HYDRO - FY 2017 Proposed Projects

O&M Projects	Notes	$ 1,565,000
CV Needle Actuator Rebuild	D	100,000
Adit 4 Stabilization	M	1,000,000
11563 Part 12 Study	M	80,000
NFDD Tunnel Maintenance	M	200,000
Paint CV Crane & Bridge	D	125,000
CV Concrete Sealing	D	60,000

General & Plant Projects	Notes	$ 70,000
Vehicle Replacement	D	70,000

Capital Development Reserve Projects	Notes	$ 1,125,000
McKays Reservoir & Dam Betterment (Clean Out)	M, CR	750,000
CV Unit 1 Generator Rewind	M, CR	250,000
Beaver Creek Dredging	M, CR	125,000

NCPA Hydro Project – FY2017

Collierville Needle Actuator Valve Rebuild

Overview:

The Collierville needle valve actuators have been in service for approximately 27 years. A sister plant of Collierville, Bradley Lake operated by Homer Electric in Alaska, experienced failures of their needle valve actuators after approximately 20 years of comparable service. The needle valves are the valves that control the water flow to the runners. Failures of the actuators could result in loss of revenue and/or hydraulic oil entering the river. The output of each unit would be limited with one pair of needle valves out of service. When one valve fails you must also take the corresponding valve out of service due to the mechanical stress placed on the runners. Because of these reasons, a preventive maintenance program has been developed. Two new actuators have been purchased. One was installed in November 2010, to allow an original actuator to be removed from service and rebuilt. The process has been repeated several times, and as of January 2016, a total of nine (9) needle actuators have been removed, rebuilt, and reinstalled. Subject to budget approvals over the next three (2) years, this process will be repeated until all 12 actuators have been rebuilt and there are two rebuilt actuators in inventory.

This proposed budget item is a continuation of the preventive maintenance program for the needle valve actuators, and will allow for rebuilding (machining) two (2) more of the actuators.

Financial Analysis:

The financial benefit of this project is a reduction in the risk of actuator failure resulting in loss of generation. The cost to rebuild each needle was originally estimated at $100,000, with a total cost of $1,200,000 to rebuild all needles. Through aggressive contractor bidding and local material sourcing, actual rebuild costs have been reduced to approximately $50,000 each. $100,000 is recommended for inclusion in the FY 2016-2017 budget. The total cost to rebuild the remaining three (3) needles is estimated at $150,000. Subject to approval, $50,000 will also be requested in FY 2017-2018 to allow all 12 needle actuators to be rebuilt. This project is estimated to have an internal rate of return of approximately 15%, a payback in the range of 9 years, and a net present value of approximately $1M.

Financial Evaluation Summary:

Useful Life (Years):	20
IRR:	13.5%
Payback (years):	9.6
NPV @ 5%:	$ 767,030
Est. Annual Benefits:	$ 94,584

Collierville Needle Actuator Spare Rebuild

Financial Summary	5 Year	10 Year	15 Year	20 Year
Internal Rate of Return (IRR)	-32%	4%	11%	13.5%
Payback	9.6	9.6	9.6	9.6
Net Present Value (NPV)	(444,665)	(23,456)	390,728	767,030
Average Annual Benefits	(74,075)	19,493	64,682	94,584
BC Ratio	0.62	0.98	1.32	1.64

Key Assumptions

Discount Rate	5.00%	
Project Life	20	years
Average Year HLH Generation	424,320	MWh
Average Year LLH Generation	138,910	MWh
MW Price	per weighted NP15 forward curve	
Collierville Capacity	253	MW
Collierville Availablility Factor	98%	
Collierville Capacity Factor	28%	
Collierville A/S Capcity Factor	72%	
Collierville Annual A/S Revenue	$3,092,136	
Single actuator failure risk factor	0.75%	
Double actuator failure risk factor	1.5%	
Dual failure loss of MW	62.50	
Actuator risk factor impact to A/S capacity	34%	
Lead time for actuators	365	Days

