Appendix 31
Power Production and Energy

Line items and numbers identified or noted as “No Action Alternative” represent the “Existing Conditions/No Project/No Action Condition” (described in Chapter 2 Alternatives Analysis). Table numbering may not be consecutive for all appendixes.

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Appendix 31: Power Production and Energy

Appendix 31A
Power Planning Study (PARO)

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California Department of Water Resources,
Power and Risk Office

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Phase 1

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North of Delta off-stream Storage (NODOS) Project

Power Planning Study (Phase 1)

This report summarizes the first phase of PARO's efforts in performing a Power Planning Study (Study) on the proposed NODOS Project (Project), and recommends additional analyses that need to be performed in the next phase of the Study. This document reports the assumptions, the modeling approach, and the results of the first phase of the Study. Additional analyses and modeling will be needed to further explore operational scenarios and design adjustments for the different Project components that would enhance its viability and value. Changes in design parameters and optimization of operational scenarios, will add valuable operational flexibilities that will be needed to participate in a complex energy market, yet, maintain Project diversions and deliveries.

1- Background

NODOS Project is an off-stream seasonal storage facility, proposed to be built, ten miles west of the town of Maxwell. The Project is in the planning, feasibility level, stage. The Project is composed of two main reservoirs (Sites and Funks), and a conveyance system that includes a number of physical components (intakes, pumps, canals, pipes, and terminal structures). The Project is designed to capture the annual seasonal cycle of the Sacramento River, where flood water could be stored during the high flow season and would be released during the low flow season.

The major storage component of the Project is Sites reservoir, a 1.8 million acre-ft reservoir that has a 14,000 acres inundation footprint. Sites reservoir storage capacity is generated through the construction of two main dams, Golden Gate Dam (310 ft Tall) and Sites Dam (290 ft Tall), and 9 saddle dams (ranging from 40 to 130 ft Tall), as shown in Figure-1. Two lower reservoirs, one existing and one new (Funks and the Terminal Regulating Reservoir), are configured to complement the Project complex, and to add the needed operational flexibility to the Project. The existing Funks reservoir would be enlarged to 5,000 acre-ft storage capacity and integrated, as part of the Project complex. And, a second reservoir would be a newly constructed, 1,200 acre-ft capacity, Terminal Regulating Reservoir, to the east of Funks reservoir.

Water would be delivered to and out of Sites reservoir through a network of pumping/generating plants and conveyances. Three pumping plants along the Sacramento River will be used to capture and divert water to the Project. The pumping plants are either existing/modified or new. The Tehama Colusa Pumping plant, and Canal, a 2,100 cfs capacity, would be the Project's upper most diversion point on the Sacramento River, near the city of red bluff. The Project's second diversion point from the Sacramento River is the Glenn-Colusa Irrigation District pumping plant and canal, a 3,000 cfs capacity plant, and a 3,000 cfs to 1,800 cfs capacity canal. And the third diversion point is a newly constructed Sacrament river pumping/generating plant and pipeline, a 2,000 cfs capacity plant. Figure-2 depicts the relative location of the three diversion points, along the Sacramento River, to Sites Reservoir. Funks reservoir will be the lower elevation collection point of the Project diversions from the Sacramento River, and a distribution point for water releases from Sites reservoir. A 5,900 cfs pumping/generating (5,100 cfs generation capacity) plant will deliver the water into and out of Sites reservoir. A 1,200 acre-ft Terminal Regulating Reservoir will be constructed

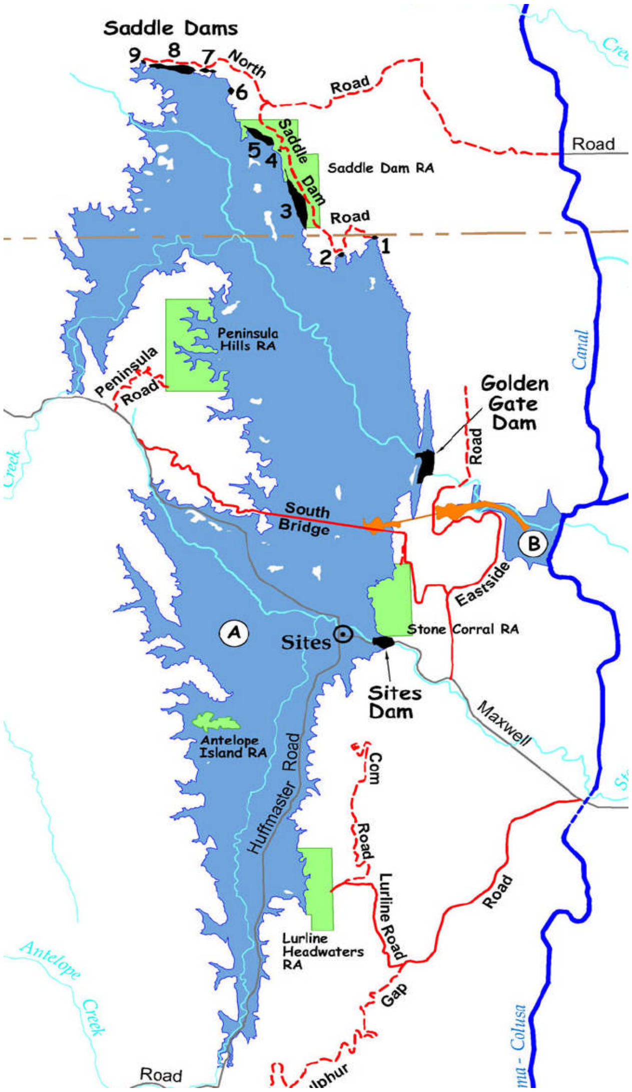

Figure 1- Sites Reservoir Vicinity Map

with a pumping/generating plant of 1,800 cfs pumping capacity, and a 1,500 cfs generation capacity, to regulate diversions into and out of the Glenn-Colusa Canal.

2- Study Objective

The objective of the PARO Power Planning Study is to analyze the current/designed components, and the operational scenarios of the NODOS Project that resulted from the most recent CALSIM model studies, from a power planning perspective. Also, the Study will provide a transmission planning roadmap for the Project interconnection with available power grid systems (CAISO, WAPA, and SMUD) in the area. The Study results are meant to complement the work done by the Division of Statewide Integrated Water Management (Sponsor) and their Consultants. The Study is implemented using current power market information and regulations, and available Power Portfolio models/tools to better evaluate energy costs and revenues of the NODOS

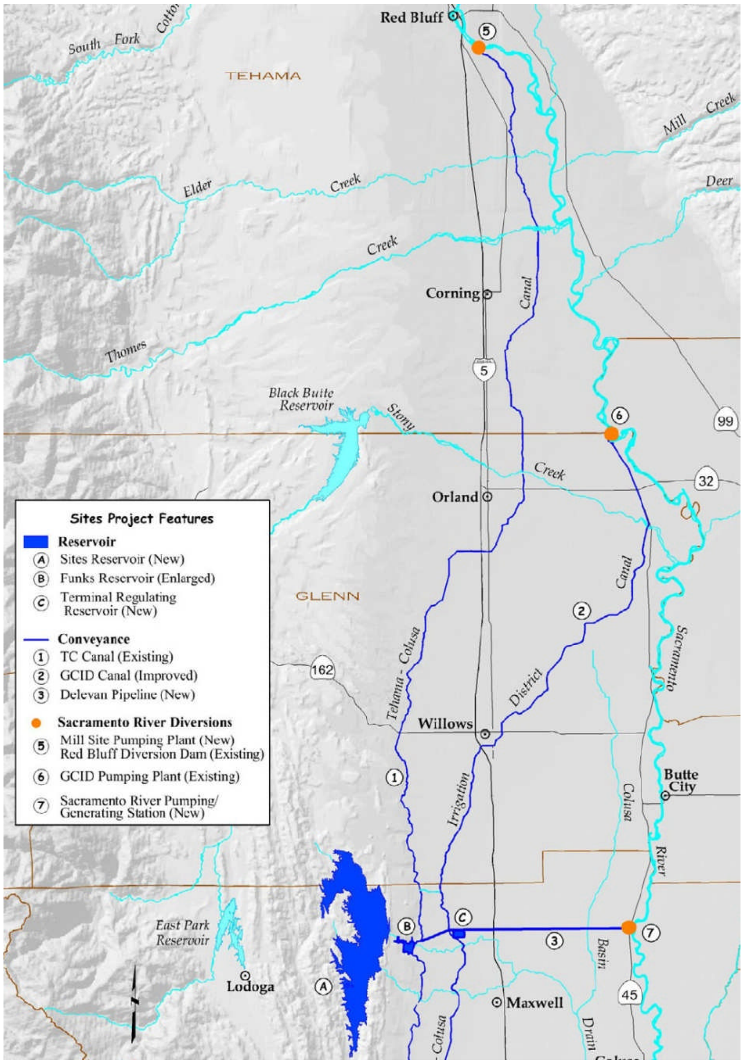

Figure 2- NODOS Project Components and Interconnection

Project. In light of the modeling results, the Study will make recommendations for modifications in the design parameters and in the operational scenarios/assumptions that may optimize and enhance the Project value. Also, the study will recommend further analysis that would be needed to study the modified operational scenarios and design parameters of the NODOS Project.

3-Modeling Approach

The Division of Statewide Integrated Water Management supplied PARO' s Power Planning Branch with the most recent CALSIM data (Benchmark Study Version 2: BST_2020D09D_ANNBENCHMARK_2_2), available to them, that describes the intended operations of the NODOS Project, based on the 82 years of historical hydrology record. PARO used the supplied CALSIM information to generate a 30-year outlook for the NODOS Project operations. Using some statistical techniques, such as moving averages and frequency analysis, a Median case of Project deliveries (30-years time-series) is identified and used as a basis for the study analysis. In addition, two additional scenarios, representing a High and Low Project deliveries cases, are identified and used. The High and Low cases represent the range of uncertainty in deliveries that surrounds the Median Case.

Project operations, constraints, and assumptions, as envisioned by the NODOS Project team, are maintained and further optimized to maximize the value of the Project's assets. Optimizing Project's operations is done to capture market opportunities and price differentials between On-Peak and Off-Peak Energy. Also, optimization of Project's operations would translate the inherent excess design capacities of the Project's components (resulting from hydrology swings) to operational flexibility, and minimize operations and maintenance costs of the Project. The resulting time-series for all Project components for the 30-year planning period are the basis for the Project's Energy Portfolio value and risk.

One of the challenges in modeling a proposed project (i.e. future construction) is in choosing an appropriate project operations start date. The start date will determine the window of time of an Energy market (power and fuel) price forecast and the corresponding volatility term structure, that the analysis will be based on. The further out the anticipated project operations start date, the further the price basis for the analysis would separate from actual market data and current market trends. An alternative approach, to overcome this problem, is to assume that the project will be operational in the near future and value all assets and power needs accordingly. Similarly, operational, maintenance, and construction costs would be valued on the same start date basis. Then, costs and revenues would be discounted to a present value consistent with the analysis date. This approach will a good comparative framework, and minimize the inherent forecast errors (i.e. speculation) in both projects' energy value and in its construction cost.

Figure-3 depicts the different steps/tracks taken in reducing CALSIM data to Energy Portfolio system of asset and contract instruments (time series of monthly pumping and/or generation for each Project component). Also, Figure-3 describes the general modeling approach that was adopted in performing the Power Planning Study.

