

Rulemaking 13-09-011
Exhibit No.: _____
Witness: Lorenzo Kristov

Order Instituting Rulemaking to Enhance the
Role of Demand Response in Meeting the
State's Resource Planning Needs and
Operational Requirements

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**REBUTTAL TESTIMONY OF DR. LORENZO KRISTOV
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION**

1 **BEFORE THE PUBLIC UTILITIES COMMISSION OF THE**
2 **STATE OF CALIFORNIA**

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8 **REBUTTAL TESTIMONY OF LORENZO KRISTOV ON BEHALF OF THE**
9 **CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION**
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11 **Q. What is your name and by whom are you employed?**

12
13 **A.** My name is Lorenzo Kristov. I am employed by the California Independent System
14 Operator, 250 Outcropping Way, Folsom, California 95630.

15 **Q. Please briefly describe your employment and educational background.**

16
17 **A.** I have 23 years of experience in the electric utility industry, which began in 1991
18 working on demand forecasting at the California Energy Commission. In 1993 and 1994,
19 I worked in Indonesia as a Fulbright scholar on the development of a commercial and
20 regulatory framework to support private power investment. Then, at the end of 1994, I
21 returned to the California Energy Commission and for the next few years represented the
22 Commission in all the retail electric restructuring proceedings and stakeholder working
23 groups that were developing the rules for Direct Access. In 1999, I joined the CAISO in
24 the Department of Market Analysis and shortly thereafter became part of the internal
25 team formed to reform the CAISO's congestion management design. That effort was
26 unfortunately interrupted by the crisis of 2000-2001, but at the end of 2001 I was able to
27 reformulate the internal team and re-initiate the CAISO market redesign effort, which

1 was the project known as Market Design 2002 or "MD02," which later was renamed
2 MRTU. The MRTU initiative developed the new CAISO market structure based on the
3 locational marginal pricing (LMP) paradigm, which was successfully implemented in
4 2009. Since that time, I have continued to be involved in market design enhancements as
5 well as infrastructure policy initiatives, particularly to develop needed changes to the
6 CAISO's transmission planning and generator interconnection procedures to facilitate the
7 development of renewable generating resources and the expansion of diverse distribution-
8 connected resources. Currently, I am leading an internal CAISO team involved in
9 working with the CEC and the Commission to better align all three entities' infrastructure
10 planning processes and to holistically address issues arising with the proliferation of
11 distribution-connected resources. I received a master's degree in Statistics from North
12 Carolina State University, and a Ph.D. in Economics from the University of California at
13 Davis.

14 **Q. What are your job responsibilities?**

15
16 **A.** I am a Principal in the Market and Infrastructure Policy group, within the Market and
17 Infrastructure Development Division at the California ISO. In that capacity I participate
18 as either a team lead or a subject matter expert on numerous initiatives in the areas
19 summarized above.

20 **Q. What is the purpose of your rebuttal testimony?**

21
22 **A.** I was asked to address issues related to demand response (DR) market integration.
23 My rebuttal testimony focuses on the opening testimony sponsored by PG&E and SCE.
24
25

1 **I. RESPONSE TO PG&E TESTIMONY**

2 **Q. PG&E witness Jay Zarnikau provides testimony about the economic and reliability**
3 **attributes of load-modifying DR and the relative benefits and costs of any**
4 **requirement that such resources be formally bid into the CAISO as supply-resource**
5 **DR. How would you summarize your response to Dr. Zarnikau's testimony?**

6
7 **A.** My primary concern with Dr. Zarnikau's testimony is that he blurs the clear
8 distinction the Commission established between load-modifying and supply-side demand
9 response, although he begins his testimony by correctly quoting the Commission's
10 definition to characterize the essential difference between the two resource types. For
11 example, he first acknowledges the distinction that load-modifying demand response
12 reduces an LSE's net load, and thus may *reduce* the LSE's resource adequacy
13 requirement (RAR), whereas supply-side demand response is a resource that *counts*
14 *towards* the LSE's RAR and participates in the CAISO market. Then in A13 he
15 immediately ignores that distinction by stating that reshaping an LSE's load curve to
16 reduce its RAR is the same thing as meeting the LSE's RAR. Although he does not
17 explicitly say so, Dr. Zarnikau seems to be advocating a third category of demand
18 response: a resource that he refers to as "load-modifying," but that would act like a
19 supply-side resource, except that the LSE, and not the CAISO, would dispatch it. By
20 thus blurring the distinction established by the Commission, Dr. Zarnikau frames his
21 argument to address the question of whether load-modifying DR resources should be
22 required to participate in the CAISO market, instead of addressing what I view is the
23 implicit and more fundamental question Dr. Zarnikau is raising, namely, whether it is
24 appropriate to create a third category of DR that is a supply-side resource dispatched by
25 the LSE rather than by the CAISO. For the reasons discussed below, in my view it is not

1 appropriate to create this third category of DR, and moreover it was not contemplated in
2 the Commission's bifurcation decision.