Cash Flow Scenario	1 FY2012	2 FY2013	3 FY2014	4 FY2015	5 FY2016	6 FY2017	7 FY2018	8 FY2019	9 FY2020	10 FY2021	11 FY2022	12 FY2023	13 FY2024	14 FY2025	15 FY2026	16 FY2027	17 FY2028
NP15 Forward Prices (HLH) $/MWh	40.72	45.76	55.79	$ 47.04	$ 38.23	$ 38.79	$ 39.50	$ 41.48	$ 43.40	$ 45.25	$ 47.28	$ 49.31	$ 51.43	$ 53.65	$ 55.95	$ 58.36	$ 60.78
NP15 Forward Prices (LLH) $/MWh	30.51	34.91	40.06	$ 38.90	$ 31.44	$ 33.06	$ 33.71	$ 34.65	$ 36.31	$ 37.92	$ 39.54	$ 41.24	$ 43.01	$ 44.86	$ 46.79	$ 48.81	$ 50.83
Weighted CV Forward Price $/MWh	38.20	43.09	51.91	45.03	36.55	37.38	38.07	39.79	41.65	43.44	45.37	47.32	49.36	51.48	53.69	56.00	58.33
Cost	(700,000)	(200,000)	(100,000)	(100,000)	(100,000)	(100,000)	(50,000)	0	0	0	0	0	0	0	0	0	0
Increased Annual Availability (hours)	Increased Ann	15.0	15.8	16.5	17.4	18.2	19.1	20.1	21.1	22.2	23.3	24.4	25.7	26.9	28.3	29.7	31.2
Operation Revenue	133,970	144,981	164,863	149,364	130,257	132,115	133,677	137,558	141,738	145,778	150,127	154,524	159,109	163,892	168,881	174,083	179,326
Total	(566,030)	(55,019)	64,863	49,364	30,257	32,115	83,677	137,558	141,738	145,778	150,127	154,524	159,109	163,892	168,881	174,083	179,326
Cumulative Cash Flow	(566,030)	(621,048)	(556,186)	(506,822)	(476,565)	(444,450)	(360,773)	(223,215)	(81,477)	64,301	214,428	368,952	528,061	691,953	860,833	1,034,917	1,214,243
Payback	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.56	9.56	9.56	9.56	9.56	9.56	9.56	9.56

Other Considerations

Loss of any needle actuator will result in the corresponding actuator to be taken out of service. `

NCPA Hydro Project – FY2017

Adit 4 Spoils Stockpile Stabilization

Overview:

Construction of the approximately 9 mile long Collierville Power Tunnel in the 1980s generated a large volume of crushed rock (tunnel spoils). Some of the tunnel spoils were stockpiled downslope of Tunnel Adit 4, adjacent to an ephemeral drainage on a Bureau of Land Management (BLM) right of way. Surface water drainage is conveyed through the rock storage area via a network of surface and subsurface culverts and drainage swales. Following heavy precipitation events in December 2015, NCPA personnel discovered that a portion of this tunnel spoils storage area was experiencing accelerated stormwater-induced erosion.

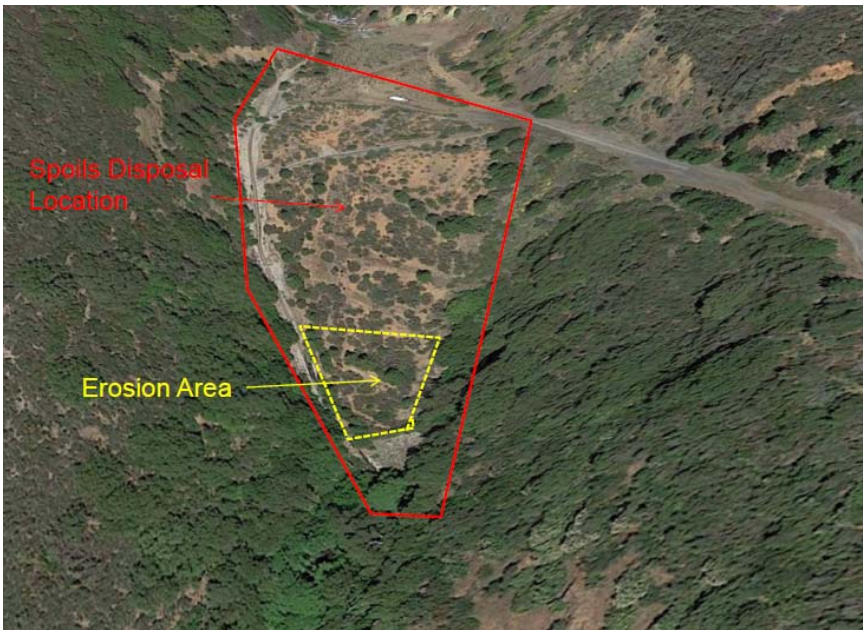

Figure 1: Adit 4 spoils disposal stockpile.

Left unmitigated, the entire 200,000+ cubic yards of material could erode and be washed down the drainage approximately 1 mile to the Collierville switchyard, and then into the Stanislaus River. The project is complicated by the extremely steep terrain, the loose / deep / unconsolidated tunnel spoils, the water flowing through the site, and the number of regulatory agencies potentially involved.

Financial Analysis:

Based on preliminary site investigations, NCPA staff recommend budgeting a minimum of $1,000,000 for site stabilization. Depending on the ultimate scale of the erosion and the necessary improvements, total project cost could exceed $1M. Engineering review and resource agency consultation are ongoing.

NCPA Hydro Project – FY2017

Project 11563 Part 12 Independent Consultant Inspection

Overview:

Part 12D of Title 18 of the Code of Federal Regulations requires an Independent Engineering Consultant Dam Safety Review of each high hazard dam every 5 years. The Part 12 reports for Lake Alpine Dams and Utica Reservoir Dams must be submitted to FERC in 2017, which requires completing all field work during the summer/fall of 2016.