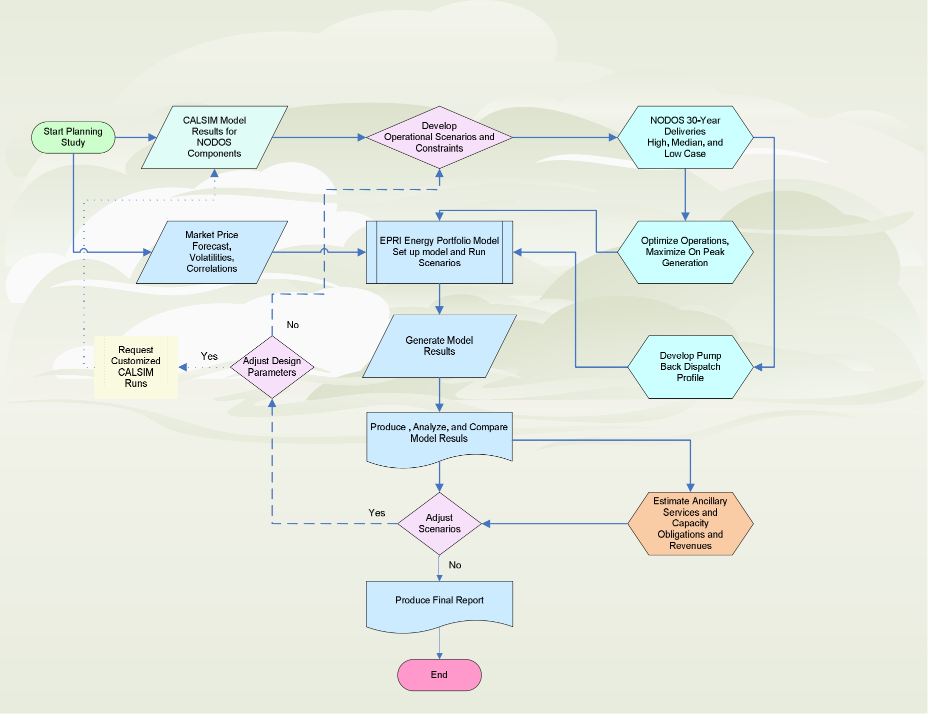

Figure 3- NODOS Project Power Planning Study Flowchart

EPRI Energy Portfolio Model

Current Power Portfolio Models available to PARO are used to execute the analysis for the NODOS Project. The Electric Power Research Institute (EPRI) Energy Portfolio Model (EPM), version 5, is used for this purpose. EPRI Fast Fit model, version 2.5, is used to describe the needed power and fuel price volatilities term structures, and the correlations between the different energy markets the NODOS Project will be participating in, or exposed to. The EPM is a computer software/model that is designed to help businesses manage value and risk in the power and energy markets. The NODOS Project Study used the EPM to value Project's assets and energy needs. The EPM is a module of a larger suite of individual modules, called the Energy Book System (EBS). Other modules within EBS are EPRI Contract Evaluator, EPRI Risk Manager, EPRI Retail Product Mix, and EPRI Fossil Asset & Project Evaluator. These modules were designed to meet the valuation and risk management needs of a targeted segment of the energy industry. Specifically, energy businesses that are exposed to a variety of risks, due to the extraordinary volatility in wholesale energy markets, specially price risk and uncertainty in the underlying fuel markets.

The objective of using the EPM model is to value the NODOS Project energy assets and contracts needs, and to assess its energy portfolio's exposure to major sources of risk. The EPM provides a set of templates that facilitates the description and evaluation of common types of power and fuel contracts, including supply contracts, standard and customized forward, and option contracts. It has the capabilities to model a number of physical assets, including full requirements contracts, power and fuel storage facilities, and generation assets. Many other assets can be modeled by combining two or more standard templates. The EPM requires the user to describe prices in the underlying commodity markets. The model characterizes each commodity market by a forward price curve and a term volatility structure. A correlation matrix characterizes the behavior of pairs of commodity markets is also needed by the model. The correlation matrix is an important concept in evaluating portfolio risk, and assets with two underlying markets, such as spread options or generating units. The model can also be used to assess the value and risk implications arising from uncertainty regarding the future level of load and stochastic generation (e.g., “run-of-river” hydro electric generation).

The EPM calculates the current market value of any number of user specified assets. EPM can also calculate and report portfolio value, cash flows, and risk exposures. This includes assessing portfolio’s exposure to both underlying commodity markets and customer loads. EPM allows users to manage price and load risk by applying methods that reflect the volatility and correlations between load and price. The market value of a resource depends on the cash flows it is expected to generate over its remaining life. Therefore, the market value of a generating unit depends on the difference between the value of the energy it is expected to produce and the value of the resources required for production. Market values fluctuate over time as conditions in the underlying markets fluctuate. EPM reports the market value of a resource or asset as the value of what it is worth today. One of the benefits of the EPM is that it will allow users to “mark-to-market” periodically each position in their book and thereby track gains and losses as they arise. EPM can report value and risk exposures on a weekly, monthly, quarterly, or annual basis over a user-specified time horizon.

Energy Forward Price Curves

Three sources of data are used to generate the energy price forecast that would be the basis for energy values for the Power Planning Study. The three sources are: forward energy “broker” quotations provided by Tullet Liberty (“Tullet”)[1]; natural gas futures and natural gas futures basis as reported by the New York Mercantile Exchange (“NYMEX”); and forecasted spot electricity and natural gas prices as provided by Ventyx semi-annual structural forecast (formerly Global Energy Decisions, GED).[2]

The derived natural gas price curve is made up of Henry Hub (“HH”) futures prices, adjusted for a specific local Hub through using basis prices (for HH to SoCal, or HH to PG&E Citygate, in this case). Basis prices represent the mark-up or discount in natural gas prices (due to transmission fees, congestion …etc) at a specific hub, relative to prices at HH. For HH futures, prices are obtained from the NYMEX website, and are current market closing prices for the date when the forward curve is being generated. There are 12 to 13 years of HH futures prices that are available through the NYMEX. These prices are extrapolated to cover the 25 years period that matches the Ventyx structural forecast period. The extrapolation is done through computing the growth/escalation rate of the last 4 years of the current market price quotations, and using the computed growth/escalation rate to extend the last year’s available market prices.

For basis prices, there are two data sources: one is market basis prices; and the other is a structural forecast of basis prices provided by Ventyx. Ventyx provides monthly basis prices for

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[1] Tullet is among other things an energy brokerage company that matches buyers and sellers.

[2] Ventyx is forecasting the actual day-ahead cash price that will occur in the sport markets in the future, not the price at which futures or forward contracts should be priced.

25 years to match its structural forecast period, reflecting potential changes in the energy market and their impacts on a specific local Hub prices (relative to HH prices). Market basis are available from NYMEX website, with basis prices available for three to five years (depending on the Hub location, whether it is SoCal or PG&E Citygate). The basis price forward curve is extrapolated to generate prices for a 25-year period by taking the last year's monthly quoted basis prices and repeating those prices for every month out to 25 years.

For SWP natural gas price forecast process, the average of the extended market basis and the structural basis (from Ventyx) is then taken and added to the Henry Hub extrapolated forward curve. The resulting natural gas forward curves for either SoCal or PG&E Citygate Hubs will be used in the study, where appropriate. The resulting natural gas forward curve for PG&E Citygate is shown in Figure-4, and is used for the NODOS Power Planning Study.

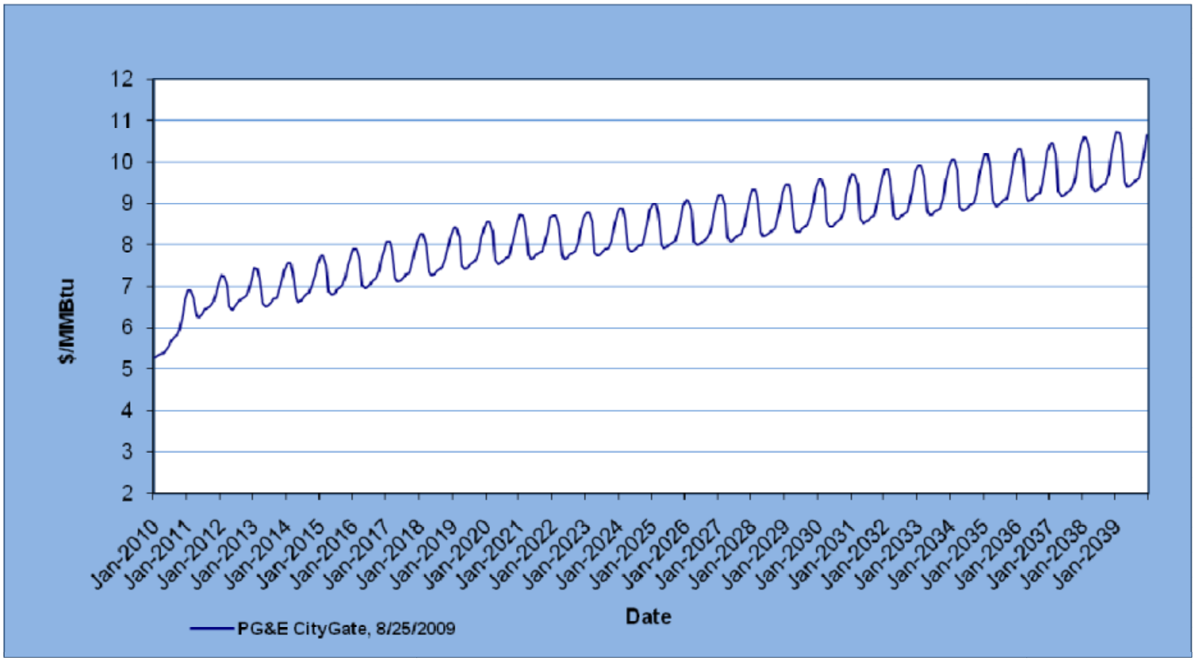

Figure 4- Natural Gas Price Forecast, Forward Curve for 2010 through 2039

For the power price forecast, the derived power forward price curve is comprised of two segments: market forwards; and synthetic forwards. The first segment uses the most current Tullet energy forwards quotations, for NP-15 and SP-15 market's different products (On-Peak, Off-Peak). This segment runs anywhere from 12 to 24 months (data availability is dependent on time of year that the power forecast is being generated).

The second segment of the price curve is the "synthetic" portion. The "synthetic" segment continues where the first segment stops, to complete the 25 years period to match the natural gas forecast period. There are two approaches that are being used to derive the "synthetic" portion of the forward curve. One approach is to calculate power prices using the natural gas forecasted prices (as described above) multiplied by historical implied heat rates.[3] The other approach is to

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[3] Historical implied heat rates were calculated from 2004 - 2008 historical price data (5 years). Daily prices were averaged into monthly prices. The heat rate is calculated as the respective period's power price divided by the respective period's gas price.

multiply the forecasted natural gas prices by a forecasted heat rate, reported as part of the structural forecast, by Ventyx. The average of those two generated power forward price curves yields the resulting "synthetic" forward curve, that make up the second segment of the power price forward curve. The same process is repeated for each of the CAISO markets and its specific products (On-Peak and Off-Peak), with the appropriate underlying fuel markets. The resulting power forward curve for NP-15 is shown in Figure-5, and is used for the NODOS Power Planning Study.