3 **Q. What is the concern with an LSE dispatching demand response?**

4
5 **A.** In general, there is no concern with an LSE dispatching DR, as long as that DR
6 resource is not a supply-side resource designated to provide RA capacity to meet the
7 LSE's RAR. The fundamental principle is that if a DR resource is going to count for RA
8 capacity (in contrast to reducing an LSE's RAR), then it must be the CAISO who decides
9 when to dispatch it. This is crucially important with respect to DR because a supply-side
10 DR resource typically has a limit on how many times it can be dispatched during a given
11 month or season, or has some other limitation on its use. If the LSE is permitted to
12 dispatch a supply-side DR resource that is part of the LSE's portfolio of RA capacity,
13 there is no guarantee that the resource will be dispatched (or will even be available to be
14 dispatched) when it is most needed. Part of the CAISO's core responsibility is to commit
15 and dispatch available resources based on its full visibility into real-time system
16 conditions, including such things as the availability of alternative resources to balance
17 demand and maintain reliability, and the occurrence of any contingency situations. The
18 LSE does not have the same visibility to system conditions. As a result there is a risk
19 that the LSE will use up the limited dispatches of the supply-side DR resource at times
20 when its dispatch was not necessary, so that when the CAISO really needs the DR
21 resource it will no longer be available. This concern about when to dispatch supply-side
22 DR resources is at the heart of the requirement that resources counting towards an LSE's
23 RAR must participate in the CAISO market. If the LSE dispatches the supply-side DR
24 resource given its insufficient knowledge of all system conditions, this can result in the

1 CAISO being short of RA capacity under critical system conditions, thus leading to
2 higher costs and lower reliability than if the CAISO dispatches these resources.

3 **Q. Does Dr. Zarnikau correctly characterize the difference between load modifying
4 and supply-side DR resources with respect to RA requirements?**

5
6 **A.** Yes, on page C-8 (A12), he agrees with the CAISO that load modifying DR reduces
7 the *need* for conventional (RA) resources by reducing an LSE's net load, whereas supply-
8 side DR acts as a substitute for conventional generation resources to serve net load by
9 participating in the CAISO markets.

10 **Q. If you agree with Dr. Zarnikau on this point, why do you have concerns with his
11 testimony?**

12
13 **A.** In the very next answer (A13), Dr. Zarnikau begins to blur the distinction between the
14 DR categories by saying "Yes" when he should have said "No." That is, he says that
15 load-modifying DR can "help meet" an LSE's RAR, which is not correct. Load-
16 modifying DR can *reduce* an LSE's RAR, but only supply-side DR counts towards and
17 thereby "helps meet" the LSE's RAR, as he stated in A12. The precise wording matters
18 as we formulate the DR policy details, because it gets to the essence of the Commission's
19 bifurcation decision. Dr. Zarnikau continues the confusion in the next sentence of A13
20 with a reference to "lowering the need" for future resources. This is not the same thing
21 as "meeting the need." The example that he provides shows a *reduction* in RA resource
22 need, again not the same thing as *meeting* RA needs. Q.15 shifts the terminology again
23 by asking whether load modifying DR can be used to meet an LSE's "load obligation."
24 In this case, his affirmative answer may be acceptable, but only if by "load obligation" he
25 means the broader concept of the LSE having sufficient resources to meet its obligation

1 to serve its load. Clearly, lowering the LSE's net demand is one way of meeting its "load
2 obligation," but this is not the same as meeting its RAR. Dr. Zarnikau's imprecise use of
3 terms here obscures the fundamental principle that only supply-side DR should count
4 towards an LSE's RAR and receive RA payments, and in such cases the DR resources
5 must be available for dispatch by the CAISO.

