 06792500, Loup River Power Canal near Genoa, NE (Loup Power Canal gage) (USGS, September 21, 2013b)

The process used in determining the available volume for USFWS Recommendations 1, 2, 3, and 5 is described below.

USFWS Recommendations 1 and 2 – Minimum Bypass Flows Year-Round

The volume of water available for hydroelectric power generation for USFWS Recommendations 1 and 2 was determined by reducing the amount of flow in the Loup Power Canal by the flow required to maintain the minimum flow (350 or 175 cfs) at the Loup River near Genoa gage. This makeup water/lost canal water is the amount of water that would be required each day to meet USFWS's recommended minimum bypass flow

amount. For example, the flow near Genoa on July 13, 2012, was 147 cfs; therefore, an additional 203 cfs would need to be bypassed to meet USFWS's recommended minimum bypass flow amount. The daily makeup water/lost canal water was summed, and an annual lost volume was determined. A synthetic hydrograph for the Loup Power Canal was developed by subtracting the makeup water/lost canal water from the original hydrograph. Based on this synthetic hydrograph, the volume of water that would be available at the Monroe and Columbus powerhouses under USFWS's recommendations was calculated and used to determine the impact of USFWS's minimum flow recommendations on Project generation and revenue.

USFWS Recommendation 3 – Limit on Maximum Canal Diversion March through August

The volume of water available for hydroelectric power generation under USFWS Recommendation 3 was determined by limiting the amount of flow in the Loup Power Canal to a maximum of 2,000 cfs. A synthetic hydrograph was developed for the Loup Power Canal such that no more than 2,000 cfs would be allowed into the Loup Power Canal from March 1 through August 31. The makeup water/lost canal water is the amount of water each day that would no longer be diverted into the Loup Power Canal [that is, flows above 2,000 cfs]). For example, the flow in the Loup Power Canal on June 22, 2011, was 2,700 cfs; to meet USFWS's 2,000 cfs maximum flow recommendation, 700 cfs would be removed from the Loup Power Canal. The daily makeup water/lost canal water was summed, and an annual lost volume was determined. Based on this synthetic hydrograph, the volume of water that would be available at the Monroe and Columbus powerhouses was calculated and used to determine the impact of USFWS's maximum flow recommendation on Project generation and revenue.

USFWS Recommendation 5 – Minimum Tailrace Flow March through August

Implementation of USFWS Recommendation 5 would not result in a direct reduction of flow in the Loup Power Canal; rather, it would require modification to the way canal flows are currently used to generate power at Columbus Powerhouse, essentially a retiming, or leveling of the daily flow through the powerhouse. Therefore, USFWS Recommendation 5 was analyzed using the actual daily flows recorded at the Loup Power Canal gage. The retiming of flow at Columbus Powerhouse is described below under "Hydroelectric Power Generation."

USFWS Recommendations1, 2, and 3 Combined

The volume of water available for hydroelectric power generation was determined for USFWS Recommendations 1, 2, and 3 combined using the methods outlined above.

Hydroelectric Power Generation

Hydroelectric power generation at the Monroe and Columbus powerhouses was determined using the available volume of water that would be available under each USFWS recommendation as well as the water that would be available under the combined USFWS recommendations. The amount of water available for current operations was based on the Loup Power Canal gage data (USGS, September 21, 2013b). The following methodologies were used to calculate the generation that would be available under each USFWS recommendation and compared to the generation under current operations to measure impacts.

Current Operations

As discussed in the District's FLA (Volume 1, Exhibit B, Section B.1.3, pgs. B-9 and B-10), water diverted into the Loup Power Canal is used to generate power in run-of-river mode at Monroe Powerhouse and in daily hydrocycling mode at Columbus Powerhouse. A reduction of flow in the Loup Power Canal, as would be required under USFWS's recommendations, would result in a corresponding reduction in energy production at both powerhouses.

Generation at Monroe Powerhouse for current operations was quantified based on the relationship between the volume of water diverted into the canal (as recorded at the Loup Power Canal gage) and the amount of energy produced at Monroe Powerhouse (see Figure 1). This relationship was developed using generation and flow data from 2007 through 2012 to account for changes in generating characteristics resulting from the refurbishment of the Monroe Powerhouse turbines and generators that was completed in 2007. From 2007 through 2012, the average generation at Monroe Powerhouse was 0.025 MWh per acre-foot of water diverted into the Loup Power Canal.