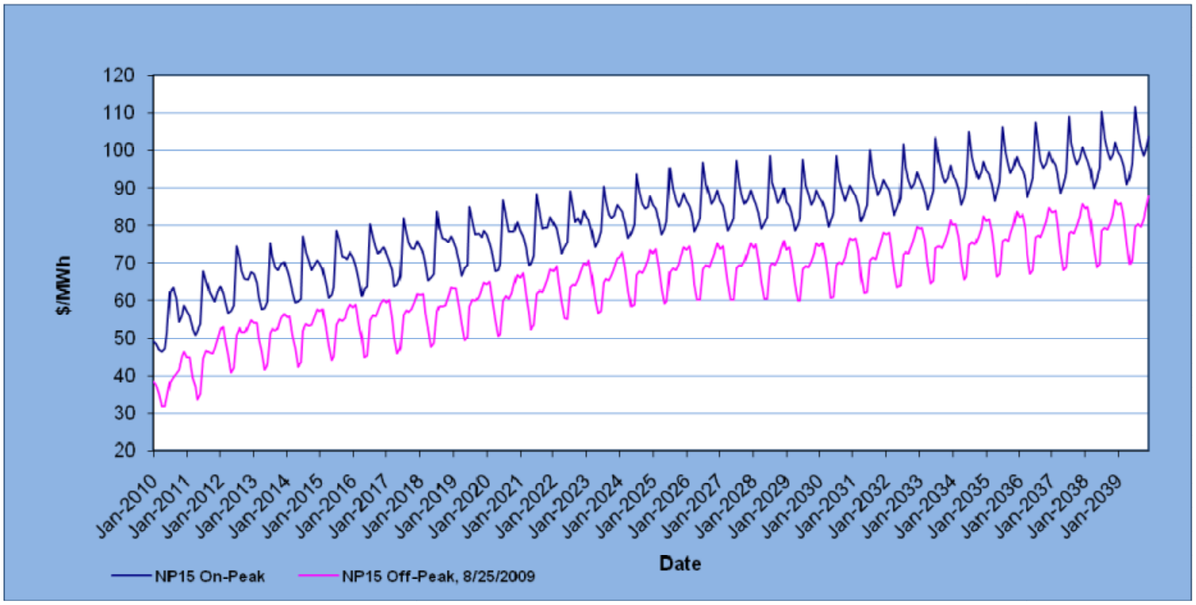
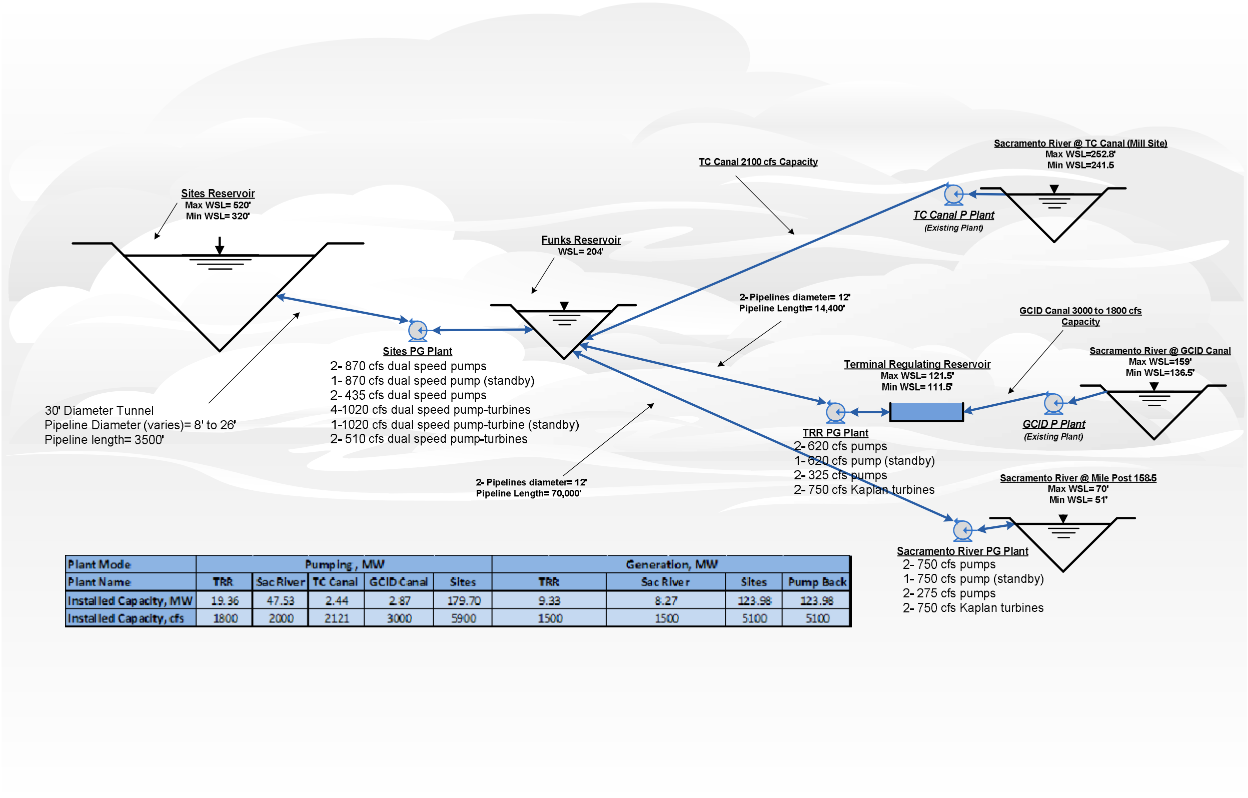


Figure 5- Power Price Forecast, Forward Curve for 2010 through 2039

4-Project Operations

For the purpose of this phase of the Power Planning study, the physical and operational attributes, of the NODOS Project components, that are used, and a schematic depiction of the Project's different components relative location, and their interconnection are shown in Figure-6.

The assumptions for the operations of the NODOS Project that are used for the current analysis are consistent with assumptions and scenarios used in developing the CALSIM model runs. Existing TC and GCID canals water diversions to the NODOS Project from the Sacramento River will take place, in a typical water year, from the month of November through March. Whereas, diversions to the NODOS Project using the proposed Sacramento River Pumping Plant are allowed year round. A total storage capacity at Sites Reservoir is assumed to be 1,800 TAF.



Plant Mode	Pumping, MW					Generation, MW			
Plant Name	TRR	Sac River	TC Canal	GCID Canal	Sites	TRR	Sac River	Sites	Pump Back
Installed Capacity, MW	19.36	47.53	2.44	2.87	179.70	9.33	8.27	123.98	123.98
Installed Capacity, cfs	1800	2000	2121	3000	5900	1500	1500	5100	5100

Figure 6- NODOS Project, Schematic of Conveyance and Storage Interconnection

Current operating rules for releases from Shasta Dam into the Sacramento River are maintained in developing the CALSIM runs for the NODOS Project. The rules for releases are governed by temperature and in stream flow requirements, contractual obligations, Delta water quality and outflow requirements, and flood control. Flood control releases are consistent with the U.S. Army Corps of Engineers, 1977, report titled; Report on Reservoir Regulation for Flood Control, Shasta Dam. For the evaluation of NODOS Project action alternatives, a generally consistent operations strategy was used for each alternative. Under each action alternative, the ability to implement this strategy effectively is subject to the operations objective focus of each alternative, the conveyance options included, and the coordinated operation of Sites Reservoir with other existing facilities. A more detailed discussion of the Sites Reservoir operations strategy could be found on Page 6-24 of the North-of-the-Delta Off stream Storage Plan Formulation Report.

In modeling the power needs for the diversion cycle of the NODOS Project, flat monthly pumping operations are assumed (24 hrs a day, 7 days a week). The pumping cycle is not optimized for this phase of the study. More in depth analysis and review of the CALSIM model runs are needed before an optimization scheme for the diversion cycle of the NODOS Project could be developed. However, with enough storage capacity at Funks reservoir and pumping capacity at Sites Reservoir, it would be more economical to get the On-Peak Sacramento River diversions to Funks Reservoir and pump that water into Sites Reservoir in the Off-Peak hours (on daily basis), when power prices are less costly. This scenario could be further tested, and refined in the next phase of the Power Planning Study of the NODOS Project.

For the generation cycle (water release cycle) of the NODOS Project, an optimization strategy is developed to maximize the revenues of the Project's generation assets. For this strategy, the assumption is that all intended daily releases from Sites Reservoir will occur during the On-Peak hours, into Funks Reservoir, to capture the most value for the energy, associated with these releases. Incidentally, water will be released into the Terminal Regulating Reservoir and the Sacramento River up to the capacities of these facilities, during the On-Peak hours. This strategy will allow for capturing the most opportunity the market offers in energy value and capacity revenues. The residual water in Funks Reservoir (from the On-Peak Sites Reservoir releases) would be released during the Off-Peak hours. A key requirement for this strategy to be effective is that Funks Reservoir's active storage would be made available before the beginning of the next On-Peak cycle (i.e. next day's cycle). This optimization strategy allows for maximizing the revenues (Energy and Capacity) of the generation assets of the NODOS Project.

5-Power Portfolio Model

Using the most current CALSIM model runs, a Median Case, seasonal cycle, operational time-series for the NODOS Project is defined. The Median Case time-series period matches the 30-year planning period of the Project. The time-series is derived from the 82-year time-series resulted from the most current CALSIM runs (Benchmark Study Version 2: BST_2020D09D_ANNBENCHMARK_2_2). Current CALSIM runs are based on the available 82-year historical hydrology record. Total water diversions from the Sacramento River into Sites Reservoir is used as a criteria for isolating the 30-year (sequential) time-series that represents the Median Case for the Study. Moving averages and frequency analysis are used to reduce the 82-year record to a 53 potential scenarios for the operations of the NODOS Project. Then, the 53 scenarios are ranked, based on the cumulative volume of diversions into Sites Reservoir, and the median of these scenarios is identified with corresponding 30-year time-series that generated its value. The underlying 30-year time-series for all Project's components is also identified and grouped, to represent the 30-year Median Case for the NODOS Project operations. Project diversions and deliveries time series are then translated into pumping and generation in MWh, based on design capacities of the appropriate components of the Project. The resulting 30-year pumping and/or generation time-series for each of the Project components is developed using designed capacities, friction factors, storage elevations, and other information necessary to make these calculations. Figure-7 through Figure-11 show the Median Case time-series, for the 30-year planning period, for the operations of each of the Project components, in terms of utilized capacity in MWs, and it is the format needed to set up the EPM model.

