

2016 Demand Response Integration Efforts Review

February 22nd DR "End of Year" Workshop

Agenda

□ Overview of Integration Efforts in 2016

- CAISO, SCE, SDG&E, PG&E, & Olivine perspectives

□ Key Successes / Challenges in 2016, and Key Trends Going Forward

- Registration of PDR/RDRR at the CAISO
- Bidding into the CAISO markets
- Dispatch by the CAISO
- Settlement with the CAISO
- DRP-IOU DRAM-specific issues
 - DRAM contractual details that impact DRPs' ability to integrate in CAISO.
- Miscellaneous

HIGH LEVEL OVERVIEW OF 2016 INTEGRATION

CAISO 2016 Integration Efforts

Successes

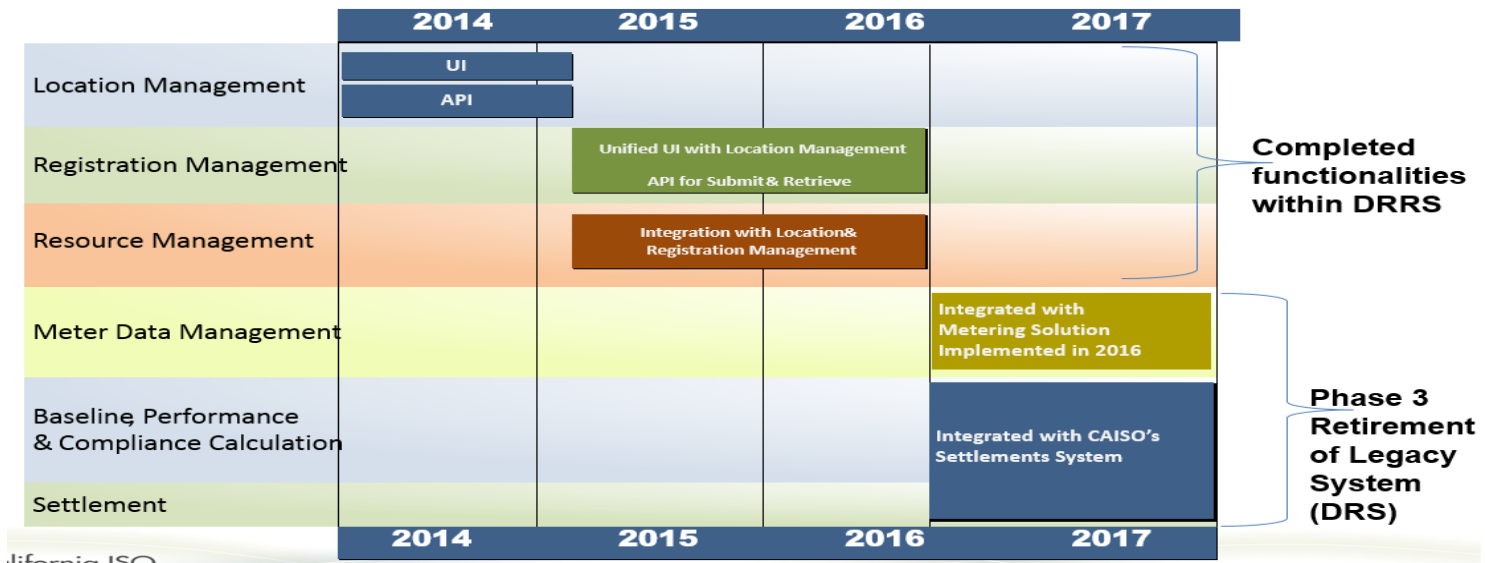
- Demand Response Registration System (DRRS) Phase 2 Enhancements
 - Deployed November 30, 2016
 - Providing greater registration flexibility, workflows and additional APIs
- Sub-LAP boundaries effective 1/1/2017 aligned with RA local capacity areas
 - Coordination of registration activities allowed for successful transition to new Sub-Laps
 - Resource Adequacy (RA) processing timelines were met for revised Sub-Laps
- Distributed Energy Resource modeling enhancements
 - Resource can now be created on demand without a Full Network Model (FNM) update
 - Significantly reduces processing timelines for resource ID requests
- Energy Storage and Distributed Energy Resource (ESDER) Policy
 - ESDER phase 1 Implemented
 - ✓ Additional baselines recognizing behind the meter generation (MGO)
 - ✓ Statistical sampling methodology clarification
 - ESDER Phase 2 policy development progressed in 2016
 - ✓ Baseline Working Group finalizing proposals by end of March 2017