Figure 1: Utica Main Dam

Figure 2: Alpine Main Dam

Financial Analysis:

The Part 12 inspection is a mandatory regulatory requirement that must be repeated for every high hazard dam every 5 years. The costs of the Project 11563 Part 12 Independent Consultant inspections, reports, and associated surveys and studies are estimated at $80,000.

NCPA Hydro Project – FY2017

North Fork Diversion Tunnel Maintenance

Overview:

The 11,382 foot long North Fork Diversion tunnel diverts an average of approximately 50,000 acre-feet per year of water from the North Fork Stanislaus River into New Spicer Meadow Reservoir, where it can be stored until needed at the Collierville powerhouse. The 12 foot diameter tunnel was constructed using a tunnel boring machine and is unlined rock over most of its length. A tunnel inspection in October 2014 identified a section of tunnel with progressing fall-out which is recommended for repair. If not repaired, this section of tunnel could progressively deteriorate and pose a threat to tunnel stability and function.

In order to maintain tunnel integrity, the areas of instability should be removed and the ground supported with permanent means such as shotcrete supported with epoxy coated rock bolts or galvanized arch sets. Work within the tunnel is complicated by stringent OSHA, Cal-OSHA, and MSHA regulations.

Figure 1: North Fork Diversion Tunnel Inspection

Financial Analysis:

A total budget of $200,000 is requested for stabilizing the tunnel, removing accumulated debris, and providing required worker protections. On an average year, the North Fork Tunnel transports approximately 50,000 acre-feet of water into New Spicer Meadow. If the tunnel were to fail, at least one (1) diversion season would be missed, which would result in lost New Spicer Meadow generation on the order of $400,000. More importantly, the 50,000 acre-feet of water would not be able to be seasonally stored, and would therefore also impact Collierville generating ability and efficiency. Assuming that the risk of tunnel failure will escalate at approximately 1% / year, and looking at just New Spicer Meadow generation, this project is estimated to have an internal rate of return of approximately 19%, a payback in the range of 8.1 years, and a net present value of approximately $494,000.

NCPA Hydro Project – FY2017

Financial Evaluation Summary:

Useful Life (Years):	20
IRR:	19.0%
Payback (years):	8.1
NPV @ 5%:	$ 493,710
Est. Annual Benefits:	$ 56,364

North Fork Tunnel Repair

Financial Summary

	5 Year	10 Year	15 Year	20 Year
Internal Rate of Return (IRR)	-27%	7%	16%	19.0%
Payback	8.1	8.1	8.1	8.1
Net Present Value (NPV)	(120,342)	24,879	232,845	493,710
Average Annual Benefits	(23,356)	10,027	33,029	56,364
BC Ratio	0.37	1.13	2.22	3.59

Key Assumptions

Discount Rate	5.00%	
Project Life	20	years
Average Year HLH Generation	10,500	MWh
Average Year LLH Generation	10,500	MWh
MW Price	per weighted NP15 forward curve	
REC Price	$15	
NSM Annual A/S Revenue	$0	
Average NF Tunnel Diversion	48959	acre-feet
NSM Water Duty	0.157	MWh / acre-foot
Annual risk of tunnel failure	2%	
Tunnel failure risk escalation	1%	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Cash Flow Scenario	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	FY2033	FY2034	FY2035	FY2036
NP15 Forward Prices (HLH) $/MWh	38.79	39.50	41.48	43.40	45.25	47.28	49.31	51.43	53.65	55.95	58.36	60.78	63.21	65.74	68.37	71.11	73.95	76.91	79.99	85.67
NP15 Forward Prices (LLH) $/MWh	33.06	33.71	34.65	36.31	37.92	39.54	41.24	43.01	44.86	46.79	48.81	50.83	52.87	54.98	57.18	59.47	61.85	64.32	66.89	71.72
REC Price $/MWh	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Weighted NSM Forward Price $/MWh	50.93	51.60	53.06	54.85	56.58	58.41	60.28	62.22	64.25	66.37	68.58	70.81	73.04	75.36	77.78	80.29	82.90	85.61	88.44	93.70
Cost	(200,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Failure Risk	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%
Operation Revenue	7,829	11,900	16,315	21,082	26,096	31,429	37,066	43,046	49,390	56,120	63,259	70,755	78,600	86,891	95,653	104,913	114,698	125,036	135,959	151,244
Total	(192,171)	11,900	16,315	21,082	26,096	31,429	37,066	43,046	49,390	56,120	63,259	70,755	78,600	86,891	95,654	104,913	114,698	125,036	135,960	151,244
Cumulative Cash Flow	(192,171)	(180,271)	(163,956)	(142,874)	(116,778)	(85,349)	(48,283)	(5,237)	44,153	100,273	163,533	234,288	312,888	399,780	495,433	600,347	715,044	840,081	976,040	1,127,284
Payback	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11

Other Considerations

Loss of NF tunnel would also have implications for Collierville operations, shifting water from the summer/fall to the spring, and also shifting water from on-peak to off-peak which would futher improve the economics.