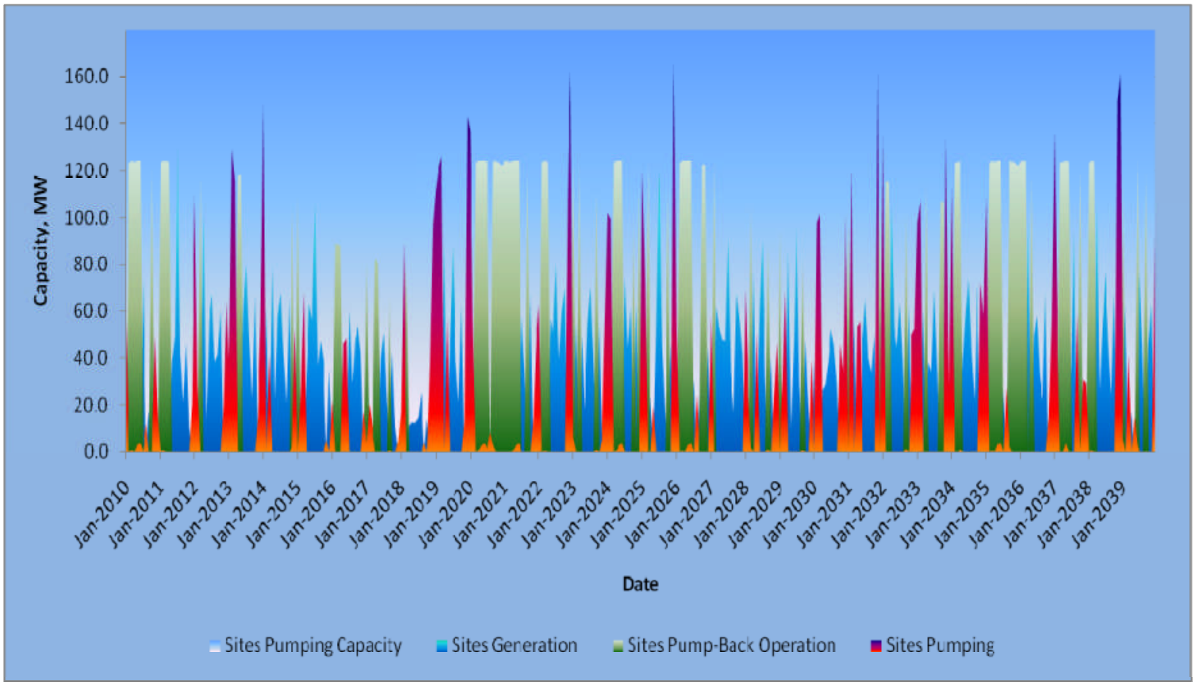


Figure 7- NODOS Project, Sites Reservoir Operations- Median Case

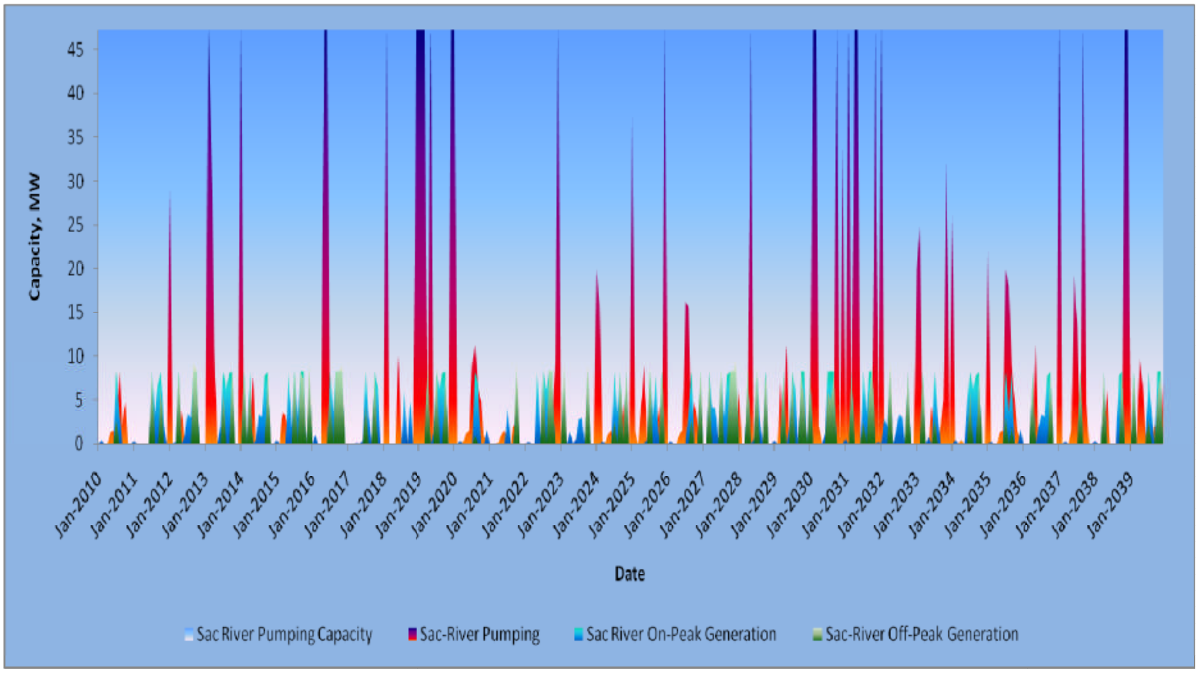


Figure 8- NODOS Project, Sacramento River Pumping Plant Operations- Median Case

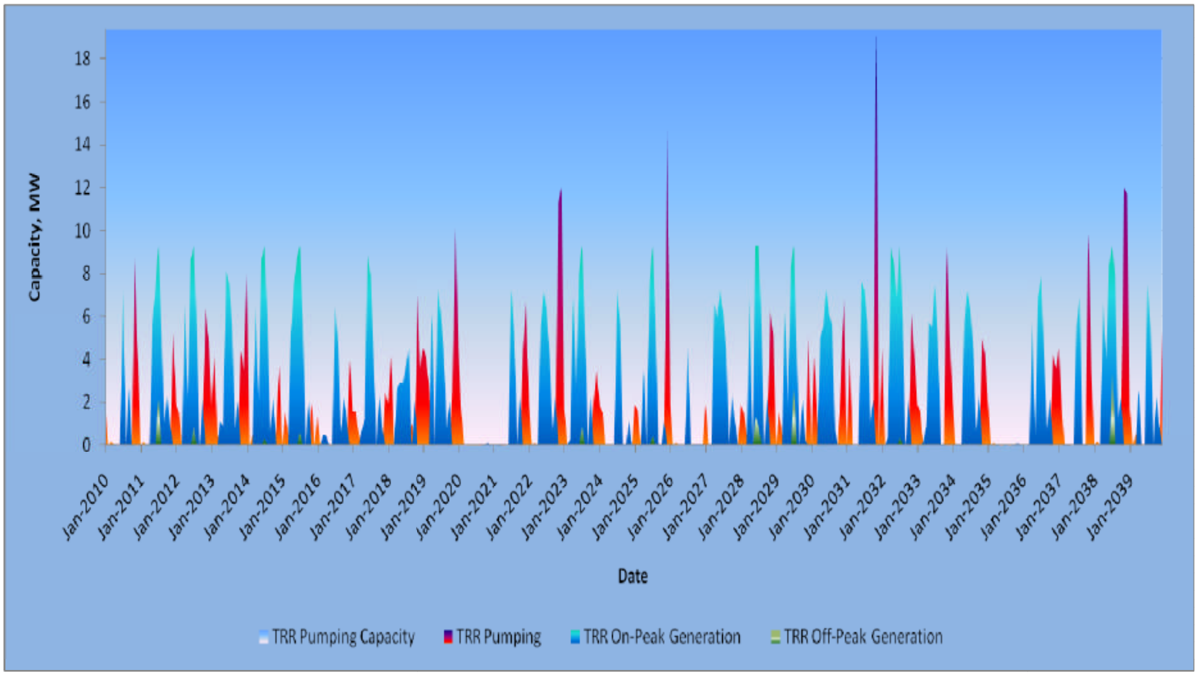


Figure 9- NODOS Project, TRR Pumping Plant Operations- Median Case

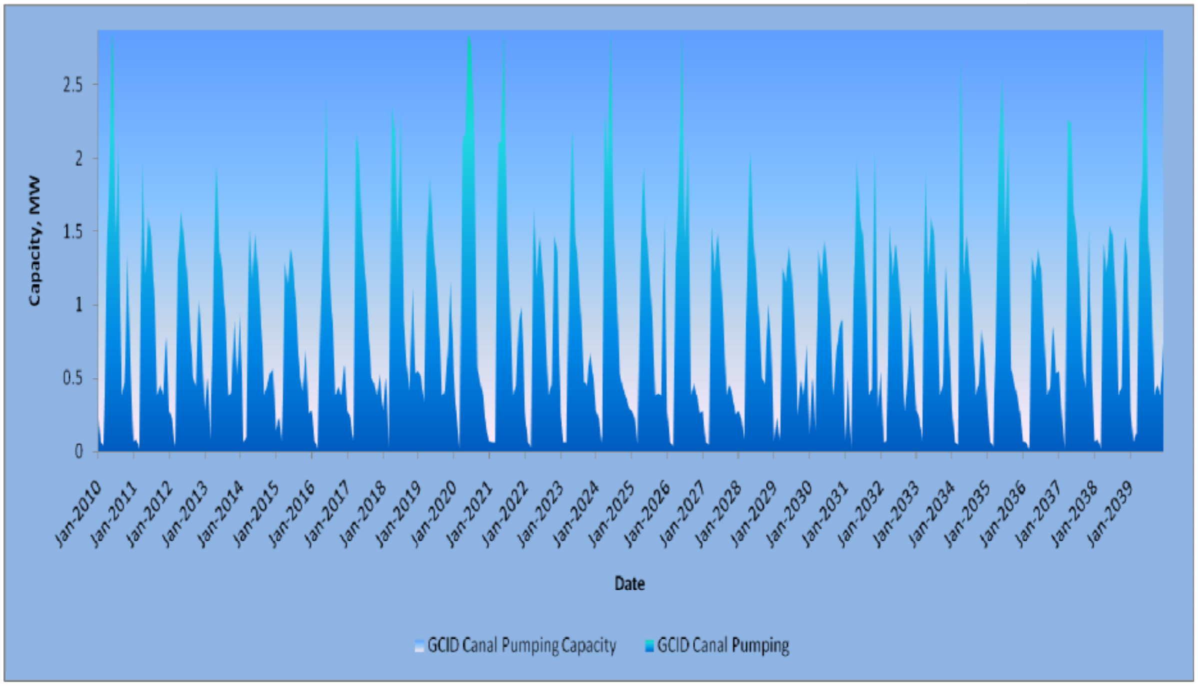


Figure 10- NODOS Project, GCID Canal Pumping Plant Operations- Median Case

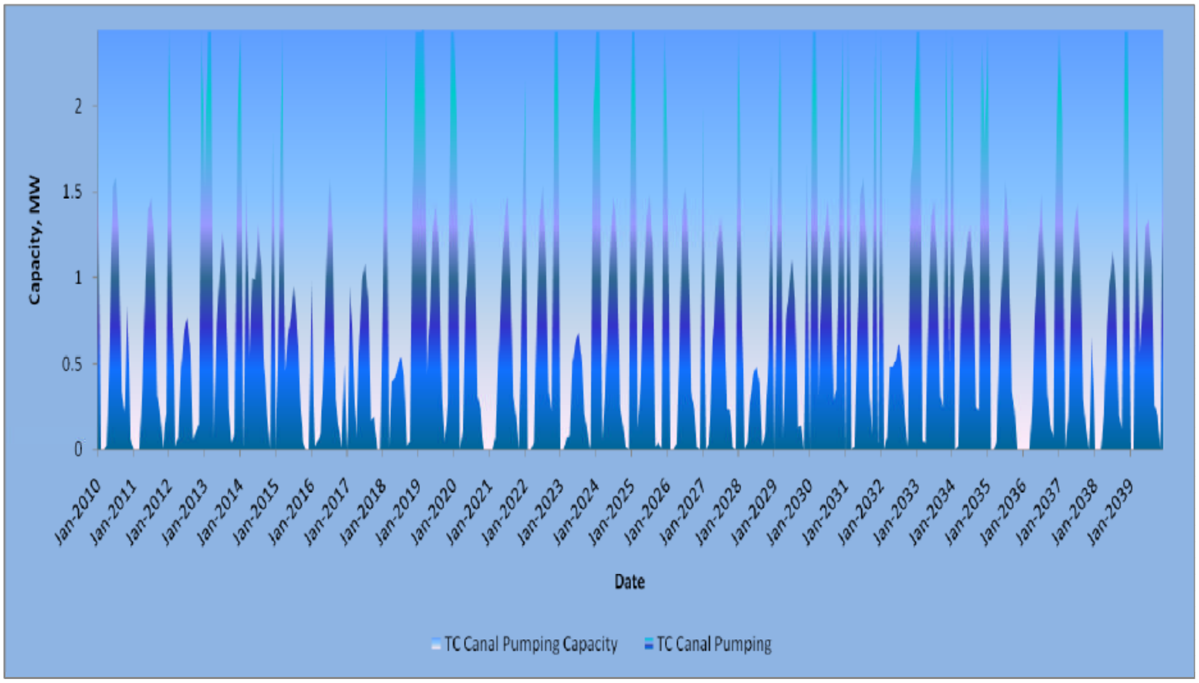
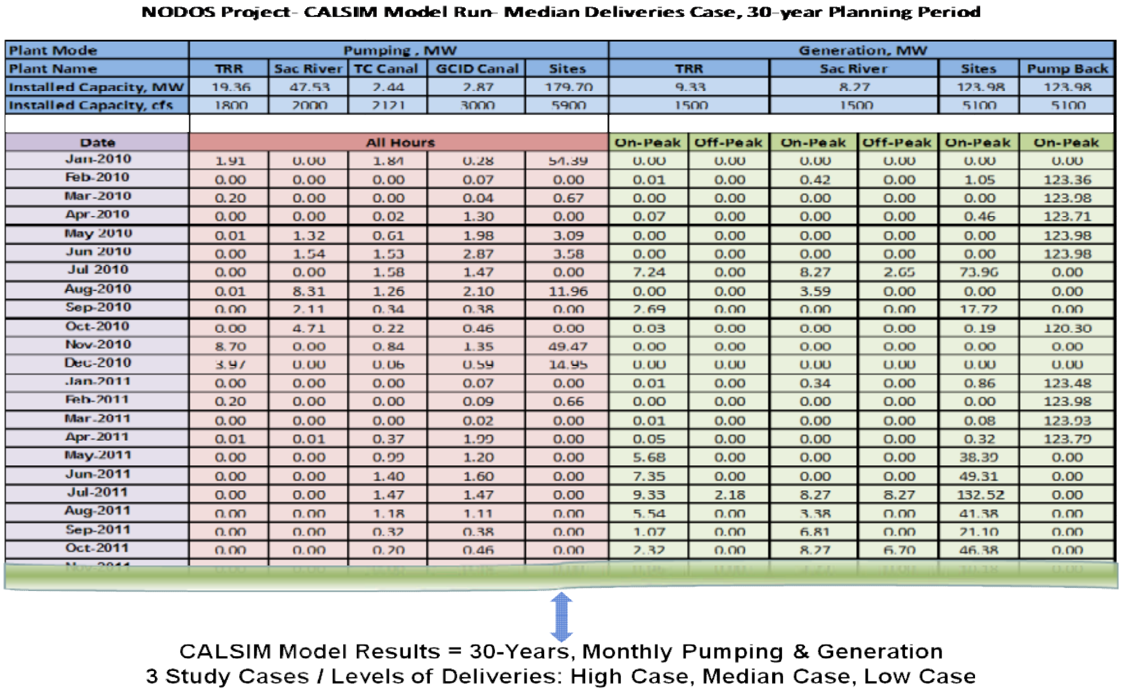


Figure 11- NODOS Project, TC Canal Pumping Plant Operations- Median Case

Also, Table-1 summarizes the monthly, 30-year planning period, pumping and generation data and capacities used to model the Median Case of the Project (See Appendix for complete version of Table-1). The information in Table-1 is the direct input data for the EPM model's different instruments, that are used to value the energy and risk associated with the operations of the NODOS Project.