CAISO 2016 Integration Efforts

Challenges

- Performance degradation of Demand Response legacy system providing meter data management, baseline and performance calculation functionalities
 - Re-tuning required to accommodate increased data streams into system
 - System variances resulting in performance calculations not completed to meet Settlement timelines
 - Missing Demand Response Energy Measurements (performance data) in Settlements

Functionality Consolidation & Timeline



SCE's Integration Efforts in 2016

- ❑ SCE integrated 70 resources with over 1,100 MW of capacity in Q3 of 2016
 - 19 PDRs and 51 RDRRs from Capacity Bidding Program (CBP), Aggregator Managed Portfolio (AMP), Agricultural Pumping Interruptible (API), Base Interruptible Program (BIP), & Summer Discount Plan (SDP) containing Bundled & Direct Access customers
 - Portions of the programs not integrated due to not meeting CAISO's minimum resource size requirements or operational complexity for SCE
 - When awarded, full program MW are dispatched
 - SCE resource count increased to 75 in 2016 due to the splitting up of two AMP resources in lieu of installing telemetry (i.e. the resources were larger than 10 MW)

Registered vs Non-Registered MW for Integrated Programs							
	<u>CBP1-4</u>	<u>CBP2-6</u>	<u>AMP</u>	<u>BIP</u>	<u>API</u>	<u>SDP</u>	<u>Total</u>
Registered MW	3.6	0.0	64.0	623.9	56.1	285.3	1,032.9
Non-Registered MW	6.8	6.1	54.1	74.4	0.4	3.0	144.9
Total MW	10.5	6.1	118.1	698.3	56.5	288.3	1,177.8

* Table reported in DR Application 17-01-012 filed on January 17, 2017

SCE's Integration Efforts in 2016 (Cont'd)

- ❑ SCE encountered significant challenges during integration and required several accommodations from CAISO. Key issues included:
 - Bulk registration of more than 300,000 Service Accounts
 - Update frequency of resource registrations
 - Discrete dispatch and granularity of dispatch
 - Self-Dispatch of Day-Of resources outside of Real-Time Market (RTM)
 - Use of hourly meter data for RDRR settlement in RTM
 - Telemetry waiver for resources greater than 10 MW
 - Dispatch response time (40 minutes for RDRRs; 20 minutes for Local RA counting)
 - Submission of outages in OMS After-the-Fact

2016 Integration at CAISO

- Overview of SDG&E's own DR Integration
 - Currently two Proxy Demand Response Resources (PDRs) bidding into the Day-Ahead Market
 - Capacity Bidding Program, partially integrated.
- CBP Integration
 - Two PDR Resources
 - Manage of more than 300 Service Accounts
 - Still partially updating data manually in our systems
- Base Interruptible Program (BIP) integration is in progress
 - Will be Reliability Demand Response Resource (RDRR) in 2017.

- ❑ PG&E focused on deploying the technologies to support RDRR and PDR for its non-pilot programs

D.16-06-029, Ordering Paragraph 23(g):

PG&E shall adhere to the milestones and deadlines it proposed in Table 1 of its March 24, 2016 comments, including items i. through iv below. Deviation from these items shall be noticed, within 30 days, by letter to the Rulemaking 13-09-011 service list or its successor service list.

- Completion of Customer Management System in the fourth quarter of 2016;
- Completion of Control Center Application and Process Orchestration Systems in the first quarter of 2017 for BIP, and the third quarter of 2017 for CBP and SmartAC;
- Completion of the registration of BIP resources as RDRR no later than May 1, 2017; and
- Completion of the registration of CBP and SmartAC no later than January 1, 2018.