6 **Q. What impacts does Dr. Zarnikau's imprecise use of terminology have on other**
7 **aspects of his testimony?**

8
9 **A.** Dr. Zarnikau's imprecise and inconsistent use of terms appears to be used to create
10 and justify a third "LSE-dispatched supply-side DR" category that really stands outside
11 the bifurcation established by the Commission. In order to avoid appearing to depart
12 from the structure of the bifurcation, Dr. Zarnikau is attempting to squeeze a new
13 category of DR into the load-modifying DR category where it really doesn't fit because
14 for all intents and purposes it has the characteristics of supply-side DR. Thus, Dr.
15 Zarnikau's argument about the high cost and lack of benefits from requiring load-
16 modifying DR to participate in the CAISO markets is not relevant (see his A31). The
17 CAISO is not insisting that all load-modifying DR participate in its markets or be
18 available for CAISO dispatch. Nor is the CAISO trying to stifle innovation by opposing
19 the expansion or the development of new types of load-modifying DR (see A28). What
20 the CAISO does emphasize is the need to assess the impacts of load-modifying DR
21 accurately for such purposes as calculating LSEs' RAR and for estimating demand-side
22 price elasticity, and to require all supply-side DR that is counted towards meeting RAR
23 to be dispatchable by the CAISO. Similarly Dr. Zarnikau's diagrams and examples to

1 illustrate the comparable impact load-modifying and supply-side DR can have on market
2 prices (see A17 – A25) are informative, but not relevant to the issues at hand.

3 **Q. What are your concerns with Dr. Zarnikau’s description of load-modifying DR on**
4 **the CAISO market operations?**

5
6 **A.** Looking specifically at Dr. Zarnikau’s A16, some of his bullet points reveal
7 misunderstandings about the structure of the CAISO market.

8 For example, in the first bullet point, Dr. Zarnikau states that an LSE can reflect the
9 impacts of a load modifying DR resource in its net load forecast. That is true enough.
10 However, in the CAISO market the LSE’s net load forecast does not play an explicit role.
11 The LSE may use its net load forecast to develop its bids into the day-ahead integrated
12 forward market (IFM), and it may or may not decide to modify its bids if its load forecast
13 is reduced by its intended dispatch of load-modifying DR. But the commitment and
14 dispatch of resources in the CAISO’s IFM are based on the submitted supply and demand
15 bids, not on any of the forecasts the market participants may consider in determining their
16 bids.

17 In the second bullet point, Dr. Zarnikau states that “the LSE’s notification to the
18 CAISO of planned activation of load modifying resource DR should enable the CAISO to
19 reduce its load forecast and alter its dispatch decision accordingly.” In concept, this may
20 appear reasonable. However, there is no mechanism for the CAISO to “alter its dispatch
21 decision” based on such notification, nor is this possible or desirable under the current
22 market construct. The IFM optimizes based on economic bids – notification from the
23 LSE does not factor in. The real-time market (RTM) dispatch is based on what’s actually
24 happening on the system, using short-term forecasts informed by the state estimator and

1 other telemetry. The only place where the ISO takes account of the LSE's intended
2 dispatch of load-modifying DR is in the day-ahead residual unit commitment (RUC)
3 procedure. But there are no energy prices created in this optimization because the RUC
4 does not issue energy dispatch instructions. Thus, Dr. Zarnikau's conclusion that LSEs'
5 intended dispatch of load-modifying demand response can directly factor into CAISO
6 dispatch decisions and the resulting prices is not consistent with how the CAISO markets
7 are actually structured.

8 In addition, Dr. Zarnikau offers this curious statement in the second bullet point:
9 "Given that PG&E notifies the CAISO of the amount of DR it plans to dispatch as well as
10 its location, there is sufficient time to enable the CAISO to use this information in its
11 dispatch model." The term "dispatch model" has no specific reference to a CAISO
12 market process and therefore the statement, while it may sound appealing, has no
13 practical meaning under the CAISO's market framework.