NODOS Project- CALSIM Model Run- Median Deliveries Case, 30-year Planning Period

Plant Mode	Pumping , MW					Generation, MW					
Plant Name	TRR	Sac River	TC Canal	GCID Canal	Sites	TRR		Sac River		Sites	Pump Back
Installed Capacity, MW	19.36	47.53	2.44	2.87	179.70	9.33		8.27		123.98	123.98
Installed Capacity, cfs	1800	2000	2121	3000	5900	1500		1500		5100	5100
Date	All Hours					On-Peak	Off-Peak	On-Peak	Off-Peak	On-Peak	On-Peak
Jan-2010	1.91	0.00	1.84	0.28	54.39	0.00	0.00	0.00	0.00	0.00	0.00
Feb-2010	0.00	0.00	0.00	0.07	0.00	0.01	0.00	0.42	0.00	1.05	123.36
Mar-2010	0.20	0.00	0.00	0.04	0.67	0.00	0.00	0.00	0.00	0.00	123.98
Apr-2010	0.00	0.00	0.02	1.30	0.00	0.07	0.00	0.00	0.00	0.46	123.71
May 2010	0.01	1.32	0.61	1.98	3.09	0.00	0.00	0.00	0.00	0.00	123.98
Jun 2010	0.00	1.54	1.53	2.87	3.58	0.00	0.00	0.00	0.00	0.00	123.98
Jul 2010	0.00	0.00	1.58	1.47	0.00	7.24	0.00	8.27	2.65	73.96	0.00
Aug-2010	0.01	8.31	1.26	2.10	11.96	0.00	0.00	3.59	0.00	0.00	0.00
Sep-2010	0.00	2.11	0.34	0.38	0.00	2.69	0.00	0.00	0.00	17.72	0.00
Oct-2010	0.00	4.71	0.22	0.46	0.00	0.03	0.00	0.00	0.00	0.19	120.30
Nov-2010	8.70	0.00	0.84	1.35	49.47	0.00	0.00	0.00	0.00	0.00	0.00
Dec-2010	3.97	0.00	0.06	0.59	14.95	0.00	0.00	0.00	0.00	0.00	0.00
Jan-2011	0.00	0.00	0.00	0.07	0.00	0.01	0.00	0.34	0.00	0.86	123.48
Feb-2011	0.20	0.00	0.00	0.09	0.66	0.00	0.00	0.00	0.00	0.00	123.98
Mar-2011	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.08	123.93
Apr-2011	0.01	0.01	0.37	1.99	0.00	0.05	0.00	0.00	0.00	0.32	123.79
May-2011	0.00	0.00	0.99	1.20	0.00	5.68	0.00	0.00	0.00	38.39	0.00
Jun-2011	0.00	0.00	1.40	1.60	0.00	7.35	0.00	0.00	0.00	49.31	0.00
Jul-2011	0.00	0.00	1.47	1.47	0.00	9.33	2.18	8.27	8.27	132.52	0.00
Aug-2011	0.00	0.00	1.18	1.11	0.00	5.54	0.00	3.38	0.00	41.38	0.00
Sep-2011	0.00	0.00	0.32	0.38	0.00	1.07	0.00	6.81	0.00	21.10	0.00
Oct-2011	0.00	0.00	0.20	0.46	0.00	2.32	0.00	8.27	6.70	46.38	0.00

CALSIM Model Results = 30-Years, Monthly Pumping & Generation
3 Study Cases / Levels of Deliveries: High Case, Median Case, Low Case

Table 1- NODOS Project, Pumping and Generation Time Series

The High and Low Cases, seasonal cycle, operational time-series for the NODOS Project are also identified using the highest and lowest 30-year cumulative deliveries (sequential) into Sites Reservoir. The High and Low cases are needed to define the uncertainty in the NODOS Project's revenues that would result from deliveries deviating from the Median Case (i.e. uncertainty from hydrology and corresponding operations). The resulting range of values for the Project's power portfolio, from modeling the High and Low cases, represents the uncertainty in Project's value from water deliveries. However, this range represents the extreme "bookends" in Project deliveries relative to its Median Case of deliveries, and not necessarily two plausible scenarios.

Daily pump-back operations of the NODOS Project facilities are considered to better use available Project facilities, and to capture market opportunities (price differential between On-Peak and Off-Peak), that would generate a revenue stream for the Project. The pump-back operations are limited to the months that the monthly average diversions into the NODOS Project are less than 200 cfs. For each month in the three CALSIM deliveries scenarios (High, Median, Low) for the NODOS Project, the available generation capacity at Sites pumping/generation plant is estimated, based on the available head at Sites Reservoir (from the previous month's operations). Then a dispatch profile for the daily pump-back operations is generated based on market opportunities, pumping/generation efficiency of the Project, and available storage at Funks Reservoir. Ultimately, the pump-back operations are modeled in the EPM model through the use of a dispatch unit instrument. The dispatch unit is set up with a heat rate that represents the collective efficiency of the full cycle pump-back operation of the NODOS Project. Ultimately, the model is set up to produce the NODOS Project pump-back potential based on the Project and market economics. The model is set up to value the consumed energy needed to lift the water into Sites Reservoir, so it could be released and generate energy during the on-peak hours, within the Project inherent efficiencies and the limits of available storage at Funks Reservoir. The Median Case dispatch profile for the pump-back operations of the NODOS Project is depicted in Figure-12

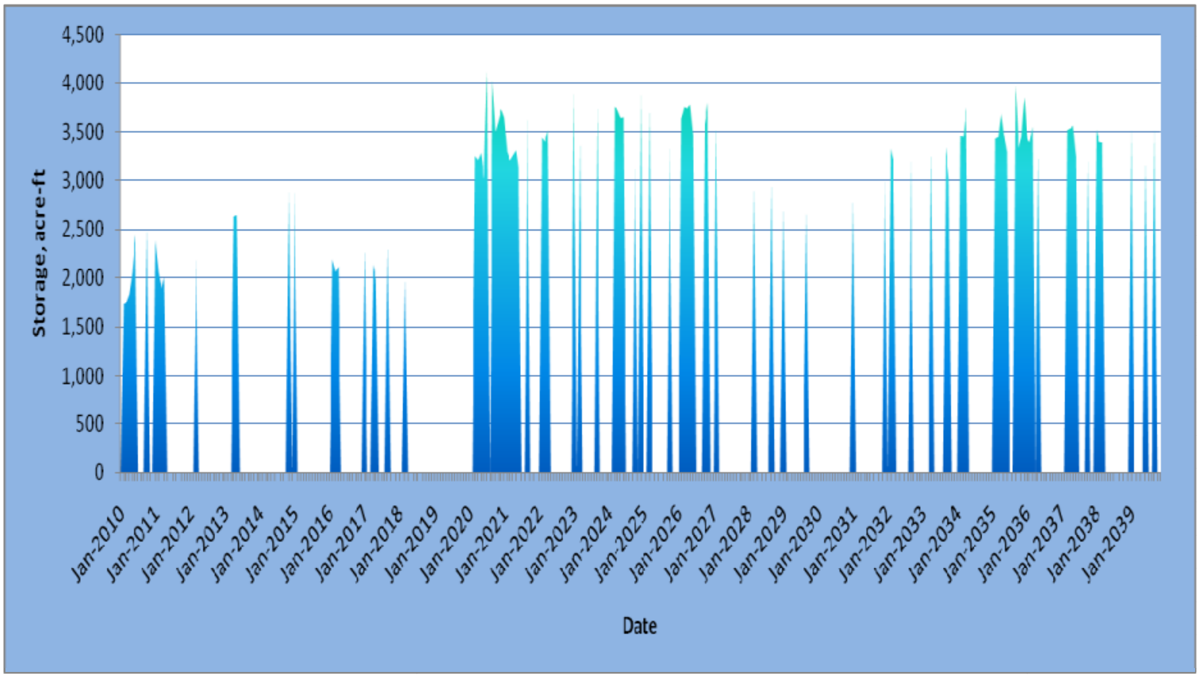


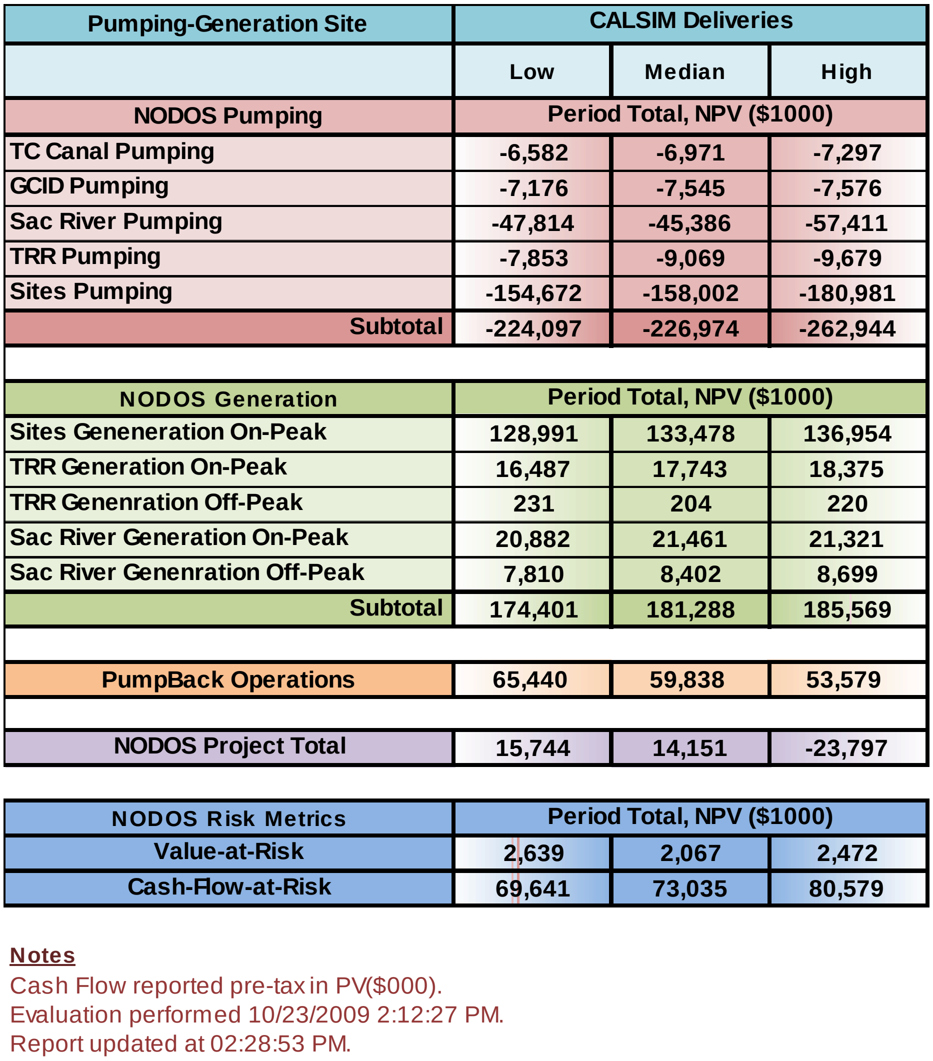
Figure 12- NODOS Project, Funks Reservoir Pump-Back Operations- Median Case

Additional information needed to run the EPM model includes forward prices, volatility term structure, correlations (between different underlying markets), delivery hours, and generation blocks. All necessary information are either generated through the EPM model's graphic user interface, or externally developed and input into the model. The EPM model runs included the High, Median, and Low cases of the Project operations.