Generation at Columbus Powerhouse for current operations was calculated using a different methodology. Monroe Powerhouse operates in run-of-river mode, so using a historical relationship to calculate the hydroelectric power generation for USFWS Recommendations 1 and 2 was appropriate. However, Columbus Powerhouse uses available stored water discharged at flow rates to maximize efficiency. Changing the flow rate at which power is generated, and the associated efficiency, required a different approach. The methodology described below was developed in order to consistently compare generation impacts of USFWS Recommendations 1, 2, and 3 with the impacts of USFWS Recommendation 5 as well as to calculate the total impact of all four USFWS recommendations combined.

At Columbus Powerhouse, the amount of generation was calculated based on the practice of operating all units at, or reasonably close to, their most efficient discharge rate of approximately 1,600 cfs. This flow rate is derived from a turbine performance test conducted on Unit 1 in May 2005 (subsequent to the refurbishment of this unit), whereby

net power (at the generator leads) is 14.45 MW at an efficient discharge of 1,600 cfs (this test-certified relationship is assumed to hold true for the other two identical units) (Acoustic Technologies, July 15, 2005). The power generated for each USFWS recommendation was calculated by converting the diverted volume into an equivalent number of hours of generation at 1,600 cfs and multiplying the hours of generation by 14.45 MW to get megawatt-hours (MWh). The methodology was tested based on 2011 and 2012 data.

Using the gage record for 2011 and 2012 at the Loup Power Canal and a maximum efficiency discharge rate of 1,600 cfs, the generation for 2011 and 2012 was determined and compared to actual generation values. As shown in Table A-1, there is good agreement between computed and actual values. The computed values are higher than actual values because computed generation was assumed at maximum efficiency, while actual generation efficiency varies.

Table A-1. Validation of Columbus Powerhouse Operational Flow

Year	Actual Generation (MWh)	Estimated Generation (MWh)	Percent Difference
2011	184,307	190,663	3.4%
2012	112,900	114,675	1.6%

Total generation for current operations was calculated by adding the generation at Monroe Powerhouse and the computed generation at Columbus Powerhouse for each.

USFWS Recommendations 1, 2, and 3 – Minimum Bypass Flows Year-Round and Limit on Maximum Canal Diversion March through August

Generation at the Monroe and Columbus powerhouses for USFWS Recommendations 1, 2, and 3 was quantified using the available water volume for each USFWS recommendation and converting it to megawatt-hours (MWh) as described above.

USFWS Recommendation 5 – Minimum Tailrace Flow March through August

Generation at Monroe Powerhouse for USFWS Recommendation 5 was quantified using the same methodology as for current operations and USFWS Recommendations 1, 2, and 3.

As discussed in the District's FLA (Volume 1, Exhibit A, Section A.2.12, pg. A-12), the Project regulating reservoirs allow for hydrocycling of the daily inflow at Columbus Powerhouse, ponding water during off-peak hours of low electrical demand and releasing water during on-peak hours of high electrical demand, all within a 24-hour period. Flows are typically released through Columbus Powerhouse in increments that maximize turbine efficiency (maximum turbine efficiency is obtained at approximately 1,600 cfs). To meet the constant flow requirement of 1,000 cfs in the Tailrace Canal, USFWS Recommendation 5 would require modification to the way canal flows are used to

generate power at Columbus Powerhouse, essentially a retiming of flow through the powerhouse.

To analyze the minimum return flow in the Tailrace Canal, the computed available volume of canal flow for each day (24 hours) was distributed using the following criteria, in order of priority, until all volume had been utilized:

- Constant flow of 1,000 cfs for 24 hours (to the extent possible)
- Additional flow of 600 cfs (to increase to maximum turbine efficiency) during on-peak generation hours (7:00 a.m. to 10:00 p.m. – 15 total hours)
- Additional flow of 1,600 cfs during on-peak generation hours (for generation with a second turbine)
- Additional flow of 1,600 cfs during on-peak generation hours (for generation with a third turbine)
- Additional flow of 600 cfs (to increase to maximum turbine efficiency) during off-peak generation hours (10:00 p.m. to 7:00 a.m. – 9 total hours)

The impacts of USFWS Recommendation 5 were then calculated by multiplying the number of hours of generation at 1,000 cfs and at 1,600 cfs (during the on- and off-peak periods) by turbine test-certified power production rates of 8.11 MW at 1,000 cfs and 14.45 MW at 1,600 cfs. The difference in efficiency per 1,000 cfs is 8.11 MW when operated at 1,000 cfs efficiency and is 9.03 MW when operated at 1,600 cfs efficiency.