- ❑ PG&E's integration efforts in 2016 included the Supply Side Pilot (SSP) and DRAM
 - ❑ Contracted with Olivine, Inc. to be program administrator and scheduling coordinator (SC) for the SSP: 4 PDRs with ~ 1 MW in the day ahead market, one of which also participated in the real time energy market

REGISTRATION OF PDR/RDRR AT CAISO

CAISO - 2016 Registration Activities

- Successfully processed 2016 resource registrations prior to enhancement deployment
 - Registration gap issue did not materialize as a limitation

- DRRS Enhancement Phase 2 successfully **deployed November 30**
 - Participants provided with the capability to automate registration processing interfaces
 - ✓ Submit/Retrieve Locations
 - ✓ Submit/Retrieve Registrations
 - ✓ Retrieve DR Batch Status
 - ✓ Submit/Retrieve Locations Review

- Training provided and continued individual attention given to help Stakeholders build their system interface

- Minor variations from design affecting user experience quickly remedied

- Participants have expressed desire for further enhancements, CAISO will be compiling and requesting prioritization by Stakeholders for future implementation

SCE's Registration of PDR / RDRR at the CAISO

- ❑ The CAISO requires that all of the SAs in a PDR/RDRR be of the same UDC, DRP, and LSE
 - This would result in about 170+ resources at SCE
- ❑ With some delays, the CAISO successfully deployed the DRRS in late fall
 - This is a major improvement in the registrations process
 - Registration gap is eliminated and registration updates should happen more frequently
 - There are still several areas that need to be improved
 - Install API to extract Resource IDs for more automated registration processes
 - Increase the limit for the extraction of the location statuses



PG&E: Registration of PDR / RDRR at the CAISO

- ❑ System connectivity to CAISO DRRS: testing in progress
 - ❑ Includes ability to start the enrollment process and include location registration as an eligibility requirement
- ❑ LSE approval for unbundled customers: 11 LSEs for BIP (~130 MW), 14 LSEs for CBP (~8 MW in 2016), 1 LSE for SSP
- ❑ BIP as RDRR
 - ❑ Anticipate 39 RDRRs with over 280 MW
 - ❑ Islanded customers (those not meeting CAISO's minimum resource size requirements) represent ~4 MW
 - ❑ Key question: if a customer is interested in DR, but we are unable to include them in a CAISO resource, should they be penalized and removed from DR?

CAISO

- Old DRRS and expected transition issues
 - Registration gaps (impacted Seller delivery)
- 2017 Issues:
 - 2017 Sub-LAP realignment
 - Resources dropping from Masterfile

IOU

- Enrollment
 - SCE alternate (GBC) method had customer ID uniqueness issues (making it unusable for even small residential aggregations)
 - Inconsistent messages from IOUs
- Missing Rule 24/34 data
 - Incomplete customer data attributes, delaying customer registration
 - Ongoing issue (e.g., 250 locations still outstanding from December)
- Incorrect conflicts of locations by IOU
 - IOU retaining in own resource (duplicates)
 - Related to IOU program drops (timing)
 - Rejected third-party re-registering own locations

BIDDING INTO CAISO MARKETS

CAISO - 2016 Bidding Activities

Bidding functionalities working as designed for PDR/RDRR use cases

- Day-ahead
 - Economic for both PDR and RDRR
 - Resource Adequacy requirements (availability per supply plan)
- Residual Unit Commitment (RUC)
 - Resource Adequacy requirements (\$0/MW RUC Availability Bids)
- Real-Time
 - Ensuring resource is set up appropriately in Masterfile
 - ✓ Must not be set for day-ahead only participation
 - ✓ Start Up/Ramp Rate/Constraints (i.e. minimum up time)
 - Economic for PDR, emergency for RDRR (95% of bid cap)
 - Resource Adequacy requirements (remaining RA capacity from resources scheduled in IFM or RUC)
- Telemetry requirements integrated into Direct Telemetry BPM Version 9.0 on May 25, 2016 (Integration Working group deliverables)
 - Expanded to 5 minute updates

SCE's Bidding into the CAISO markets

- ❑ Inability to submit “dec” bids for RDDR resources in Real-Time Market (RTM)
 - RDRRs with a Day-Ahead economic award cannot provide a decremental bid in RTM
- ❑ Inability to specify maximum run hours per day constraint for resources
 - Maximum Daily Energy Limit can be used as a proxy, but has limitations
- ❑ SCE DR resources have different limitations for Day-Ahead and Real-Time Markets, but CAISO does not allow for differences
 - E.g. maximum daily energy limits, number of starts, etc.
- ❑ Setting Pmin other than 0 and the need to specify a minimum load cost for resources that have implied market heat rate triggers
- ❑ Submission of outages in OMS After-the-Fact is time-consuming
- ❑ Will use-limited outage cards be available per RSI 1?
- ❑ Proposal to change availability assessment hours to later in the day. (PRR 914)
 - Study, proposal and recommendation expected by July 2017, for 2018 compliance year.
- ❑ RA Availability Incentive Mechanism (RA AIM) penalty exposure
 - Each resource must be bid at Pmax (QC) to avoid penalties
 - DR resources cannot be de-rated in OMS, and partially replaced