6-Modeling Results

Power Portfolio Energy Value

A summary of the EPM model results (energy value and risk) for the three CALSIM deliveries scenarios (High, Median, and Low) is shown in Table-2. The results are in $1,000 of Net Present Value (NPV), for the 30-years planning period, for each of the Project's cycles, and components. For the purposes of this Study, NPV is defined as the current market value of the net portfolio's cash flows in $1,000 of present value. The results are grouped based on the operational cycle of the Project facilities. The basic assumption is that pumping at all Project facilities is incidental to water diversions from the Sacramento River, except during pump-back operations. And generation is incidental to the NODOS Project water release/deliveries cycle, except during pump-back operations. Revenues from pump-back operations are presented separately, to allow for a better break down of costs and revenues, of Project water diversions and deliveries. In studying the modeling results, it is important to keep in mind that the numbers present the energy costs and revenues, and not the water use benefits of the Project. Also it could be noted that, for the High deliveries scenarios, pumping costs are significantly higher because of consistently higher water surface elevations at Sites reservoir for the 30-year planning period (Higher Pump Head). Another note, the pump-back operations will net more revenues under the Low deliveries scenarios because of the fact that Project facilities would be less frequently used, and more opportunity (months) would be available to perform the pump-back operations.



Pumping-Generation Site	CALSIM Deliveries		
	Low	Median	High
NODOS Pumping	Period Total, NPV ($1000)		
TC Canal Pumping	-6,582	-6,971	-7,297
GCID Pumping	-7,176	-7,545	-7,576
Sac River Pumping	-47,814	-45,386	-57,411
TRR Pumping	-7,853	-9,069	-9,679
Sites Pumping	-154,672	-158,002	-180,981
Subtotal	-224,097	-226,974	-262,944
NODOS Generation	Period Total, NPV ($1000)		
Sites Geneneration On-Peak	128,991	133,478	136,954
TRR Generation On-Peak	16,487	17,743	18,375
TRR Genenration Off-Peak	231	204	220
Sac River Generation On-Peak	20,882	21,461	21,321
Sac River Genenration Off-Peak	7,810	8,402	8,699
Subtotal	174,401	181,288	185,569
PumpBack Operations	65,440	59,838	53,579
NODOS Project Total	15,744	14,151	-23,797

NODOS Risk Metrics	Period Total, NPV ($1000)		
Value-at-Risk	2,639	2,067	2,472
Cash-Flow-at-Risk	69,641	73,035	80,579

Notes
Cash Flow reported pre-tax in PV($000).
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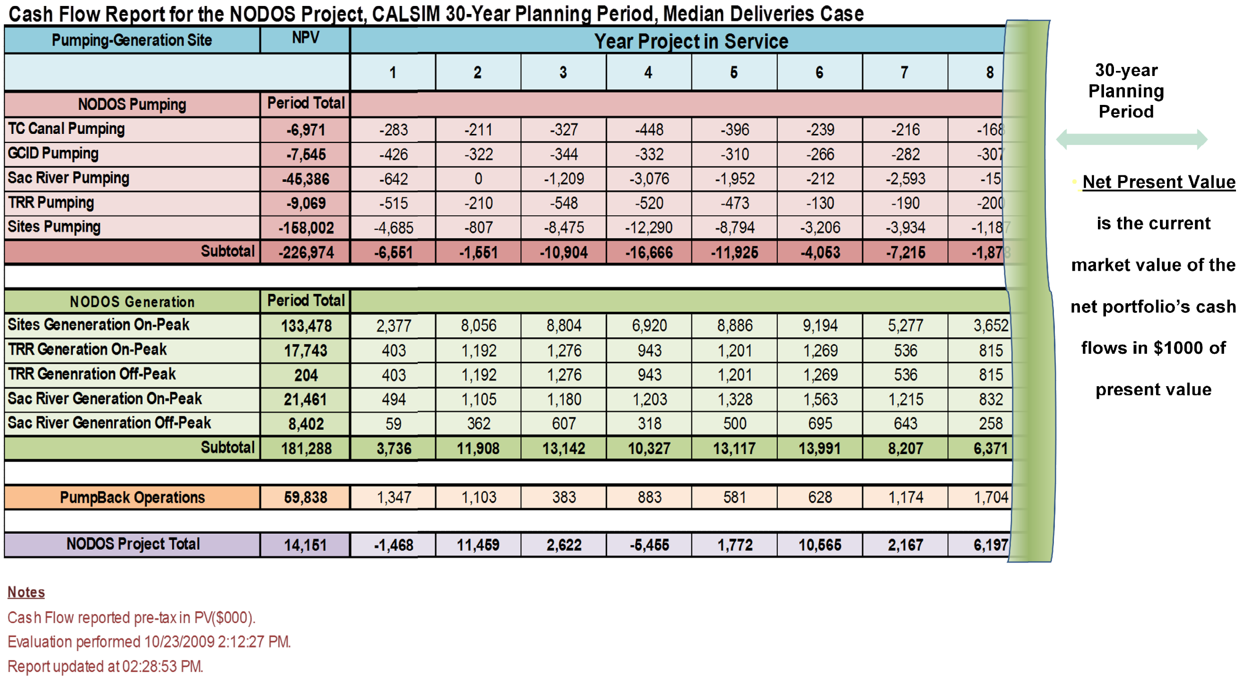
Table 2- NODOS Project, Summary Modeling Results, NPV ($1000)

The total pumping costs, of the Median Case of deliveries, for the Project in NPV are $226,974,000, whereas the corresponding generation revenues, associated with Project releases, in NPV are $181,288,000. Additional revenues in NPV of $59,838,000 would be realized from the Pump-Back operations (daily operations) of the Median Case deliveries scenario. Pump-back operations are limited to the months that the Project's average pumping (diversions) is less than 200 cfs (i.e. Project components are not in use).

The NODOS Project net total value (generation revenues-pumping cost) for the Median Case in NPV is $14,151,000. A High and Low NODOS Project net total values (corresponding to the High and Low cases) in NPV are $-23,797,000 and $15,744,000, respectively. Table-2 provides a summary break down of the net Project values based on the contributions of each Project component, and in each of the Project's operational cycles (pumping and generation cycles).

Table-2 is the NODOS Project Power Portfolio annual cash flow, in present value in $1,000s, for the Median Case of deliveries. The annual cash flows are reported, in present value, through the 30-year planning period of the Project. The cumulative value of the cash flows in present value for each Project component represents the NPV of that component. The sum of the NPV of all Project components is the net total value of the Project.



Cash Flow Report for the NODOS Project, CALSIM 30-Year Planning Period, Median Deliveries Case

Pumping-Generation Site	NPV	Year Project in Service							
		1	2	3	4	5	6	7	8
NODOS Pumping	**Period Total**								
TC Canal Pumping	**-6,971**	-283	-211	-327	-448	-396	-239	-216	-168
GCID Pumping	**-7,545**	-426	-322	-344	-332	-310	-266	-282	-307
Sac River Pumping	**-45,386**	-642	0	-1,209	-3,076	-1,952	-212	-2,593	-15
TRR Pumping	**-9,069**	-515	-210	-548	-520	-473	-130	-190	-200
Sites Pumping	**-158,002**	-4,685	-807	-8,475	-12,290	-8,794	-3,206	-3,934	-1,187
Subtotal	**-226,974**	**-6,551**	**-1,551**	**-10,904**	**-16,666**	**-11,925**	**-4,053**	**-7,215**	**-1,878**
NODOS Generation	**Period Total**								
Sites Geneneration On-Peak	**133,478**	2,377	8,056	8,804	6,920	8,886	9,194	5,277	3,652
TRR Generation On-Peak	**17,743**	403	1,192	1,276	943	1,201	1,269	536	815
TRR Genenration Off-Peak	**204**	403	1,192	1,276	943	1,201	1,269	536	815
Sac River Generation On-Peak	**21,461**	494	1,105	1,180	1,203	1,328	1,563	1,215	832
Sac River Genenration Off-Peak	**8,402**	59	362	607	318	500	695	643	258
Subtotal	**181,288**	**3,736**	**11,908**	**13,142**	**10,327**	**13,117**	**13,991**	**8,207**	**6,371**
PumpBack Operations	**59,838**	1,347	1,103	383	883	581	628	1,174	1,704
NODOS Project Total	**14,151**	**-1,468**	**11,459**	**2,622**	**-5,455**	**1,772**	**10,565**	**2,167**	**6,197**

Net Present Value is the current market value of the net portfolio's cash flows in $1000 of present value

Notes

Cash Flow reported pre-tax in PV($000).

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Table 3- NODOS Project, Modeling Results, Annual Cash Flow, NPV ($1000)

Figure-14 graphically depicts the NODOS Project Power Portfolio cash flows in each delivery period for the 30-year horizon modeled in EPM, for the Median Case of deliveries. The solid "diamond" markers represent the present value of the Portfolio's cash flow for a specific period. And the High and Low "error" bars correspond to the upper and lower percentiles of the cash flow distribution estimated using the Monte-Carlo simulation. The error bars correspond to the 95% and 5% confidence limits of the cash flow distribution for that specific period.

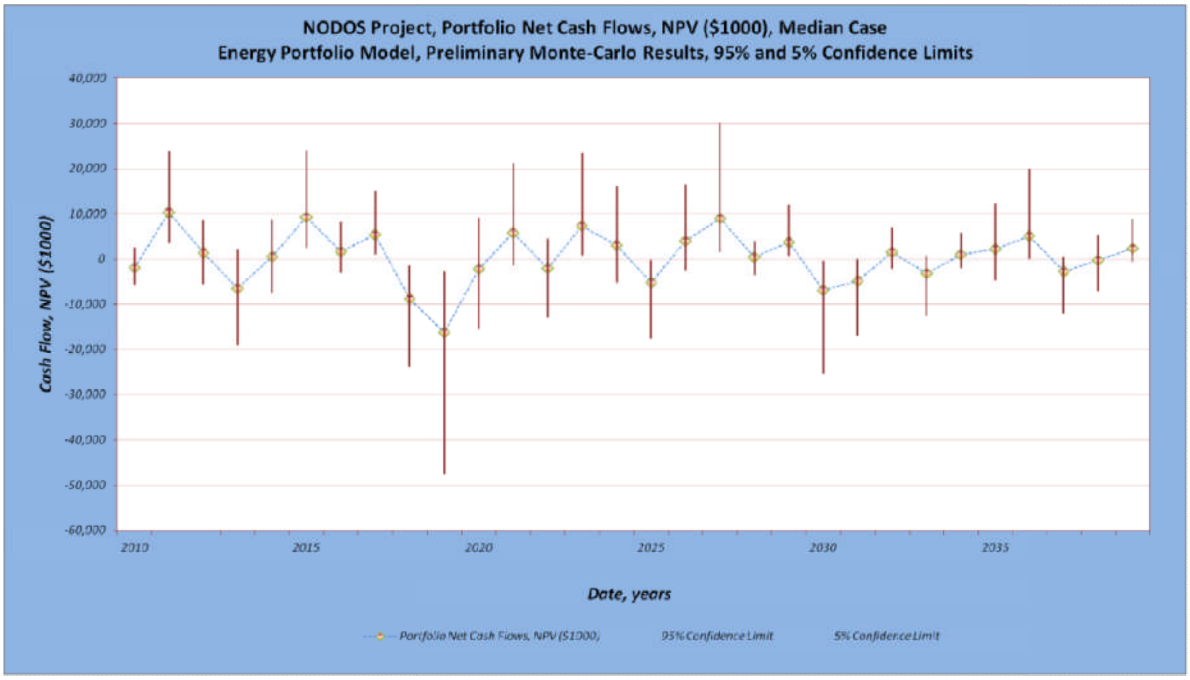

Figure 14- NODOS Project, Portfolio Cash Flow, 2010 through 2039

Power Portfolio Risk Metrics

EPM model results, also, include a description of the financial risk resulting from uncertainty and volatility of the underlying fuel and power markets, in which the NODOS Project will be participating. The EPM model produces risk metrics associated with a portfolio of assets that correspond to the exposure of an individual asset in a portfolio, or risk metrics that describe the collective risk associated with the portfolio, as a whole. The EPM model uses a Monte-Carlo based algorithm (random generation based) to generate a pre-assumed log-normal distribution of the cash flow of an asset. The generated distribution is based on the specific period's marginal volatility, time to delivery, and the analysis date. The number of draws for the Monte-Carlo approximation (2,000 draws are being used for this Study), the specified confidence level (95% is being used for this Study), the volatility and correlations of the underlying markets, and the holding period, (all are input parameters to EPM) are the basis for the Monte-Carlo generated distribution of the cash flow of an asset. Financial risk associated with an asset or a portfolio of assets could be measured from the Monte-Carlo generated distribution.