14 Dr. Zarnikau's final bullet point of A16 is particularly troubling. He makes the
15 statement that even without notification from the LSE, "the CAISO can, over time, learn
16 how various events trigger deployments of load modifying resource DR programs, as
17 well as program participants' actions." How exactly would the CAISO do this?
18 Apparently, Dr. Zarnikau believes that the CAISO would develop a smart algorithm that
19 observes the LSE's load-modifying DR dispatches over time and becomes able to predict
20 future LSE load-modifying DR dispatches accurately based on some exogenous factors
21 such as weather conditions, etc. Setting aside concerns about the cost in time and human
22 resources, not to mention the feasibility of developing accurate predictive models of LSE
23 dispatch behavior, suppose the CAISO develops such a model and uses it to determine

1 that, based on expected system conditions for the next day or the next hour, the LSE is
2 going to dispatch 100 MW of load modifying DR. What happens if the LSE dispatches
3 only 20 MW, perhaps because the limited number of dispatches of some of the load-
4 modifying DR resources have been used up and are no longer available. Dr. Zarnikau's
5 suggestion here underscores the fundamental principle I stated earlier. When it comes to
6 DR resources being counted towards LSEs' RAR, the critical point is who decides when
7 to dispatch these use-limited RA resources. If the DR resource is to count for RA it must
8 be the CAISO who decides.

9 **Q. At Q. 28 Dr. Zarnikau states that requiring all DR to be bid into the CAISO market**
10 **as supply-side resources could stifle DR innovation. Is this true?**

11 **A.** No. To be clear, the CAISO is not insisting that all DR be categorized as supply-side
12 and integrated into the market. Indeed, the CAISO has repeatedly stated that it supports
13 the benefits that load modifying DR can provide and expects that most existing DR
14 programs will be load-modifying. The CAISO is certainly not opposed to the LSE
15 developing a variety of load-modifying DR, and if the load impact of such DR is counted
16 accurately, there will be cost-reduction benefits through the reduction of the LSE's RA
17 requirement. The threshold requirement that must be satisfied if a DR resource is going
18 to function like a supply-side resource and be counted towards an LSE's RAR, is that the
19 CAISO must be able to dispatch it when and where needed to meet certain specific
20 system and local conditions.

22 **Q. Dr. Zarnikau states that both load modifying and supply-side DR can assist utilities**
23 **in managing local congestion on the distribution system (Q. 30). Do you agree?**
24

1 **A.** There is no problem with using load-modifying DR in this manner. However, if the
2 DR resource is supply-side DR and provides RA capacity towards an LSE’s RAR, then in
3 order to use the resource to manage distribution-system congestion, the scheduling
4 coordinator for the resource must notify the CAISO by means of an outage ticket that the
5 resource is not available for CAISO dispatch.

6 **Q. Dr. Zarnikau concludes his testimony with a discussion about how requiring “all or
7 most” DR resources to be dispatched by the CAISO does not necessarily lead to a
8 lower-cost or more efficient electricity market. What is your response to this
9 testimony?**

10
11 **A.** Once again, no one has suggested that all DR be bid into the CAISO market, only the
12 DR that is counted towards meeting an LSE’s RAR. Dr. Zarnikau’s concerns and
13 practical considerations in this regard are therefore not really relevant to the
14 Commission’s consideration of the two DR categories.

15 **II. RESPONSE TO SCE TESTIMONY**

16 **Q. At testimony page 11, SCE argues that two of its existing DR programs, Critical
17 Peak Pricing (CPP) and Peak Time Rebate (PTR), are “dispatchable” and therefore
18 should continue to receive RA credit, even though the Commission’s bifurcation
19 order (D.14-03-026) categorized these programs as load-modifying DR. Do you
20 share SCE’s concerns about these products?**

21
22 **A.** No, I do not. As I explained above in response to PG&E’s testimony, load modifying
23 demand response programs, if their impacts are properly accounted for, can reduce the
24 need for resource adequacy capacity, whereas supply-side demand response can count
25 directly as resource adequacy capacity and receive resource adequacy payments provided
26 it is available to the CAISO to dispatch when and where needed. Because the CPP and

1 PTR programs are not available for dispatch by the CAISO, they should not be counted as
2 RA capacity. If SCE operates its load modifying programs effectively so as to reduce and
3 flatten their load curve, then their load modifying programs will provide comparable
4 benefits to SCE in the form of reduced RA requirements.

