

**BEFORE THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR**

**CAISO 2014 2015 Transmission Planning  
TPP 2014-2015 Comments Due March 13,  
2014**

**COMMENTS OF ALTON ENERGY  
BISON PEAK PUMPED STORAGE PROJECT  
CAISO 2014-2015 TRANSMISSION PLANNING PROCESS**

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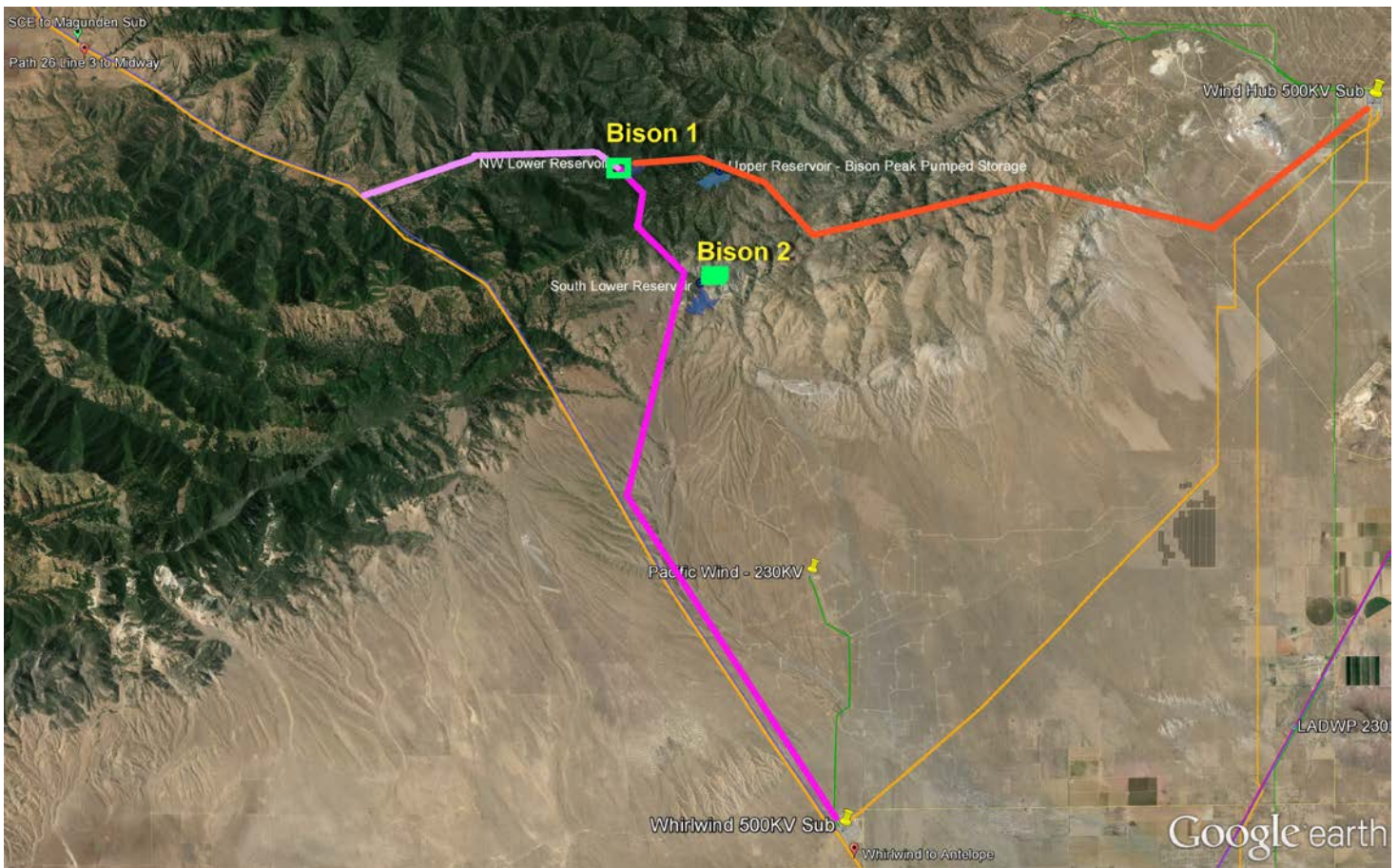
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## **I. CLARIFICATION AND INFORMATION ON BISON PEAK PUMPED STORAGE AND ITS ALTERNATIVE CAPABILITIES.**

We call attention to our submittal of January 16, 2014, copy attached, which provides substantial information on the Bison Peak Pumped Storage Project, and includes a number of helpful graphics on the project and its location. A copy of that submittal is included with this submittal.