NCPA Hydro Project – FY2017

Paint Collierville Crane & Bridge

Overview:

The original paint coatings on the Collierville bridge crane and recreation access bridge have exceeded their 20-year design lives. Both the crane and the access bridge are located outside at Collierville in the North Fork Stanislaus River Canyon, where they are exposed to harsh winter conditions. The paint coating is wearing thin in many places, and rust is starting to develop - especially at the bolt connections. Within the past year, both the Federal Energy Regulatory Commission (FERC) and the facility owner (Calaveras County Water District) have inquired about NCPA's schedule for maintenance painting. The 1985 power purchase agreement obligates NCPA to perform all necessary maintenance, including painting, to keep the facilities in satisfactory condition. A similar painting job, the crane at New Spicer Meadow Intake, was painted in 2013.

Figure 1: Collierville

Financial Analysis:

The cost to paint the Collierville crane and recreation bridge are estimated at $125,000. Deferring the painting project could lead to progressive rusting and structural damage.

NCPA Hydro Project – FY2017

Collierville Concrete Sealing

Overview:

The Collierville Powerhouse is basically a large concrete building built into the side of a mountain. Much of the powerhouse is located "below grade", and because it is a subsurface structure it is subject to water intrusion. In 2015, emergency repairs (localized concrete epoxy injection) were required to mitigate water that was intruding into the generator housings. Water has also been observed seeping into numerous other areas of the powerhouse. In consideration of the age of the concrete, as well as the critically of the electrical components inside of the powerhouse, the top deck of the powerhouse is recommended for concrete maintenance sealing.

Financial Analysis:

The cost to seal the Collierville concrete top deck is estimated at $60,000. Deferring the sealing could lead to progressive water intrusion, which directly increases the risk to critical electrical components such as the excitation system, governors, generators, protection systems, etc.

Figure 1: Collierville powerhouse.

Vehicle Replacement - Trucks

Overview:

The NCPA Hydroelectric Project operates and maintains a rolling stock consisting of 18 trucks used on a daily basis for operations, maintenance, and regulatory tasks at the remote hydroelectric facility sites. Each vehicle is typically driven 15,000 to 25,000 miles per year (200,000 to 400,000 miles annually for the fleet) on the rough roads of the hydro project. Within approximately 10 years, most vehicles are at the end of their useful life, with high mileage and escalating repair costs. Leaving these vehicles in service could be considered a safety issue.

Financial Analysis:

It is recommended that $70,000 capital funds be budgeted in FY2017 for Hydro project vehicle replacement as needed. Vehicles may be considered for replacement due to high mileage, escalating maintenance cost, unreliability, and or safety concerns.

NCPA Hydro Project – FY2017

McKays Cleanout Capital Development Reserve

Overview:

Heavy precipitation in 1997 resulted in a large landslide upstream of McKays Point Reservoir that deposited debris consisting of trees, sands, gravels, boulders and soil into the North Fork of the Stanislaus River. Much of this debris (>260,000 cubic yards) was washed into McKays Point Reservoir resulting in a loss of approximately 8% of the reservoir capacity. Sediments have continued to accumulate against the arch dam and upstream of the cofferdam. Bathymetric surveys indicate that deposits in the upper area of the reservoir are continuing to migrate downstream toward the dam (Figure 1).