5 **Q. SCE goes on to suggest that, should the Commission find that only supply-side DR**
6 **will receive RA capacity payments, the CAISO should adjust its rules and allow DR**
7 **resource aggregation across a D-LAP rather than limit aggregation to the sub-LAP**
8 **as is currently the policy, so that its CPP and PTR programs will be able to**
9 **participate as supply-side resources. Will the CAISO consider changing its tariff to**
10 **accommodate this recommendation?**

11 **A.** The CAISO does not support this recommendation, which has been expressed by
12 other parties as well and is also addressed by Mr. Laundergan in his rebuttal testimony.
13 SCE is arguing that it would be able to have its CPP and PTR resources participate in the
14 CAISO market if only the CAISO allowed resources to be aggregated over the larger D-
15 LAP. Thus, SCE and other parties are requesting that the CAISO relax the geographic
16 specificity of supply-side resources in the ISO market so that supply-side DR resources
17 would be dispatched at the D-LAP level, which is essentially an IOU service territory, as
18 opposed to being dispatched at the sub-LAP level, which is a sub-area of a D-LAP that is
19 defined by grid congestion.
20

21 Putting aside the matter of whether these resources would actually be dispatchable by
22 the CAISO, which I addressed in the last answer, there are important reasons why the
23 CAISO does not support the aggregation of supply resources to the D-LAP level. The
24 most basic reason is that when a supply-side resource is comprised of numerous
25 component facilities spread over a broader area of the grid, the CAISO cannot be certain

1 when it dispatches such a resource exactly where the response will occur. At the same
2 time, the locational marginal pricing (LMP) paradigm underlying the CAISO market
3 structure is explicitly designed to ensure that market dispatches are aligned with grid
4 conditions and the laws of physics, which govern how energy flows over the grid. In
5 particular, the LMP paradigm is designed to manage congestion, so that market
6 dispatches are “feasible,” meaning that they can flow on the system without overloading
7 any grid facilities or creating other conditions that may compromise reliable operation of
8 the grid.

9 The existing limitation of DR resource aggregation to the sub-LAP level is one of the
10 provisions necessary to ensure the alignment between market dispatches and physical
11 energy flows. The sub-LAPs have been defined so that congestion within a sub-LAP,
12 given the distribution of loads and resources on the grid, is infrequent, while congestion
13 between sub-LAPs is much more likely, even between sub-LAPs within the same D-LAP.
14 Thus, if a supply-side DR resource were to be comprised of component facilities
15 aggregated over the various sub-LAPs within a D-LAP, the CAISO would be unable to
16 ensure that its dispatch of such a resource would not cause congestion between two or
17 more of those sub-LAPs and create an operational problem for grid operators.

18 To provide a bit more historical context, the CAISO began operation in 1998 with a
19 simpler zonal market structure comprised of only two zones, one for northern and one for
20 southern California. (Shortly after start-up, the CAISO added a third intermediate zone
21 that was bounded by the two major north-south internal pathways, Path 15 and Path 26.)
22 Under this zonal structure, the CAISO’s day-ahead and hour-ahead markets only resolved
23 inter-zonal congestion at the interface points between the zones and at the points of

1 interchange with neighboring balancing areas. Thus, the original markets ignored intra-
2 zonal congestion or congestion within each zone. Before long, however, the zonal model
3 was shown to be problematic because intra-zonal congestion cannot be ignored in real
4 time. When the energy actually flows, it obeys the laws of physics. This meant that
5 zonal-based market schedules created in the day-ahead or hour-ahead market were often
6 infeasible due to intra-zonal congestion that was ignored when the schedules were
7 established. CAISO operators then had to re-dispatch resources in the real-time market to
8 undo infeasible day-ahead or hour-ahead market schedules, often at considerable expense
9 to buyers in the market. This problem was one of the factors that led to the CAISO's
10 development of the LMP or "nodal" market, called the Market Redesign and Technology
11 Upgrade (MRTU) initiative which began operation in 2009.

12 The point of this lengthy discussion is that enabling D-LAP aggregation and dispatch
13 of DR supply-side resources would be a step backwards to a market structure that was
14 much less effective and efficient than the LMP markets we have today and certainly not
15 compatible with evolving smart grid capabilities. The grid locations where supply
16 resources inject power or reduce load matter. In fact, the sub-LAP aggregation of DR
17 resources is already a compromise in and of itself. The fact that sub-LAPs are
18 determined so as to minimize the frequency of congestion within a sub-LAP is not a
19 guarantee that congestion will never occur, only that it will be infrequent enough not to
20 create significant operational problems. The CAISO determined that this was an
21 acceptable compromise for the sake of enabling small DR resources to be aggregated
22 over a reasonably sized geographic area where the individual constituent loads can be
23 distributed among a number of specific nodes for dispatch in the CAISO market

1 optimization. Based on the explanation above, the CAISO would not support aggregation
2 of supply-side DR resources beyond the sub-LAP level.

3 **Q. Does this conclude your testimony?**

4
5 **A. Yes.**

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