Figure 1, below is a Google Earth Image of the vicinity of Bison Peak Pumped Storage, including Whirlwind Substation, Windhub Substation, Path 26 Line 3, Big Creek Corridor Lines 4 & 5, TRTP Lines, and the LADWP Corridor is shown at the bottom right which includes the HVDC Pacific Intertie and the 230 KV Owens Valley to Barren Ridge to Rinaldi Line that we understand is being expanded to include two additional 230 KV lines.



Bison Peak Pumped Storage has been organized into two primary phases, each of which may have phases internal to that phase. The entire project consists of man-made reservoirs, both the upper and lower reservoirs, and the system is fully closed loop with covered reservoirs for

very low water evaporation and loss. There is an Upper Reservoir area that will be composed ultimately of two reservoirs, one for Phase 1 and the other for Phase 2. Phase 1 is called Bison 1 in the above Figure 1, and Phase 2 is called Bison 2. Phase two is potential future capability, very similar to Phase 1, but is in the future and full dependent upon Phase 1 being completed and utilized successfully. So, the discussion here is for Phase 1 only.

Bison 1 is a world class Pumped Hydro Storage Project with a Head of approximately 2,400 feet, an ultimate storage capacity in the order of 12,000 MWH to 14,000 MWH. Hydro Equipment modularity is currently set at 250 MW and each Pump Turbine is planned as a doubly fed variable speed set of equipment, each with its own full capacity penstock for fully flexible operation, controllability, and response. Based on our understanding of an approximate 6 hour storage capability being near optimum in balancing cost and performance, Bison 1 can have an ultimate capacity of up to 2,000 MW with the initial plan being dependent upon market conditions and need, but a lower end size of approximately 1,000 MW is planned, with possibly 750 MW being feasible.

The electric system configuration is planned for each 250 MW pump-turbine to have its own doubly fed variable speed power converter and step up transformer with a high side voltage of 230 KV. The full development of Bison 1 is anticipated to be 2,000 MW which at 0.90 power factor equates to approximately 2,240 MVA or the full utilization of a standard double bank of 500/230 KV Transformers.

## **II. INTERCONNECTION DETAILS AT 500 KV OR 230 KV**

Interconnection to the grid could be at either 230 KV or 500 KV, depending upon the phasing and the desired integration with wind and solar generators that are interconnected at Whirlwind and Windhub Substations. If interconnection is selected at 230 KV, there is maximum flexibility, and each pump-turbine could be interconnected individually or in groups of the most convenient size, but most likely in groups of two pump-turbines or 500 MW and at 560 MVA for each single circuit Gen-Tie line. Alternatively, up to the entire Bison 1 capability at 2,000 MW could be first tied to a Breaker and a Half substation configuration at the Bison 1 Pump House and that linked into 500/230 KV transformers either in the CAISO Substation, or in a Bison 1 project substation a modest distance from the Bison 1 Pump House. We believe there is adequate room for the 230 KV transformers and substation at the Pump House, but not for the 500/230 KV equipment. Further, overall system losses are likely lower with a 230 KV configuration into Whirlwind or Windhub Substations, because of the way Pumped Storage would most likely be coordinated with wind and solar generation feeding into these same substations, typically also at 230 KV. In any case, the configuration of the interconnection can most likely be adapted to the optimum configuration for best reliability and efficiency.

Referring to Figure 1, three optional interconnection configurations are show, with each having the ability for the Gen-Tie to be at 230 KV or 500 KV. We think the most likely interconnection is the Red color line at Whirlwind, and most likely into the 230 KV bus. Such a configuration would allow Bison 1 to reduce peak generation onto the 500 KV system from the solar and wind peak generation and prevent overload of the 500/230 KV transformer banks, and

also likely reduce the need for additional 500/230 KV transformer capacity with potentially material savings in transformer banks, protection equipment, and in the short circuit duty contributed onto the 500 KV system. Alternatively, Bison 1 could have 500/230 KV transformation located near Bison 1, and then the Red color line to Whirlwind would be a 500 KV line. This line circuit distance is approximately 12 miles and is quite short.