SCE's Bidding into the CAISO markets

- ❑ CCE 3 opportunity cost modeling for PDR registering as use-limited resource (ULR)
 - ULR registration process may need clarification (e.g. proving ULR status at program level, proving ULR status for DRAM contracts)
 - Start-up and min-load costs can only be updated monthly
 - Availability of use limit reached outage cards for non-ULR PDR for fatigue and monthly use limits
- ❑ Telemetry requirements (cost issues)
 - Telemetry is required for resources over 10 MW, resulting in breaking apart larger resources, increasing bidding challenges
 - Telemetry will be required for spinning reserve and regulation
- ❑ Challenges associated with operations for potentially 170+ DR resources to extract full RA value for the resources



- ❑ No bids were submitted from PG&E's non-pilot programs in 2016
- ❑ 4,476 day ahead bids and 458 real time bids submitted through the SSP in 2016
- ❑ Bidding processes and outage management
 - ❑ Clarity on bidding requirements, i.e., bid anytime the resource is available independent of RA assessment hours; consequently, awards/dispatch outside of RA assessment hours count towards dispatch exposure
 - ❑ Outage to be submitted if that resource (or portion of it) is utilized for an out-of-market event (e.g., T&D use of DR or a retail event impacting dual participants)

Supply Side Integration

- SIBR, CMRI and ADS integration straightforward
- Disconnect on CPUC and CAISO RA rules for day-ahead resulted in RT dispatch, resulted in bidding RT to “protect” from happening

DISPATCH BY THE CAISO

CAISO - 2016 Dispatching

Dispatching functionalities working as designed in 2016 for PDR/RDRR use cases

- Two dispatch related issues corrected in 2015 had impact to 2016 settlements
 - RTD dispatching RDRR resources to zero
 - Incorrect calculation of dispatch operating points (DOP) resulted in expected energy calculation errors
 - ✓ incorrect event start and end times in baseline development
 - ✓ Incorrect load point adjustment development
- Automated Dispatching System (ADS) RDRR dispatches unique
 - Receive economic day-ahead awards and bid as an emergency resource in real-time
 - Providing participants training and market simulation opportunities to learn dispatch behavior
- Participants receiving real-time five minute dispatches as expected
 - Minimum up time constraints being met when $P_{min} = 0$
- Load return after DR dispatch period is over
 - Creates real time deviations for operators to manage
 - How to model load return after the dispatch period is over for significant amount of DR dispatch
 - Interim solution in place with IOU's need to extend to third party DRP's

SCE's Dispatch by the CAISO

- ❑ SCE received Day Ahead economic PDR and RDRR awards frequently in 2015-2016. There were no reliability awards in the Real Time Market.
- ❑ Continuing operations challenges include:
 - Cycling of SCE resources between Pmin and Pmax or a partial award in between
 - SCE to re-register resource Pmin closer to Pmax where possible
 - The lowest granularity that may be dispatched for some programs is program x SLAP
 - If there are two resources within the same program x SLAP combination, the two resources will need to be dispatched together
 - Inability to specify maximum run hours per day constraint for resources
 - Maximum daily energy limits are used as proxies but is imperfect
 - CAISO treating an award to 0 MW (i.e. Pmin) as a dispatched hour
 - CAISO Day-Ahead market awards published after 1 p.m. (as late as 4:30 p.m.)
 - Operational complexity of participating in the CAISO market using internal systems
 - SCE currently automating more processes via improvements to internal IT systems
 - Self-Dispatch of Day-Of resources outside of Real-Time Market (RTM)
 - Dispatch response time (40 minutes for RDRRs; 20 minutes for Local RA counting)
 - Limitation in the number of messages that may be transmitted by SCE's Direct Load Control systems