Total generation under USFWS Recommendation 5 was calculated by adding the generation at Monroe Powerhouse and the generation at Columbus Powerhouse.

Because USFWS Recommendation 5 would result in a retiming of flows through Columbus Powerhouse, it also would result in a reduction in power production during on-peak hours and an increase in power production during off-peak hours. In order to identify the impact of this shift in power production, a second analysis was conducted.

On- and off-peak generation under current operations and USFWS Recommendation 5 were calculated as follows:

- Current operations – All generation was assumed at peak efficiency at 1,600 cfs; daily volume was assigned to maximize flow for on-peak generation (15 hours), and the remaining volume was used for off-peak generation (9 hours).
- USFWS Recommendation 5 – On- and off-peak generation at each flow rate (1,000 cfs and 1,600 cfs) was developed as described above.

USFWS Recommendations 1, 2, 3, and 5 Combined

Generation for USFWS Recommendations 1, 2, 3, and 5 combined was calculated using the same methodology as used for USFWS Recommendation 5, but using the combined synthetic hydrograph to develop the number of hours of generation at each flow rate. Analysis of the impact on on- and off-peak generation was also analyzed using the same methodology as used for USFWS Recommendation 5.

Tables A-2 and A-3 summarize the on- and off-peak generation under current operations, USFWS Recommendation 5, and USFWS Recommendations 1, 2, 3, and 5 combined for the 20-year period of analysis (1990 to 2012 [excluding 2004, 2005, 2006]).

Analysis of Revenue

Lost revenue associated with each USFWS recommendation was calculated using the District's 2010 PPA contract price of $44.16 per MWh and compared to revenue under current operations.

Table A-2. Columbus Powerhouse On- and Off-Peak Generation under Current Operations and USFWS Recommendation 5 (1990 – 2012 data [excluding 2004, 2005, 2006])

	Columbus Powerhouse Generation						
	On-Peak (MWH)			Off-Peak (MWH)			TOTAL
	1000 cfs	*1600 cfs*	*Total*	*1000 cfs*	*1600 cfs*	*Total*	**On & Off-**
January							
Current Operations	0	7,359	7,359	0	0	0	7,359
Recommendation 5	0	7,359	7,359	0	0	0	7,359
Change in Generation	0	0	0	0	0	0	0
February							
Current Operations	0	9,032	9,032	0	0	0	9,032
Recommendation 5	0	9,032	9,032	0	0	0	9,032
Change in Generation	0	0	0	0	0	0	0
March							
Current Operations	0	12,679	12,679	0	6	6	12,685
Recommendation 5	762	9,400	10,162	1,754	0	1,754	11,916
Change in Generation	762	(3,279)	(2,517)	1,754	(6)	1,748	(769)
April							
Current Operations	0	14,438	14,438	0	10	10	14,448
Recommendation 5	8	11,945	11,953	2,190	0	2,190	14,143
Change in Generation	8	(2,493)	(2,485)	2,190	(10)	2,180	(305)
May							
Current Operations	0	14,076	14,076	0	7	7	14,083
Recommendation 5	36	11,443	11,479	2,253	0	2,253	13,732
Change in Generation	36	(2,633)	(2,597)	2,253	(7)	2,246	(351)
June							
Current Operations	0	13,827	13,827	0	27	27	13,854
Recommendation 5	274	11,114	11,388	2,142	0	2,142	13,530
Change in Generation	274	(2,713)	(2,439)	2,142	(27)	2,115	(324)
July							
Current Operations	0	10,910	10,910	0	15	15	10,925
Recommendation 5	931	7,712	8,643	1,910	0	1,910	10,553
Change in Generation	931	(3,198)	(2,267)	1,910	(15)	1,895	(372)
August							
Current Operations	0	10,582	10,582	0	4	4	10,586
Recommendation 5	1,065	7,209	8,274	1,928	0	1,928	10,202
Change in Generation	1,065	(3,373)	(2,308)	1,928	(4)	1,924	(384)
September							
Current Operations	0	11,091	11,091	0	2	2	11,093
Recommendation 5	0	11,091	11,091	0	2	2	11,093
Change in Generation	0	0	0	0	0	0	0
October							
Current Operations	0	14,482	14,482	0	2	2	14,484
Recommendation 5	0	14,482	14,482	0	2	2	14,484
Change in Generation	0	0	0	0	0	0	0
November							
Current Operations	0	13,718	13,718	0	7	7	13,725
Recommendation 5	0	13,718	13,718	0	7	7	13,725
Change in Generation	0	0	0	0	0	0	0
December							
Current Operations	0	6,170	6,170	0	0	0	6,170
Recommendation 5	0	6,170	6,170	0	0	0	6,170
Change in Generation	0	0	0	0	0	0	0
March to August Total							
Current Operations	0	76,512	76,512	0	69	69	76,581
Recommendation 5	3,076	58,823	61,899	12,177	0	12,177	74,076
Change in Generation	3,076	(17,689)	(14,613)	12,177	(69)	12,108	(2,505)
January to December Total							
Current Ops	0	138,364	138,364	0	80	80	138,444
Recommendation 5	3,076	120,675	123,751	12,177	11	12,188	135,939
Change in Generation	3,076	(17,689)	(14,613)	12,177	(69)	12,108	(2,505)