Referring still to Figure 1, the Orange-Red color line to Windhub is quite similar in detail to the Red Color Line discussion above, except that it interconnects into Windhub. Due to the space limitations of access into the 230 KV side of Windhub, it may be that if Windhub at 230 KV is preferred, that a special arrangement using linking into some of the existing 230 KV lines from Windhub that go conveniently closer to Bison 1. We believe there are at least three candidate 230 KV lines that could be used for this purpose, but to be determined in the Study process, and potentially in discussion with rights holders. The circuit miles into Windhub is likely to be less than 15 miles in all alternative conditions.

Again referring to Figure 1, the Pink color line is the shortest distance for a Gen-Tie into the 500 KV system and would create a new 500 KV Switchyard or 500/230 KV Substation at the point where the Pink color line meets Path 26. A point of interconnection at this point may be the lowest cost option, and obviously is the least congested. The Bison 1 500/230 KV Substation could be built directly at the POI with Path 26, and could facilitate a number of useful options for grid expansion over the longer term. We note that the Path 26 line segment from Whirlwind to Midway is the only upgrade needed to likely increase the capacity of Path 26 materially. Further, it is likely that the Bison 1 routing Whirlwind-Bison 1-Pink POI environmentally may be acceptable as an expansion route for Path 26 through some or all of the sensitive Tejon property, and allow a way forward for expansion of Path 26 to Midway or Gates. These considerations may be particularly useful if or when Diablo Canyon retires, and Bison 1 or Bison 2 can provide reliable and flexible replacement capacity for that large generator, using much of the same transmission capacity currently being used by Diablo Canyon.

Referring again to Figure 1, the 230 KV Pacific Wind Substation is shown at its location less than 8 miles from Bison 1, and 5 miles from the future Bison 2. The potential exists to interconnect maybe 500 MW to that substation, provided effective integration rules are developed during the TPP 2014-2015 Planning Cycle, or in Cluster 7, and suitable arrangements can be worked out with the owner. A similar situation may exist if the planned Morgan Hills 230 KV Substation is built as planned. Current planning documents show that substation to be located within 1 to 3 miles of Bison 2, and convenient to Bison 1. Use of Morgan Hills would likewise require effective integration rules and cooperation with the owner. Morgan Hills should be able to interconnect an additional 500 MW, if conditions are suitable.

Figure 1 shows in green, two 230 KV lines originating in Windhub that may be useful for partial interconnection as well. These are approximately 8 to 10 miles from Bison 1. One line is SCE owned, CAISO controlled, and the other is currently a Gen-Tie line. Each line should be able to interconnect an additional 500 MW, with the same qualifications as above.

Figure 1 shows the clear potential to utilize two of the three Bison 1 Gen-Tie lines, if constructed at 500 KV as a future second circuit between Windhub and Whirlwind; or from

Windhub up to Midway or Gates; or from Whirlwind to Midway or Gates; or alternatively as part of such a future expansion. It is not the intention of this submittal to request the inclusion of such Gen-Tie lines into the CAISO TPP evaluation, unless CAISO sees an obvious need or benefit and chooses to bring that evaluation into consideration on their own initiative. However, we continue to recall the importance and potential expansion of the substantial solar and wind resources in this area, at the same substations, and the great potential value of having so significant a cost effective Pumped Hydro Storage resource so closely integrated.

### **III. CONFIGURATION ALTERNATIVES OF THE PUMP-TURBINE EQUIPMENT**

The planned base case configuration for the pump-turbine equipment is that each 250 MW pump-turbine be equipped with its own doubly fed variable speed controller, similar to a Type 3 wind turbine generator and controller. This configuration is well proven in Pumped Hydro Storage applications, as well as it is so well known with modern wind turbine generators. The doubly fed design lends itself to a balance of flexibility and efficient cost effective performance. Short circuit contribution to the Grid is rather limited, well known, and extensively modelled. Argonne National Labs has created a Pumped Hydro Storage Model that is available for PSS/E and we think also for PSLF. We understand the PSS/E model is directly included in and available in the latest releases of PSS/E.

An alternative highest performance configuration of the Pump-Turbine equipment is to use one or more Ternary Pump-Turbines, each at the same 250 MW rating and capability. The standard configuration of the Ternary design is that it utilizes a conventional Salient Pole Synchronous electric machine at constant speed. The Ternary design gets its very high performance from its configuration where it utilizes one 250 MW motor-generator, and achieves rapid and responsive flow variability by its circulating design. The Ternary design utilizes a separate pump and a separate turbine. A single purpose Pelton type turbine sits on top of the optimized assembly directly coupled to fixed speed synchronous motor generator, with a single purpose Francis type pump sits at the bottom of the assembly where it gets maximum suction Head. Sophisticated piping and valving links the assembly, creating a very efficient and responsive overall hydro system giving maximum flexibility and responsiveness. The Salient Pole electric machine is conventional similar to those on gas turbines, and of course has greater short circuit duty contribution to the 500 KV system, and is directly connected inertia onto the grid. It is possible to use a combination of pump-turbine types to optimize overall system performance and balance costs more effectively.