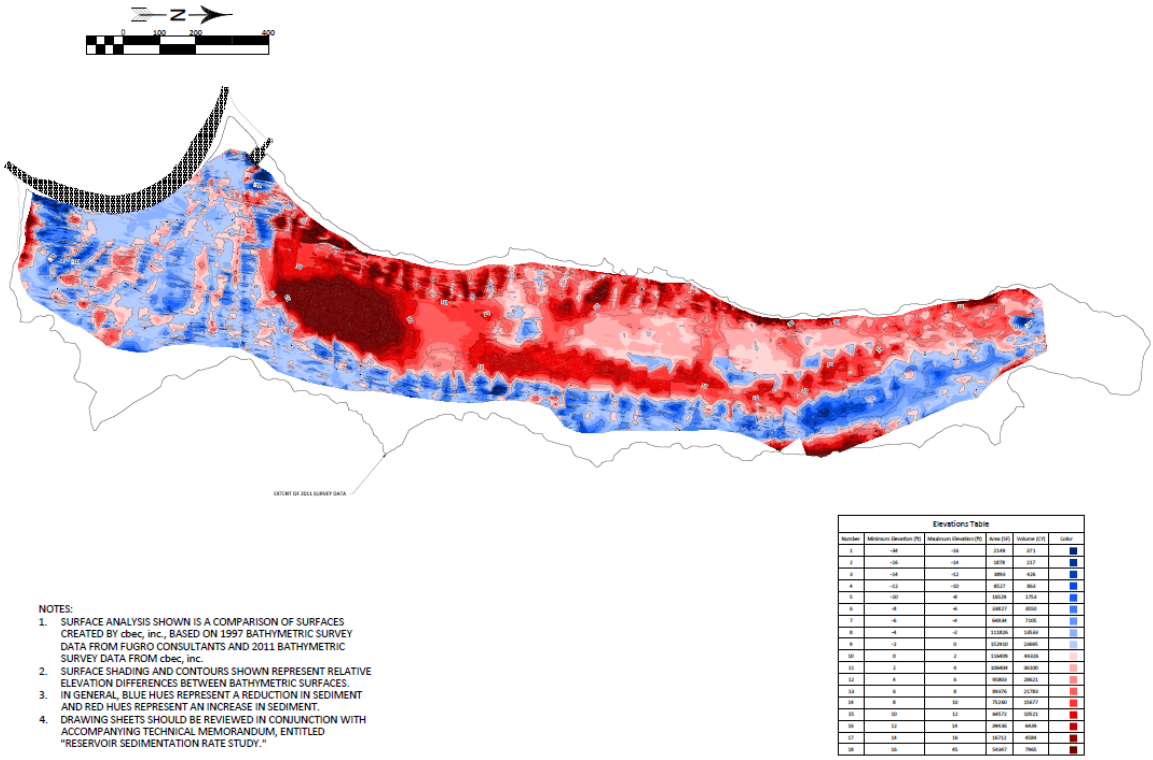

Figure 1: Bathymetric survey showing change in depth in 2011 compared with 1997 (post-Sourgrass landslide).

Removal of a portion of the sediments is necessary to clear the approach pathway to the Low Level Outlet works, reduce the sediment load against the dam, and clear the area in front of the Diversion Tunnel Inlet Structure. Increased turbine wear and eventual blockage of the Low Level Outlet passageway will occur if this project is not pursued. Complete removal of siltation from the reservoir, while desirable, may not be possible from a cost perspective. The removal of 87,000 cubic yards of sediment (35,000 behind arch dam + 52,000 behind cofferdam) is mandatory, and should be the absolute minimum first effort, with further removal planned for the future. Removal of 200,000+ cubic yards is preferred. It is possible that other contractual obligations could necessitate a full clean-out.

NCPA Hydro Project – FY2017

Financial Analysis:

Removing at least some of the accumulated sediment is mandatory to comply with FERC and DSOD dam safety regulations; however, the project also provides some financial benefit as removing sediment will positively impact the live storage capacity (and therefore energy producing capability and flexibility) of the reservoir. Depending on the quantity of sediment to be removed, the regulatory requirements of the removal (unknown at this time), and the ultimate disposal location of the sediment, the total project cost might range from $10M to $30M. Based on preliminary regulatory permitting discussions and economic assumptions, NCPA staff recommend budgeting a minimum of $20.5M for this project. Including insurance claims and OES contributions, a total of approximately $13.8M has been collected for this project. Collections are tentatively scheduled through at least FY2025. Assuming a project price of $20.5M, and an increased McKays operational flexibility of 4% after removal of the sediment, this project has a payback of approximately 16 years, and a net present value of approximately $300K.

Financial Evaluation Summary:

Useful Life (Years):	20
IRR:	5.3%
Payback (years):	15.7
NPV @ 5%:	$ 289,805
Est. Annual Benefits:	$ 433,670

McKays Cleanout Capital Development Reserve

Financial Summary	5 Year	10 Year	15 Year	20 Year
Internal Rate of Return (IRR)	113%	112%	-1%	5.3%
Payback	N/A	N/A	N/A	15.7
Net Present Value (NPV)	(11,524,215)	(8,043,175)	(3,815,476)	289,805
Average Annual Benefits	(2,894,520)	(921,102)	(81,617)	433,670
BC Ratio	0.28	0.52	0.77	1.02

Key Assumptions

Discount Rate	5.00%	
Project Life	20	years
Average Year HLH Generation	424,320	MWh
Average Year LLH Generation	138,910	MWh
MW Price	per weighted NP15 forward curve	
Collierville Capacity	253	MW
Collierville Availablility Factor	98%	
Collierville Capacity Factor	28%	
Collierville Annual A/S + RTM Revenue	$3,500,000	
A/S Escalation	6%	
Increased Operational Flexibility	4.00%	