Table A-3. Columbus Powerhouse On- and Off-Peak Generation under Current Operations and USFWS Recommendations 1, 2, 3, and 5 Combined (1990 – 2012 data [excluding 2004, 2005, 2006])

	Columbus Powerhouse Generation						
	On-Peak (MWH)			Off-Peak (MWH)			TOTAL
	1000 cfs	*1600 cfs*	*Total*	*1000 cfs*	*1600 cfs*	*Total*	**On & Off-**
January							
Current Operations	0	7,359	7,359	0	0	0	7,359
Recommendations 1, 2, 3, 5	0	7,337	7,337	0	0	0	7,337
Change in Generation	0	(22)	(22)	0	0	0	(22)
February							
Current Operations	0	9,032	9,032	0	0	0	9,032
Recommendations 1, 2, 3, 5	0	9,029	9,029	0	0	0	9,029
Change in Generation	0	(3)	(3)	0	0	0	(3)
March							
Current Operations	0	12,679	12,679	0	6	6	12,685
Recommendations 1, 2, 3, 5	762	8,244	9,006	1,754	0	1,754	10,760
Change in Generation	762	(4,435)	(3,673)	1,754	(6)	1,748	(1,925)
April							
Current Operations	0	14,438	14,438	0	10	10	14,448
Recommendations 1, 2, 3, 5	10	9,982	9,992	2,190	0	2,190	12,182
Change in Generation	10	(4,456)	(4,446)	2,190	(10)	2,180	(2,266)
May							
Current Operations	0	14,076	14,076	0	7	7	14,083
Recommendations 1, 2, 3, 5	199	9,081	9,280	2,260	0	2,260	11,540
Change in Generation	199	(4,995)	(4,796)	2,260	(7)	2,253	(2,543)
June							
Current Operations	0	13,827	13,827	0	27	27	13,854
Recommendations 1, 2, 3, 5	532	8,268	8,800	2,040	0	2,040	10,840
Change in Generation	532	(5,559)	(5,027)	2,040	(27)	2,013	(3,014)
July							
Current Operations	0	10,910	10,910	0	15	15	10,925
Recommendations 1, 2, 3, 5	1,463	5,477	6,940	1,517	0	1,517	8,457
Change in Generation	1,463	(5,433)	(3,970)	1,517	(15)	1,502	(2,468)
August							
Current Operations	0	10,582	10,582	0	4	4	10,586
Recommendations 1, 2, 3, 5	1,345	5,534	6,879	1,671	0	1,671	8,550
Change in Generation	1,345	(5,048)	(3,703)	1,671	(4)	1,667	(2,036)
September							
Current Operations	0	11,091	11,091	0	2	2	11,093
Recommendations 1, 2, 3, 5	0	9,955	9,955	0	2	2	9,957
Change in Generation	0	(1,136)	(1,136)	0	0	0	(1,136)
October							
Current Operations	0	14,482	14,482	0	2	2	14,484
Recommendations 1, 2, 3, 5	0	13,958	13,958	0	2	2	13,960
Change in Generation	0	(524)	(524)	0	0	0	(524)
November							
Current Operations	0	13,718	13,718	0	7	7	13,725
Recommendations 1, 2, 3, 5	0	13,376	13,376	0	5	5	13,381
Change in Generation	0	(342)	(342)	0	(2)	(2)	(344)
December							
Current Operations	0	6,170	6,170	0	0	0	6,170
Recommendations 1, 2, 3, 5	0	6,117	6,117	0	0	0	6,117
Change in Generation	0	(53)	(53)	0	0	0	(53)
March to August Total							
Current Operations	0	76,512	76,512	0	69	69	76,581
Recommendations 1, 2, 3, 5	4,311	46,586	50,897	11,432	0	11,432	62,329
Change in Generation	4,311	(29,926)	(25,615)	11,432	(69)	11,363	(14,252)
January to December Total							
Current Ops	0	138,364	138,364	0	80	80	138,444
Recommendations 1, 2, 3, 5	4,311	106,358	110,669	11,432	9	11,441	122,110
Change in Generation	4,311	(32,006)	(27,695)	11,432	(71)	11,361	(16,334)

References

Acoustic Technologies. July 15, 2005. "Loup Power District, Columbus Powerhouse Unit 1 Performance Test." Wareham, MA.