It is also possible to select alternative electric machine designs and pump-turbine configurations. We do not currently contemplate other alternatives, but such is possible, particularly due to the substantial number of pump-turbines that would be utilized on a fully developed installation. Such may be considered based on final system design, and if certain performance or cost objective adjustments are felt necessary.

#### **IV. SYSTEM PERFORMANCE**

The Bison 1 system design is one with extremely short, close coupling between the upper and lower reservoirs. While the Head is in the order of 2,400 feet, the highest head currently planned or operating in the United States, the total penstock distance between the upper reservoir and the pump-turbine equipment is only one mile. The high Head significantly reduces the water flow required to generate full power, or to develop full motor load. With short distances, exclusive use of penstocks to link the equipment is practical and efficient, and gives dramatically improved operating characteristics for the overall system, because each pump-turbine is individually controllable. Further, the short penstock distances and reduced flows improve overall efficiency.

Overall round trip system efficiency is anticipated to be in the order of 82.5%, possibly better. Accurate overall efficiency numbers will not be available until later in the design and project development process, but due to the high Head and very close coupling, we anticipate the overall round trip efficiency to be quite high.

Good dynamic performance and a broad or near infinite control of flow volumes is helpful and may be important for achieving highest flexible generating capability. The base variable speed pump-turbines, particularly at the higher overall system MW ratings will be good, but the very best dynamic performance and full range of flexibility is obtained from the Ternary design pump-turbine. However, there may be some loss of overall system efficiency with the Ternary design, due to circulating losses. Optimum design balance will be evaluated with overall system cost in later design stages. Current cost estimates used, based on the variable speed design show outstanding cost effectiveness and great economic potential from the use of this advanced equipment.

#### **V. PHASING**

Bison 1 is planned for between 12,000 MWH and 14,000 MWH of storage capacity. The project will be built in a module size of 250 MW. The tentative project design lends itself to a construction method and technology where phasing is not difficult to achieve with reasonable cost effectiveness. However, our current design and project performance studies have been based on 1,000 MW as the minimum size to initially build. However, we believe that if a smaller initial phase is necessary to match system or market need, such can be arranged with modest loss of cost effectiveness. If less than a full buildout of Bison 1 occurs in the first phase, that the additional add-on phases and work can be accomplished with little or no interruption of the initial phases, as long as we are able to so plan and construct, initially.

Bison 2 is not a part of Bison 1, but will be fully disclosed and initially planned in the permitting process for Bison 1. Thus, we anticipate that Bison 2 can be built in an orderly and cost effective manner, following Bison 1, according to market or system need.

Our current planning calls for completing construction and testing and reaching overall completion and commercial operation on a 250 MW module basis every 6 months.

## **VI. SCHEDULE**

The Bison Peak Pumped Storage Project has a FERC Preliminary Permit. However, Bison Peak is a completely of stream, closed loop synthetic Pumped Hydro Storage system that we believe meets all of the FERC criteria for not needing a FERC License to operate. We believe there are important advantages for Bison Peak to be permitted under local and state CEQA process permitting control, and if and to the extent that FERC NEPA evaluation is required, such can be accomplished in the Kern County as Lead Agency permitting process, which is experienced in such joint environmental processes. The local agency has a far better track record in achieving permitting schedules, in spite of having a more rigorous process to be qualified for the permitting to proceed. We have been working diligently to meet the standards necessary to begin the formal permitting process, and we anticipate submitting our initial application for Bison 1 within the next two months or so. Thus, we feel our planned schedule can be reliably met, and it is backed by a detailed development schedule.

We anticipate Start of Construction for Bison 1 to be April 1, 2017; start of Power House construction to start July 1, 2017; and start of Penstock, Pump-Turbine, and Electrical construction to start October 1, 2018. We anticipate first electrical energization to be approximately October 1, 2019; Trial Operation for the first turbine to start March 1, 2020; and Commercial Operation Date for the first turbine to be December 1, 2020. A second turbine could be ready for Commercial Operation on January 1, 2021. Additional turbines would follow at the rate of one additional turbine each six months.