Cash Flow Scenario	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NP15 Forward Prices (HLH) $/MWh	38.23	38.79	39.50	41.48	43.40	45.25	47.28	49.31	51.43	53.65	55.95	58.36	60.78	63.21	65.74
NP15 Forward Prices (LLH) $/MWh	31.44	33.06	33.71	34.65	36.31	37.92	39.54	41.24	43.01	44.86	46.79	48.81	50.83	52.87	54.98
Weighted CV Forward Price $/MWh	36.55	37.38	38.07	39.79	41.65	43.44	45.37	47.32	49.36	51.48	53.69	56.00	58.33	60.66	63.09
A/S Revenue	3,500,000	3,710,000	3,932,600	4,168,556	4,418,669	4,683,790	4,964,817	5,262,706	5,578,468	5,913,176	6,267,967	6,644,045	7,042,688	7,465,249	7,913,164
Cost	(40,000)	(40,000)	(40,000)	(14,750,000)	(4,750,000)	(933,334)	(200,000)	0	0	0	0	0	0	0	0
Increased Annual Availability (hours)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operation Revenue	963,535	990,512	1,015,027	1,063,266	1,115,062	1,166,051	1,220,776	1,276,646	1,335,120	1,396,324	1,460,387	1,527,445	1,595,805	1,665,272	1,737,855
Total	923,535	950,512	975,027	(13,686,734)	(3,634,938)	232,717	1,020,776	1,276,646	1,335,120	1,396,324	1,460,387	1,527,445	1,595,805	1,665,272	1,737,855
Cumulative Cash Flow	923,535	1,874,047	2,849,074	(10,837,660)	(14,472,598)	(14,239,881)	(13,219,105)	(11,942,459)	(10,607,339)	(9,211,015)	(7,750,629)	(6,223,183)	(4,627,378)	(2,962,107)	(1,224,252)
Payback	N/A	0.03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Other Considerations

Analysis based on FY2016-2035 prices from NCPA NP15 Forward Curve , even though expenditures and revenues are deferred 8+ years.

NCPA Hydro Project – FY2017

Collierville Generator Rewind – Capital Development Reserve

Overview:

The Collierville generators are approximately 27 years old and starting to show signs of minor deterioration as documented by routine partial discharge testing and as evidenced by visual burn damage which is repaired every year during the annual outage. Generator winding insulation is exposed to many aging mechanisms which shorten its life, including electrical and mechanical stresses during normal operation. When the stator winding insulation fails, high voltage can arc to the surrounding framework, and protective relaying shuts down the generating unit. The unit must be repaired before it can be restarted. Extensive failures require partial or complete stator winding replacement, repair to the stator core, and/or repair to the rotor. In recent years, failures at hydro facilities near NCPA have resulted in units being unavailable for 9 months to more than a year, with lost revenues for these hydro plants ranging from $10M+ to $100M+. Rewinding generators on a planned schedule allows the design and manufacturing phases to be performed while the unit is still in service, which minimizes the impact on unit availability.

Planned, scheduled rewinds will generally provide the most cost-effective means to maintain the reliability of old generators. Based on test results, reliability records, and economic analysis, NCPA estimates that the Collierville generators will need to be rewound in approximately 3 to 10 years, with Unit 2 likely needing a rewind before Unit 1. The ultimate timing will depend on how well the partial discharge continues to respond (drop) after insulation paint repairs (see Figure 1). Partial discharge levels remain relatively low at the moment. At the request of the Hydro participants, Capital Development Reserve funds are being collected for the upcoming rewinds.

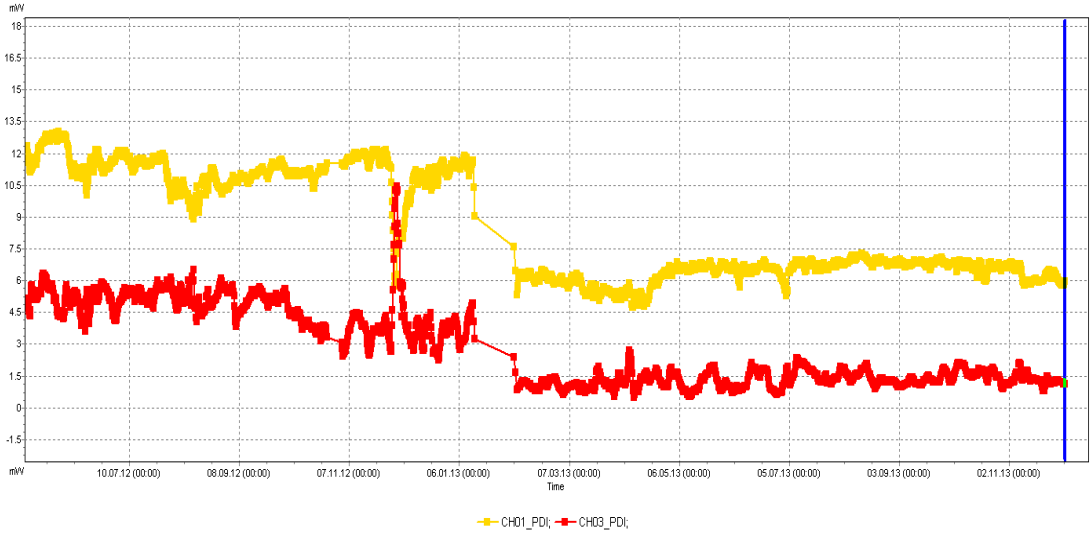

Figure 1: Collierville Unit 2 generator partial discharge intensity (PDI) on the two highest PD channels. The alarm is set at 27. Note the reduction in PD in the February 2013 timeframe corresponding to NCPA's cleaning and "painting" all observed end-turn burn spots.