Two commonly used risk metrics in describing the financial risk associated with a portfolio are the Value-at-Risk, and Cash-Flow-at-Risk. Value-at-Risk is a measure of the potential for loss on a Portfolio of assets or an asset value, within a specified holding period. Value-at-Risk is a commonly used risk metric to describe the risk associated with the value of a portfolio of assets within a short period of time (days). A second risk metric is a Cash-Flow-at-Risk, and is defined as the maximum loss that could be realized over a specified holding period at a specified confidence level. Other risk metrics, such as Price Exposure, could also be reported, as partial output of the EPM risk report. Price Exposure measures an asset exposure to a specific price risk, and reports how many dollars of the value of that asset is at stake.

The NODOS Project Power Portfolio cumulative probability distribution is depicted in Figure-15. It provides the cumulative probability distribution of the NODOS Project portfolio's cash flows around its mean value. On Figure-15, the Cash-Flow-at-Risk could be measured from the difference in NPV of Portfolio cash flows between the 50% and the 0% probabilities, for the pre-specified confidence level (95% in this case). Cash-Flow-at-Risk for a specific period could also be generated. The annual Cash-flow-at-Risk is graphically depicted on Figure-15, as the difference between the "Diamond" markers and the lower end of the error bar, for that specific period. Value-at-Risk and Cash-Flow-at-Risk of the NODOS Project are summarized, for the three deliveries cases (High, Median, and Low), in Table-2.

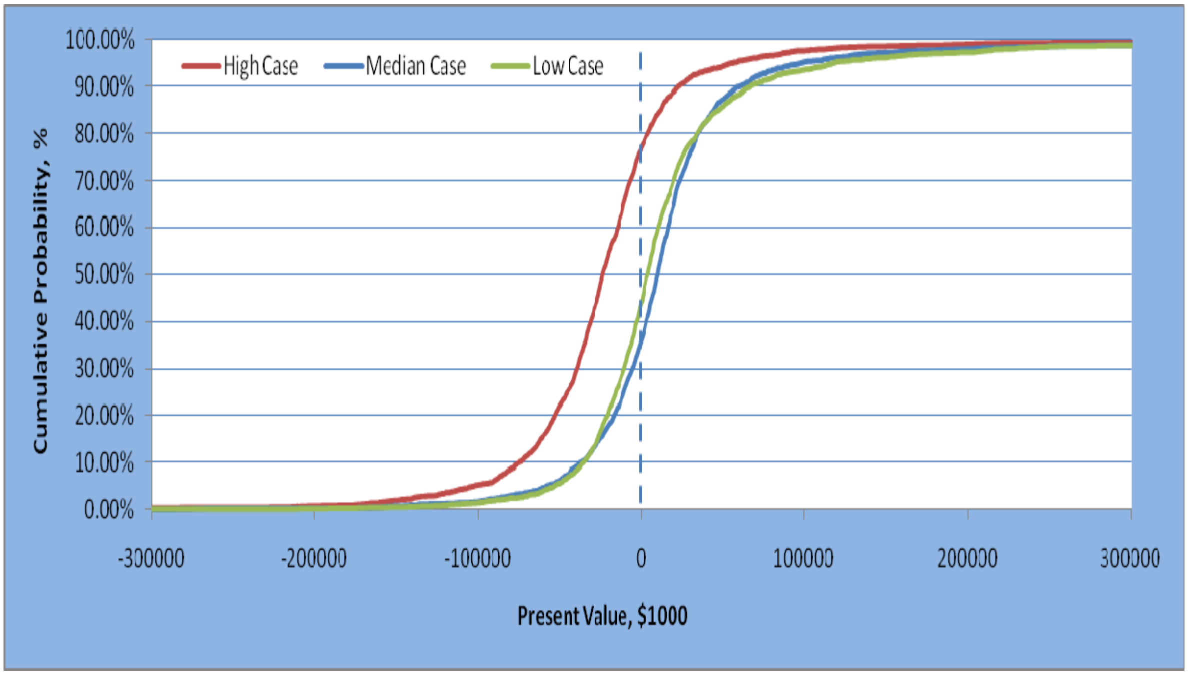

Figure 15- NODOS Project, Cumulative Cash Flow Distribution Comparison

7-NODOS Project Capacity and Ancillary Services

Capacity Value Analysis:

CAISO is charged, under both California law and by the Federal Energy Regulatory Commission (FERC), with the responsibility of maintaining and operating a reliable grid system (transmission system) – a system that is under their operational control. System reliability is a very complex subject, as it is inextricably intertwined with market economics-a subject that is beyond the scope of this Study. Nevertheless, a crucial element of reliable grid operations, and relevant to the NODOS Project operations, is Resource Adequacy (RA). CAISO through their FERC approved Tariff, along with RA requirements by adopted State CPUC mandates, are intended to establish a process that ensures that capacity procured for RA purposes is available when and where it is needed. For the NODOS Project, RA obligations are a pseudo financial obligation in pumping/diversion cycle (Self-Provided), and a revenue opportunity in generation/release cycle.

There are several ways through which capacity value of a power asset can be harnessed. One way is the consideration of RA capacity value utilization. The state of California has embraced an RA mandate/regime (AB380) in order to make power resources available when and where they are needed, and to promote investment on new resources and maintenance of existing facilities. The California Public Utilities Commission (CPUC) governs the RA program for entities under its jurisdiction and the CAISO monitors the RA program implementation by utilities, including publicly owned utilities and government agencies. Currently, RA capacity is being traded bilaterally through a solicitation and bidding process and the price of capacity negotiation is opaque. However, the CAISO Tariff requires the CAISO to procure capacity as a backstop, should a load serving entity fail to meet its RA obligation showings. The RA obligation showings take place in an annual showing, as well as monthly showings. The FERC has authorized the CAISO to charge or pay the default RA capacity procurement price of $41/KW-year. In terms of capacity rate determination needed to estimate RA revenues and/or obligations, three options can be considered:

1) Bilateral trade capacity value: It is not transparent and the rate at which the capacity is procured is unknown. It could be lower in some months and higher during summer months (seasonal trend).
2) Default Interim Capacity Procurement Mechanism (ICPM) procurement rate: The FERC approved CAISO tariff rate of $41/KW-year is the backstop procurement rate. It is constant for all the months, and represents an implied cap on RA value in the CAISO market. This default rate is subject to change in the upcoming stakeholder process at the CAISO and subsequent FERC approval.
3) Based on escalated 2007 CEC costs of generation technologies: Capacity value would be the revenue stream from selling capacity needed to make an economic/feasible investment in a simple cycle generation unit. Modeling a 100 MW simple cycle generation unit, using the escalated 2007 CEC costs of generation technologies, revealed a capacity revenue requirement of $25.19/KW-year.

For the NODOS Project, RA obligations for the pumping cycle are met through the “Self-Provided” provisions of current CAISO Tariff, providing that it meets CAISO participating load requirements. In reality, the NODOS Project would meet its RA obligation in the pumping cycle through a load dropping scheme, and would satisfy CAISO’s RA requirements. Capacity revenues and obligations for the NODOS Project are estimated using the $25.19/KW-year value described in #3 above, as this value represent a conservative estimate relative to the ICPM in #2. The monetary value of meeting RA obligations for the NODOS Project, which can be described as avoided cost, have a NPV of $12,895,000 for the Median Case deliveries and the 30-year planning period. For the NODOS Project generation cycle, the corresponding potential capacity revenues are estimated at a NPV of $29,946,000. It is assumed that the NODOS Project will offer capacity in the CAISO market, to participants that need to secure capacity to meet their RA obligations. Figure-16 depicts the NODOS Project RA obligations and Revenues streams in NPV, for the Median Case Deliveries and the 30-year planning period.

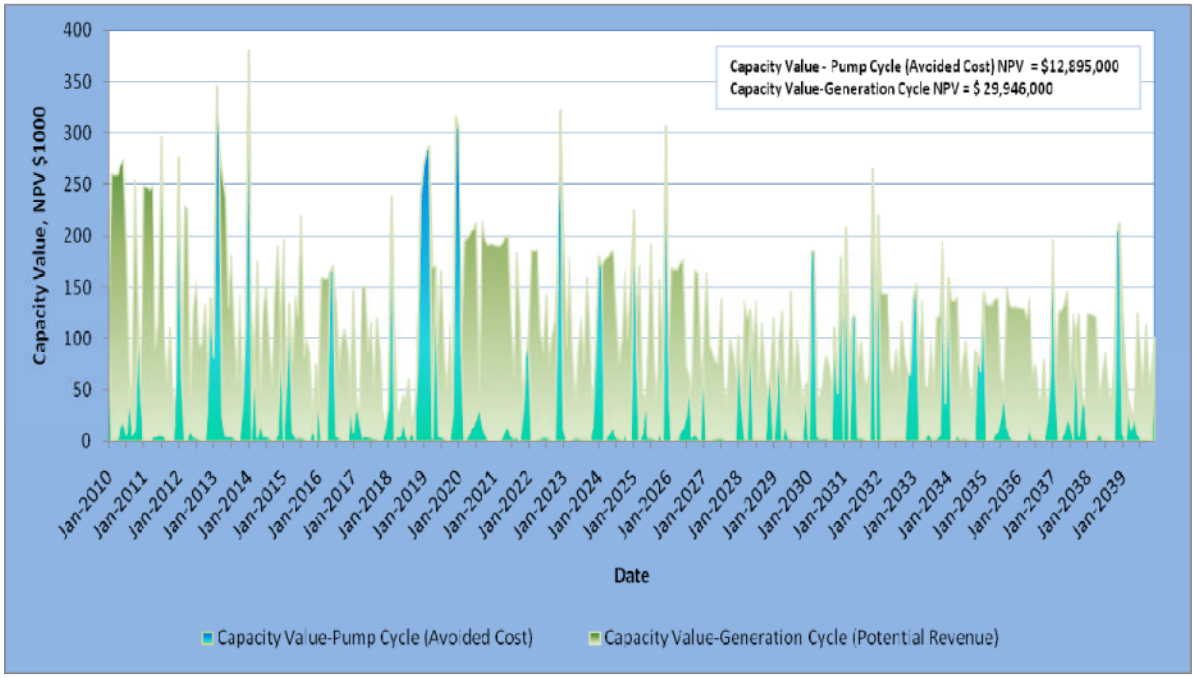

Figure 16- NODOS Project, Capacity Revenues and Obligations, Median Case

Ancillary Services Potential

The CAISO procures Ancillary Services (AS) to ensure that it has adequate reserve generation capacity to maintain the electric system reliability and system frequency, by matching generation and load at all times under both normal and abnormal operating conditions. In their restructured electricity market (Post MRTU), CAISO obtains AS services through a competitive bidding process. On a daily basis, CAISO procures four primary AS services (regulation, spinning reserves, non-spinning reserves, and replacement reserves), in day-ahead and in hour-ahead markets. The two additional AS that CAISO procures are black-start and voltage support services, which are procured on a long term basis. The four primary AS are procured on separate basis, in a competitive open market environment, designed as being an integral component of the energy market. The Primary AS are defined by CAISO, as follow:

> **1-Regulation:** Generation that is on-line, and synchronized with the CAISO controlled grid so that the energy can be increased or decreased instantly through automatic generation control (AGC), directly by the CAISO monitoring system. Regulation is used to maintain continuous balancing of resources and load within the CAISO controlled grid, as well as maintains frequency during normal operating conditions.
>
> **2-Spinning Reserve:** Generation that already on-line, or “spinning”, with additional capacity that is capable of ramping over a specified range within 10 minutes and running for at least two hours.
>
> **3-Non-Spinning Reserve:** Generation that is available but not on-line, that is capable of being synchronized and ramping to a specified level within 10 minutes, and capable of producing dispatched energy for at least two hours.