USGS. September 21, 2013a. "USGS 06793000 Loup River near Genoa, Nebr." *National Water Information System: Web Interface*. Retrieved on September 21, 2013. http://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=06793000.

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ATTACHMENT C

DEPENDABLE CAPACITY IMPACT ANALYSIS METHODOLOGIES

ATTACHMENT C
DEPENDABLE CAPACITY IMPACT ANALYSIS METHODOLOGIES

As noted in the District's FLA (Volume 1, Exhibit B, Section B.2.1, pg. B-14), the dependable capacity of the Project is defined as 45 megawatts (MW) based on the Nebraska Public Power District (NPPD) Columbus hydro accreditation and does not include generation at Monroe Powerhouse, since it operates as run-of-river. The dependable capacity of 45 MW is based on a straightforward, periodic, demonstration testing protocol consistent with the following Southwest Power Pool (SPP) criteria:

- "Capability Tests are required to demonstrate the claimed capability of all generating units, excluding run-of-the-river hydroelectric plants and wind plants. During a Capability Test, a unit shall generate its rated net capability for a specified Test Period" (SPP, July 30, 2013). [The length of these periods is determined by the type and size of the units. The test period for non-steam units is 1.0 hour.]
- "The total seasonal [June, July, August, and September] net capability rating shall be that available regularly to satisfy the daily load patterns of the member and shall be available for a minimum of four continuous hours taking into account possible fuel curtailments and thermal limits" (SPP, July 30, 2013).
- "The seasonal net capability established for hydro electric plants, including pumped storage projects, shall be determined taking into consideration the reservoir storage program and any restrictions imposed by governmental agencies and shall be based on median hydro conditions" (SPP, July 30, 2013).

The impact on dependable capacity was determined using the following two criteria, consistent with SPP criteria (SPP, July 30, 2013) and NPPD's expectation that the Project's dependable capacity be available for 4 continuous hours of 45-MW generation daily during the summer season:

- Average number of hours of 45-MW generation during the summer season (June, July, August, September) for the period from 1990 through 2012 (excluding 2004, 2005, and 2006).
- Average number of days when 45 MW could be produced for 4 continuous hours during the summer season for the period from 1990 through 2012 (excluding 2004, 2005, and 2006).

These criteria were analyzed under current operations and each USFWS recommendation using the following methodology:

- The daily volume of water available for generation at Columbus Powerhouse was determined as discussed in Attachment A.

- This volume was divided by 5,100 cfs (the flow required to generate 45 MW[1]) to determine the number of hours of 45-MW generation that could be produced each day.
- To assess the impact of USFWS Recommendation 5 and USFWS Recommendations 1, 2, 3, and 5 combined, the daily volume of water available (after 1000 cfs is provided for the entire day) was divided by 4,100 (to increase generation to 45 MW) to determine the number of hours of 45-MW generation that could be produced each day.
- The total hours of 45-MW generation were summed and averaged over 20 years.
- The total number of days when 4 hours or more of 45-MW generation could be produced were summed and averaged over 20 years.

The average values for total hours of peak generation and total days with a 4-hour block of peak generation were tabulated for current operations; USFWS Recommendations 1, 2, 3, and 5; and the combination of all four USFWS recommendations. The changes between current operations values and the values associated with USFWS's recommendations were then compared on a percentage change basis to quantify the relative impact of each USFWS recommendation.

References

Southwest Power Pool. July 30, 2013. "Southwest Power Pool Criteria." Available online at http://www.spp.org/publications/SPP%20Criteria%20and%20Appendices%20July%202013.pdf.

[1] This flow rate is derived from a turbine performance test conducted on Unit 1 in May 2005, whereby net power (at the generator leads) is 15 MW at a discharge of 1,700 cfs (this test-certified relationship is assumed to hold true for the other two identical units). Therefore, total flow required to produce 45 MW is 5,100 cfs.