NCPA Hydro Project – FY2017

Financial Analysis:

Rewinding both generators is anticipated to cost $5M to $7M, with materials (robell bars, wedges, winding supplies, etc.) costing $1.5M to $1.75+M per unit (depending largely on the cost of copper), and labor (disassembling the unit, striping the stator, cleaning and testing the core, installing new robell bars, etc.) costing $1M to $1.5M per unit. $6M has been targeted for Capital Development Reserve collection. $4.75M will have been collected by the end of FY 2015-2016, with an additional $250,000 proposed for collection in FY 2016-2017. Financial evaluation for this project assumes the future avoidance of a generator failure resulting in lost generation. Based on these assumptions, scheduled rewinds (with the timing based on continued partial discharge monitoring and physical inspection), has an associated internal rate of return of 16%, a payback of approximately 8 years, and a net present value close to $5M.

Financial Evaluation Summary:

Useful Life (Years):	20
IRR:	16.0%
Payback (years):	7.7
NPV @ 5%:	$ 4,971,718
Est. Annual Benefits:	$ 566,127

Collierville Generator Rewind

Financial Summary

	5 Year	10 Year	15 Year	20 Year
Internal Rate of Return (IRR)	-20%	8%	14%	16.0%
Payback	7.7	7.7	7.7	7.7
Net Present Value (NPV)	(1,942,020)	551,830	2,930,116	4,971,718
Average Annual Benefits	(356,368)	193,003	427,446	566,127
BC Ratio	0.63	1.10	1.53	1.90

Key Assumptions

Discount Rate	5.00%	
Project Life	20	years
Average Year HLH Generation	424,320	MWh
Average Year LLH Generation	138,910	MWh
MW Price	per weighted NP15 forward curve	
Collierville Capacity	253	MW
Collierville Availablility Factor	98%	
Collierville Capacity Factor	28%	
Collierville Annual A/S Revenue	$3,110,845	
Annual Risk of Catastrophic Failure	5.00%	per generator
Estimated Catastrophic Failure Downtime	270	Days
Percentage of time above 1 unit capacity	30.0%	

Cash Flow Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
NP15 Forward Prices (HLH) $/MWh	38.23	38.79	39.50	41.48	43.40	45.25	47.28	49.31	51.43	53.65	55.95	58.36	60.78	63.21	65.74	68.37	71.11
NP15 Forward Prices (LLH) $/MWh	31.44	33.06	33.71	34.65	36.31	37.92	39.54	41.24	43.01	44.86	46.79	48.81	50.83	52.87	54.98	57.18	59.47
Weighted CV Forward Price $/MWh	36.55	37.38	38.07	39.79	41.65	43.44	45.37	47.32	49.36	51.48	53.69	56.00	58.33	60.66	63.09	65.61	68.24
Cost	(4,750,000)	(250,000)	(200,000)	(200,000)	(200,000)	(200,000)	(200,000)	0	0	0	0	0	0	0	0	0	0
Increased Annual Availability (hours)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operation Revenue	749,224	754,788	759,463	771,085	783,602	795,698	808,723	821,888	835,619	849,940	864,878	880,458	896,157	911,900	928,274	945,303	963,013
Total	(4,000,776)	504,788	559,463	571,085	583,602	595,698	608,723	821,888	835,619	849,940	864,878	880,458	896,157	911,900	928,274	945,303	963,013
Cumulative Cash Flow	(4,000,776)	(3,495,989)	(2,936,526)	(2,365,441)	(1,781,838)	(1,186,140)	(577,417)	244,470	1,080,089	1,930,029	2,794,907	3,675,365	4,571,521	5,483,422	6,411,696	7,356,999	8,320,011
Payback	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70

Other Considerations

FY2016-2035 prices from NCPA NP15 Forward Curve

NCPA Hydro Project – FY2017

Beaver Creek Cleanout

Overview:

Due to upstream erosion and natural bed load, the Beaver Creek Reservoir accumulates sediment and debris during each winter and runoff season. The rate of sediment accumulation is highly dependent on the intensity of winter storms. During a normal winter, approximately 440 cubic yards of additional sediment accumulates in the reservoir. Historically, severe weather has typically occurred approximately every 8 years bringing large amounts of sediments into the reservoir. Therefore, at least partial sediment removal is also typically needed every five to eight years. The reservoir had sediment removed during the summer of 1997, winter of 2006 (emergency cleanout due to inability to divert water due to clogged fish screen structure), and summer of 2008. At this time, the diversion facility is still functional; however, a substantial amount of sediments and debris have accumulated again and are starting to encroach on the fish screen structure. Based on the most recent topographical survey, it appears that even during the recent drought years, approximately 700 cubic yards has accumulated over the previous two (2) years. A large winter storm could mobilize or augment the sediment and plug the screens again, thereby preventing diversion of water.