> **4-Replacement Reserves:** Generation that is capable of starting up if not already operating, synchronized with CAISO controlled grid and ramping to a specified load within one hour, and running for at least two hours.

The two remaining AS (voltage support, and black-start) are procured primarily through the Reliability Must Run (RMR) contracts. CAISO is responsible for conducting a competitive market of the four primary AS on behalf of the market participants.

For the NODOS Project pumping/generating facilities, if interconnected to CAISO grid, AS would be a significant operations and costs/revenues concern. For the NODOS Project to participate in the CAISO AS market, the CAISO Tariff requires a participating Generator to undergo a certification process- the process details are beyond the scope of this Study. CAISO Tariff states that a participating generator is a generator or other seller of Energy or AS through a Scheduling Coordinator over the CAISO grid from a generating unit with a rated capacity of 1 MW or greater, or from a generating unit providing AS and/or Imbalance Energy through an aggregation arrangement approved by the CAISO- a criteria that the NODOS Project will clearly meet. The CAISO accepts market bids for Energy and AS only from Scheduling Coordinators on behalf of the participating generator.

A preliminary assessment for AS opportunities for the NODOS Project is conducted using the Median Case CALSIM deliveries, for the 30-year planning period. Although the opportunity exists for the Project's facilities to participate in providing AS in the CAISO day- ahead and hour- ahead markets, the current analysis focuses on the day-ahead market opportunities. More thorough analysis will be conducted in the next phase of the study as the NODOS Project evolves into an advanced stage, and more granular details are developed through improved modeling efforts (daily, and hourly time steps) for Project operations. In general, participation in the AS market is an opportunity to translate inherent operational flexibilities, and excess capacities into revenue opportunities. For the NODOS Project, the ultimate priority is to maintain the intended seasonal water cycle diversions/deliveries that the Project was designed to capture. Therefore, revenue opportunities from participating in the AS market will have to be designed as an incidental activity to satisfying the intended Project's operations. More operational scenarios will be considered in the next phase of the Study, where operations would be optimized to capture the most revenues the market offers for both Energy and Ancillary Services, coincidently.

The restructured CAISO market (post MRTU) is still evolving, and price signals have not necessarily matured, to reflect long term market trends for AS prices. Also, price forecasts for AS marginal prices, for the CAISO market, are not available, for now. The best available option is to use recent historical AS hourly clearing prices for the CAISO market- available on CAISO's OASIS web site. For the current phase of the Study, six months of historical hourly CAISO AS clearing prices are used as a basis for the NODOS Project AS revenues assessment.

For the pumping cycle, the NODOS Project will have the opportunity, as a participating load (meeting CAISO Tariff definition), to sell Non Spin AS (as described in #3 above) into the CAISO market. However, the AS participation will be limited to the Sites Reservoir pumping plant, so that water diversions from the Sacramento River could be maintained, at all times. The assumption is that if the pump load at Sites Reservoir pumping plant got dropped by CAISO, water diversions from the Sacramento River could be stored in Funks Reservoir for the period of time CAISO needs the service- currently, a two hours maximum period for a Non Spin AS.

Stored water at Funks Reservoir could then be pumped into Sites Reservoir at a later time within the same day. Current CALSIM runs indicate that in months with potentially highest water diversions from the Sacramento River, it is possible to use the excess pumping capacity at Sites Reservoir pumping plant to move the water stored in Funks Reservoir, resulting from a Non Spin AS called upon by CAISO. More detailed analysis is needed for the pumping cycle in the next phase of the Study to ensure that participating in the Non Spin AS market would not hinder water diversions from the Sacramento River. Figure-17 depicts the Non Spin AS potential in MWh, for Sites Reservoir pumping plant.

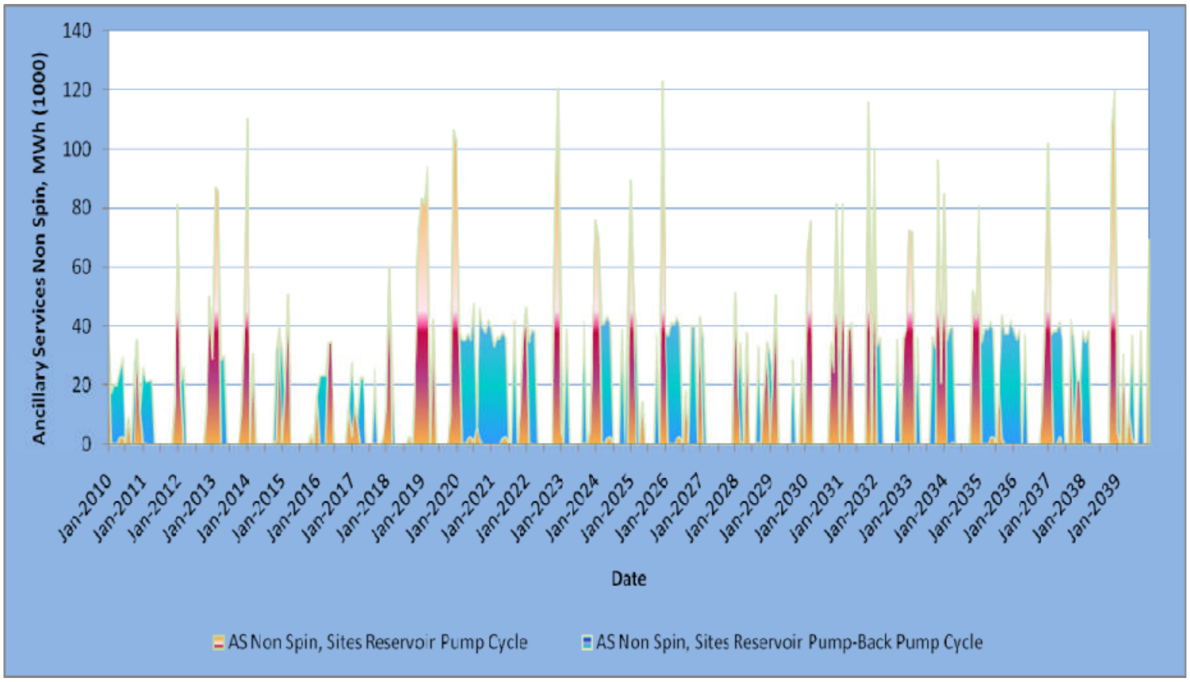

Figure 17- Ancillary Service Potential, Sites Reservoir Pumping Cycle, Median Case

For the generation cycle, the NODOS Project, will have the opportunity to sell Regulation Down AS (as described in #1 above) into the CAISO market. In this Study, the NODOS Project water release cycle is optimized to capture the most value of the associated energy (generation-cycle). Hence, water releases from Sites Reservoir are designed to occur in the On-Peak hours. Accordingly, the Project generation facilities are assumed to sell Regulation Down AS mostly in the On-Peak hours, and to a lesser extent in the Off-Peak hours. The assumption is that Regulation Down AS for the NODOS, if called upon, represents a temporary delay in water releases, and could be rectified within few hours. Also, it is assumed that the NODOS Project facilities will be equipped with AGC system and would be of the type that could be ramped down to satisfy CAISO requirements for this type of AS support. Participating in the Regulation Down AS market may result in foregoing some of the On-Peak generation revenues. More detailed analysis will be conducted in the next phase of the Study to estimate the value of lost opportunity, from shifting generation. Also, more information is needed on the frequency at which CAISO calls upon this type of AS support, so that it can be reflected in the analysis. The NODOS Project interconnection location to the CAISO grid would be an important factor in analyzing the Project's AS participation and value- a level of detail that is left to the next phase of the Study. Figure-18 depicts the Regulation Down AS potential for the NODOS Project generation facilities in MWh.

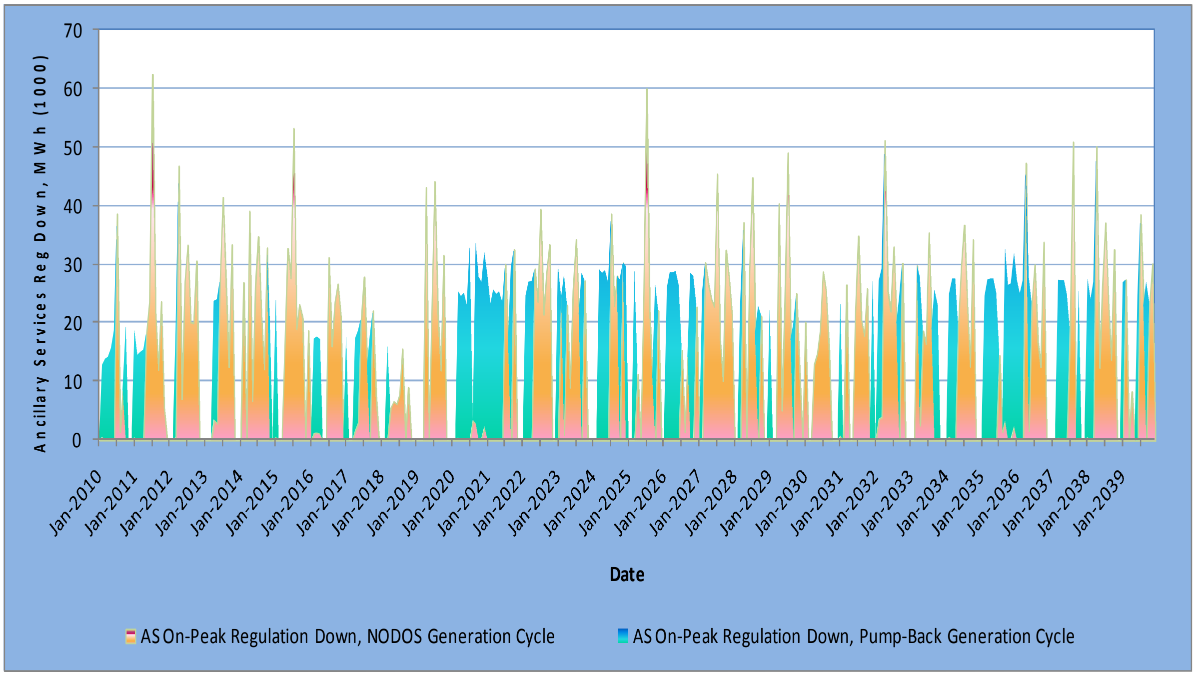

Figure 18- Ancillary Service Potential, NODOS Project Generation Cycle, Median Case

Figure-19 depicts the duration curves for the historical clearing prices for the AS markets currently trading in the CAISO day ahead market. The average values for Non Spin, Regulation Down On-Peak, and Regulation Down Off-Peak are calculated from the data sets used to generate Figure-19. Accordingly, a calculated, all hours, average value for Non Spin is $ 1.62 per MWh for the CAISO market. The duration curves for the Regulation Down AS based on On-Peak and Off-Peak clearing prices are shown in Figure-20, for the CAISO market. And, the calculated average values for the Regulation Down in the On-Peak and Off-Peak hours are $3.49 and $5.52 per MWh, respectively, for the CAISO market.