Federal Hydro IPR Follow Up Questions

1. **CO2 avoidance value, provide as follow up. Analysis was not performed but can be run based on 7th Power Plan.**

   Requesting new analysis is outside the scope of the IPR process; however, please see the response to question 3 below in relation to this question.

2. **Please describe which facilities are in the Area Support and Local Support categories—Is it based on size, location, role in the system? It would be helpful to have a complete list in supporting documentation.**

Plant	ID	Units	MW Capacity	aMW Energy	Strategic Class	Operator
Grand Coulee	GCL	24	6,735	2,497	Main Stem Columbia	Reclamation
Chief Joseph	CHJ	27	2,614	1,387	Main Stem Columbia	Corps
McNary	MCN	14	1,120	575	Main Stem Columbia	Corps
John Day	JDA	16	2,480	991	Main Stem Columbia	Corps
The Dalles	TDA	22	2,052	773	Main Stem Columbia	Corps
Bonneville	BON	18	1,195	513	Main Stem Columbia	Corps
Dworshak	DWR	3	465	214	Headwater/Lower Snake	Corps
Lower Granite	LWG	6	930	272	Headwater/Lower Snake	Corps
Little Goose	LGS	6	930	263	Headwater/Lower Snake	Corps
Lower Monumental	LMN	6	930	278	Headwater/Lower Snake	Corps
Ice Harbor	IHR	6	693	211	Headwater/Lower Snake	Corps
Libby	LIB	5	605	238	Headwater/Lower Snake	Corps
Hungry Horse	HGH	4	428	113	Headwater/Lower Snake	Reclamation
Albeni Falls	ALF	3	49	24	Area Support	Corps
Detroit	DET	2	115	46	Area Support	Corps
Big Cliff	BCL	1	21	13	Area Support	Corps
Green Peter	GPR	2	92	30	Area Support	Corps
Foster	FOS	2	23	12	Area Support	Corps
Lookout Point	LOP	3	138	37	Area Support	Corps
Dexter	DEX	1	17	10	Area Support	Corps
Cougar	CGR	2	28	17	Area Support	Corps
Hills Creek	HCR	2	34	18	Area Support	Corps
Lost Creek	LOS	2	56	36	Area Support	Corps
Palisades	PAL	4	177	74	Area Support	Reclamation
Minidoka	MIN	4	28	22	Local Support	Reclamation
Anderson Ranch	AND	2	40	18	Local Support	Reclamation
Boise Diversion	BDD	3	3	2	Local Support	Reclamation
Black Canyon	BCD	2	10	9	Local Support	Reclamation
Roza	ROZ	1	13	10	Local Support	Reclamation
Chandler	CDR	2	12	9	Local Support	Reclamation
Green Springs	GSP	1	17	6	Local Support	Reclamation
Total		**196**	**22,060**	**8,716**		

The 31 hydroelectric plants in the FCRPS are grouped into four strategic classes based on the role they play in the system.

Main Stem Columbia: plants that provide the majority of power, ancillary services, and non-power benefits to the Pacific Northwest.

Headwater/Lower Snake: plants that support the region as a whole, providing power and non-power benefits (navigation, fish passage, and transmission support).

Area Support: plants that do not support the region as a whole, but provide key power and non-power benefits to a sub-basin, primarily in the Willamette Valley.

Local Support: plants that provide services locally, primarily in Southern Idaho.
The criticality of a hydro asset is based largely on the quantity of energy produced, particularly at peak periods, and the financial impact of a loss of generation. Assets in the Main Stem Columbia and Headwater/Lower Snake strategic classes provide more than 96 percent of energy and capacity for the system.