## **VII. ALTERNATIVE TO TRANSMISSION EXPANSION**

We recognize the CPUC Guidance of February 27, 2014 given to CAISO for TPP 2014-2015 Planning Studies contains rather light amounts of variable generation additions by 2024 considering the substantial need represented by the ARB GHG Goals as expressed in their adopted Scoping Plan and processes, as well as is currently included in their in process Update to their Scoping Plan, scheduled to be adopted in 2014. We believe that the CAISO in its TPP 2014-2015 in fact conduct sensitivities and planning that is more representative of the more likely need for substantial addition of variable resources. We believe that appropriate study at these higher end policy levels will substantially increase the cost effective utilization of Pumped Storage. We believe there are a number of factors for CAISO to consider and evaluate in TPP 2014-2015 so that well located Pumped Storage is included as an effective alternative to Transmission Expansion and other alternatives.

One condition to be studied in TPP 2014-2015 is the retirement of Diablo Canyon in 2023. Bison 1 should be in a strong strategic position to serve as a zero carbon replacement for Diablo Canyon capacity, particularly when used supplementing the low capacity value zero carbon variable energy interconnected at Windhub, Whirlwind, and Antelope Substations, along with the variable resources associated with the Antelope-Bailey system that is falling under the control of SCE and away from CAISO, but which still delivers substantial variable energy into these CAISO Substations, and which are all connected and feed from these substations north to PG&E at the same points where Diablo Canyon now interconnects. We believe it is extremely

important that the zero carbon Diablo Canyon resource be replaced by a similar zero carbon highly reliable resource in the form of the variable wind and solar resource made very reliable and flexible by the addition of Bison 1, and which can also firm and shape the Over Generation anticipated by the substantial solar energy being anticipated and studied in this process. For this zero carbon generation to count toward meeting the ARB GHG Goals, it must be used to serve California Loads, any energy diverted out of state does not meet ARB GHG Goals.

Another factor to evaluate in TPP 2014-2015 is the alternative utilization of Bison 1 coupled with the substantial zero carbon variable generation associated with TRTP and the related locations above, coupled together to deliver cost effective zero carbon energy and capacity into the West LA Basin Load Center, and elsewhere in the Southern California Load Centers, such that Bison 1 coupled with this zero carbon generation, and with some modest small scale transmission expansion close to load, can serve as an effective capacity substitute. In particular, Bison 1, coupled with the stated zero carbon variable generation is so located that it can feed the Ventura and West LA Basin Area cost effectively with energy and flexible capacity. Modest upgrades to consider is the upgrade of Pardee Substation to 500 KV and better linking it to the load pockets in need of local capacity. The two 230 KV lines currently feeding Pardee are constructed at 500 KV, and only the substation upgrade is needed to increase the capacity in that area materially. From Pardee, as well as from Vincent, it would appear that when coupled with the recent transmission upgrades, including the planned Mesa Loop-in that Bison 1 and TRTP area zero carbon variable generation should materially assist in meeting the local capacity needs in these areas.

Yet another factor to evaluate is the coupling of Bison 1 with Out of State high capacity factor, low cost new wind energy coming into California from the vicinity of Eldorado and related, but made reliable and highly effective in combination with Bison 1 and local single axis Solar located in the vicinity of TRTP, and the major lines feeding those facilities.

We believe these three approaches, and potentially some variations from this will solve one or more needs being evaluated in TPP 2014-2015. See in particular graphic information and explanations: PDF Pages 7, 16, 20-24 or content Pages 5, 14, 18-22 of our January 16, 2014 document submittal, copy attached.

## **VIII. COST EFFECTIVE**

Planning cost numbers can be provided in an appropriate format. Generally, it may be best to evaluate Bison 1 on the basis of a Tolling Agreement for a system with a firm capacity of 1,000 MW with 250 MW increments, with six hour minimum capability, and pricing based on a capacity price stated in \$/KW-yr.

Alternatively, we have planning cost numbers for firm and shaped renewables on a \$ per MWH basis. In addition, we can provide planning cost numbers based on a mixture of the two approaches, with assumptions given.



**IX. CONTACT INFORMATION PROJECT SPONSOR**

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**X. CONCLUSION**

Alton Energy thanks CAISO for its attention to the issues and discussion presented in these comments.

Respectfully submitted,

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