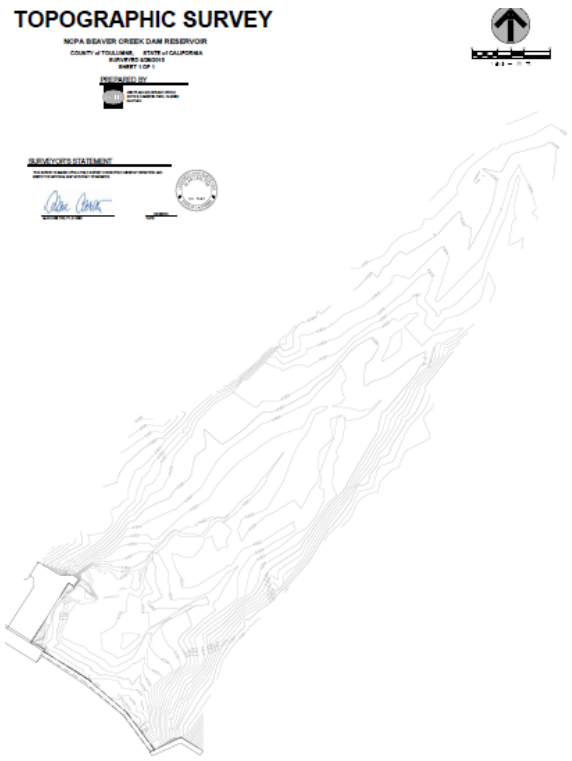

Figure 1: Example of most recent topographical survey (October 2015).

The unit cost for the emergency cleanout in December 2006 was $86 / cubic yard (not including the cost of lost diversion from Beaver Creek). The unit cost for the 2008 cleanout was approximately $100 / cubic yard. Approximately 10,000 to 15,000 cubic yards of silt, gravel, and debris would need to be removed to restore the reservoir to its

as-built condition. The proposed project would remove 5,000 to 6,000 cubic yards of materials when needed, to maintain functionality of the diversion facility.

Financial Analysis:

$300,000 was collected in FY2013-2014, and $125,000 in FY2015-2016 and placed into the Hydroelectric Capital Development Reserve account. An additional $125,000 is proposed for inclusion in the FY2016-2017 budget (and ongoing into the indefinite future) to allow removal of approximately 5,000 to 6,000 cubic yards of accumulated sediment and debris on a routine basis when needed. The quantity of water diverted through the Beaver Creek facility to McKays and Collierville range from a dry year estimate of 10,000 acre-feet to a normal year estimate of 33,000 acre-feet. Collierville's water duty is approximately 2 MWh per acre-foot. Therefore, in a normal year, Beaver Creek contributes approximately 66,000 MWh. Assuming an average price of $25 / MWh, the loss of a single runoff season would result in lost revenue on the order of $1.7M. Assuming sediment removal avoids the loss of a season of diversion, the cleanout project has a Net Present Value of approximately $960,000 and a benefit to cost ration of 2.68.

Financial Evaluation Summary:

Useful Life (Years):	5
IRR:	182%
Payback (years):	1.4
NPV @ 5%:	$ 962,585
Est. Annual Benefits:	$ 218,250

Beaver Creek Cleanout

Financial Summary	5 Year	10 Year	15 Year	20 Year
Internal Rate of Return (IRR)	181.9%	182%	182%	182%
Payback	1.4	1.4	1.4	1.4
Net Present Value (NPV)	962,585	962,585	962,585	962,585
Average Annual Benefits	218,250	109,125	72,750	54,563
BC Ratio	2.68	2.68	2.68	2.68

Key Assumptions

Discount Rate	5.00%	
Project Life	20	years
Average Year Diversion	33000	acre-feet
Collierville Water Duty	2.05	MWh / acre-foot
Average Year HLH Generation	424,320	MWh
Average Year LLH Generation	138,910	MWh
MW Price	$ 25.00	MWh

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Cash Flow Scenario	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
NP15 Forward Prices (HLH) $/MWh	38.23	38.79	39.50	41.48	43.40	45.25	47.28	49.31	51.43	53.65	55.95	58.36	60.78	63.21	65.74	68.37
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Weighted CV Forward Price $/MWh	36.55	37.38	38.07	39.79	41.65	43.44	45.37	47.32	49.36	51.48	53.69	56.00	58.33	60.66	63.09	65.61
Discounted spring runoff price																
Cost	(600,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation Revenue	0	1,691,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	(600,000)	1,691,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative Cash Flow	(600,000)	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250	1,091,250
Payback	N/A	1.35	N/A	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Other Considerations

17	**18**	**19**	**20**	
2032	2033	2034	2035	
71.11	73.95	76.91	79.99	
59.47	61.85	64.32	66.89	
68.24	70.97	73.80	76.76	
0	0	0	0	(600,000)
0	0	0	0	1,691,250
0	0	0	0	1,091,250
1,091,250	1,091,250	1,091,250	1,091,250	
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	