3. **Please provide the table of modeling assumptions for the current Fed Hydro Asset Investment analysis.**

Assumption	Value	Source	Comment
Discount Rate	8.2%	BPA Finance	Official Agency Risk Adjusted Discount Rate
Price Forecast	Varies by year	BPA Power Services Forecasting and Planning	Analysis based on "Expected" case with sensitivities for "High" and "Low"
Avoided CO2 Value*	Common Planning Assumptions – "Medium"	BPA Finance Capital Investment Group	Based on methodology used in the Northwest Power and Conservation Council's Seventh Power Plan
Inflation	2.1%	BPA Finance	Varies by year

Note that although avoided CO2 emissions benefits are calculated for all investments, they are not included in the lost generation risk charts or NPV of the investment program as they have in years past. The values included in the table are based on the historical and forecast price of purchasing a greenhouse gas allowance on the California Air Resources Board quarterly auction. This assumption is consistent with the methodology employed in the Northwest Power and Conservation Council's Seventh Power Plan. The price per ton equates to the purchase price of one allowance. The cost per ton is converted to cost per MWH using the carbon emissions of a natural gas generating unit (per the Energy Information Administration's Average Operating Heat Rate statistics). This assumes that a natural gas generating unit is the marginal resource dispatched.

Market Price Forecast (Nominal Dollars)			
Based on FY 18/FY19 Final Rate Proposal Posted November 2017 (Dollars per MWh)			
Year	Expected	Low	High
2018	23.49	19.21	27.36
2019	23.25	19.17	26.97
2020	22.89	18.79	26.80
2021	24.83	20.29	28.86
2022	25.97	20.92	30.27
2023	27.50	22.36	31.95
2024	28.26	22.85	32.91
2025	30.36	24.52	35.37
2026	31.72	25.58	36.93
2027	33.99	27.25	39.86
2028	35.80	28.41	41.97
2029	37.14	29.64	43.52
2030	38.42	30.40	45.30
2031	40.26	31.73	47.46
2032	41.71	32.67	49.40
2033	43.55	34.27	51.34
2034	44.43	34.58	52.73
2035	45.86	35.84	54.40
2036	47.62	37.21	56.48
2037	49.44	38.63	58.64
2038	51.33	40.11	60.88
2039	53.29	41.64	63.21
2040	55.33	43.24	65.62
2041	57.45	44.89	68.14
2042	59.64	46.61	70.74
2043	61.93	48.40	73.45
2044	64.30	50.25	76.27
2045	66.76	52.18	79.19
2046	69.32	54.18	82.22
2047	71.98	56.26	85.38
2048	74.74	58.42	88.65
2049	77.61	60.66	92.05

Carbon Value Assumption

This table monetizes the value of avoiding the emission of a ton of CO2 based on historical CARB Cap and Trade auction results projected using the 7th Power Plan methodology for the medium case.

	Price Per Ton			Price Per MWh*		
Year	Low	Medium	High	Low	Medium	High
2018	13.95	14.40	15.12	5.84	6.02	6.33
2019	14.20	15.12	16.68	5.94	6.32	6.98
2020	14.45	15.87	18.40	6.04	6.64	7.70
2021	14.70	16.67	20.29	6.15	6.97	8.49
2022	14.96	17.50	22.38	6.26	7.32	9.36
2023	15.22	18.38	24.68	6.37	7.69	10.32
2024	15.49	19.29	27.22	6.48	8.07	11.39
2025	15.76	20.26	30.02	6.59	8.48	12.56
2026	16.03	21.27	33.11	6.71	8.90	13.85
2027	16.31	22.34	36.52	6.82	9.34	15.28
2028	16.60	23.45	40.28	6.94	9.81	16.85
2029	16.89	24.63	44.42	7.07	10.30	18.58
2030	17.19	25.86	48.99	7.19	10.82	20.49
2031	17.49	27.15	54.03	7.32	11.36	22.60
2032	17.79	28.51	59.59	7.44	11.93	24.93
2033	18.11	29.93	65.73	7.57	12.52	27.50
2034	18.42	31.43	72.49	7.71	13.15	30.32
2035	18.75	33.00	79.95	7.84	13.81	33.45
2036	19.08	34.65	88.18	7.98	14.50	36.89
2037	19.41	36.38	97.25	8.12	15.22	40.68
2038	19.75	38.20	107.26	8.26	15.98	44.87
2039	20.10	40.11	118.30	8.41	16.78	49.49
2040	20.45	42.12	130.47	8.55	17.62	54.58
2041	20.81	44.22	143.89	8.70	18.50	60.20
2042	21.17	46.44	158.70	8.86	19.43	66.39
2043	21.54	48.76	175.03	9.01	20.40	73.22
2044	21.92	51.20	193.05	9.17	21.42	80.76
2045	22.30	53.75	212.91	9.33	22.49	89.07
2046	22.69	56.44	234.82	9.49	23.61	98.23
2047	23.09	59.26	258.99	9.66	24.79	108.34
2048	23.50	62.23	285.64	9.83	26.03	119.49
2049	23.91	65.34	315.03	10.00	27.33	131.79
2050	24.33	68.61	347.45	10.18	28.70	145.35
2051	24.75	72.04	383.21	10.36	30.14	160.31
2052	25.19	75.64	422.64	10.54	31.64	176.80
2053	25.63	79.42	466.13	10.72	33.22	195.00
2054	26.08	83.39	514.10	10.91	34.89	215.06
2055	26.54	87.56	567.01	11.10	36.63	237.20
2056	27.00	91.94	625.35	11.30	38.46	261.60
2057	27.47	96.54	689.71	11.49	40.38	288.53

*Assumes a 7,878 heat rate natural gas plant represents the marginal resource

This information was made publicly available on July 13, 2018, and contains information sourced directly and not directly from BPA financial statements.

4. **Regarding slide 11 of the Fed Hydro workshop materials, BPA has significantly underspent its capital program in this area. Please provide an analysis of the sources of this historical underspending. What, if any, factors have changed such that there is reason to believe this pattern will not continue?**

   For the Corps, there have been many factors that have contributed to the historical underspending of the capital program. Some of these factors include resource constraints, contracting and procurement issues, poor contractor performance, delays in funding approval, and overly optimistic planning.

   For Reclamation, the main drivers for under-execution relative to the budget request are major delays in several of the largest investments and the cultural shift in the three agency investment planning that came out of the Asset Investment Excellence Initiative.

   One of the goals of the Asset Investment Excellence Initiative (AIEI) that was kicked off in 2015 was to improve program execution. Given the lengthy project execution windows that are inherent to many of our capital projects it takes time to realize the effects of making program and process improvements, but many of these improvements have been initiated. We are striving to continually improve the program. Development of the first FCRPS System Asset Plan, in its current form, began in 2016. This iteration of the System Asset Plan was the first to incorporate an optimization of the FCRPS capital investment portfolio based on an assessment of each investment's respective benefits and costs.

   The Corps and Reclamation have taken several steps for the 2018 revision of the System Asset Plan to refine their plant capital plans, especially at Grand Coulee, by further evaluating the total amount of work planned at each plant respectively. At some plants, this has resulted in reducing or limiting the amount planned investments to a more achievable level in order to improve execution of the budget and reallocate resources to other valuable capital investments.

5. **Regarding slide 13 of the Fed Hydro workshop materials, please provide the data and work papers underlying the charts. Please also identify the projects grouped respectively into the "Area Support" and "Local Support" categories.**

   Please see the Strategy Documentation attachment.

6. **Regarding the Fed Hydro workshop materials, page 10: please provide the analysis indicating that increasing annual hydro investment from $200 million to $300 million results in an incremental NPV of $500 million compared to the status quo.**

   Please see the Strategy Documentation attachment.

7. **Please provide supporting data and work papers (in spreadsheet format where applicable) for the charts on pages 26 through 28 of the "2018 Detailed IPR Publication" document.**

This information is not readily available for distribution.