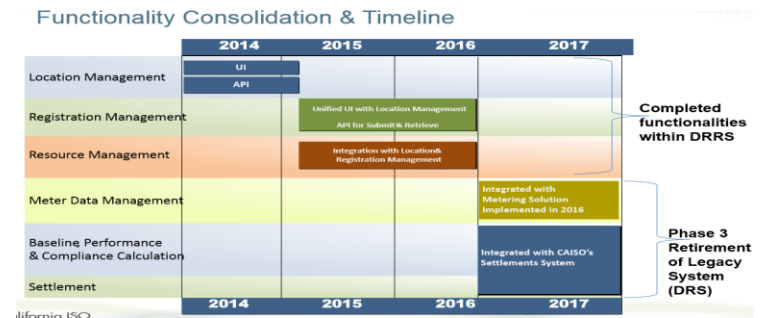
- ❑ No awards/dispatch instructions were received for PG&E's non-pilot programs in 2016
- ❑ 462 day ahead awards in the SSP in 2016
- ❑ ADS dispatch instructions
 - ❑ The Dispatch Operating Point (DOP) and the Dispatch Operating Target (DOT) provide the start-up and shutdown instructions for RDRR dispatch, respectively
 - ❑ Since DOT provides 5-minute dispatch instructions, DRPs (and therefore, also customers/aggregators) will not have visibility on event duration at the start of the event

SETTLEMENT WITH THE CAISO

CAISO 2016 Settlements

Participants experienced inaccurate settlements of their resources due to errors in post processes performed in Legacy Demand Response System

- System configuration changes were made as issues were observed and root cause identified throughout 2016
 - To date, processing issues still continue to be observed intermittently
- CAISO is undertaking a comprehensive review of 2015/2016 processing of PDR/RDRR market activities and settlement
 - Identification of all settlement disputes
 - Validation of dispute resolutions retroactive and prospective settlement corrections
 - Developing timeline for complete resolution of settlement disputes
 - Implementing additional monitoring controls to identify and expedite resolution
- Legacy system replacement planned for 2017
 - Migrate remaining functionality into robust systems
 - ✓ Meter data management and Settlements
 - Stakeholder input needed for implementation planning
 - ✓ Meter data submittal interfaces changed



SCE's Settlement with the CAISO

- ❑ CAISO settlement statements not matching SCE's resource performance calculations
 - Examples:
 - Missing or incorrect bill determinants (e.g. meter) in settlement statements
 - Incorrect interpretation of performance data as meter data by CAISO systems
 - Large charges in instructed energy that offset the payment received from Day-Ahead award
 - Missing settlements in Demand Response System (DRS)
 - Incorrect calculation of the Day-Of adjustment for DA-only resources
 - CAISO recognized the issues and is working with SCE to resolve issues and recalculate settlements when necessary
- ❑ Continuing challenges with baseline calculation
 - Impact of the Day Of Baseline Adjustment cap of +/- 20% on SDP (AC Cycling)
 - Baselines Working Group (BAWG) developing proposals for improved baselines
 - Residential: Control group, 5-in-10, Weather Matching
 - Non- Residential: Control group, 10-in-10, Weather Matching
 - Proposal due to CAISO BOG by July, hopefully implemented in time for 2018
- ❑ Meter data submission size limitations in current DRS
- ❑ Inability to efficiently extract the performance calculation of the DR resources from DRS
- ❑ Submitting load data—not net load—of NEM customers for PDR/RDRR settlement



- ❑ No CAISO settlement activities occurred for PG&E's non-pilot programs in 2016
- ❑ Creation of new PG&E SCID to mitigate risks encountered by SSP with DRS
- ❑ CAISO Baseline Accuracy Working Group (BAWG) proposal for improved baselines would inform PDR integration for residential programs

CAISO Challenges

- Baseline challenges
 - Incorrect handling of day types and holidays. For example, July 4 treated as a weekday
 - Event days included in baseline calculation on registration change
- Challenges in receiving RQMD from IOUs impacted settlements

CAISO Challenges

- Disappearing events from DRS
 - Many events in the market never make into DRS or disappear after the fact.
 - This results in no energy settlement.
- Lack of valid energy settlements
 - In a very high percentage of cases pseudo-generation performance from DRS does not make it to CAISO Settlements
 - Results in clawback of all delivered energy at RT IIE price (i.e., resource is paid at DA and pays back at RT)

DRP-IOU DRAM-SPECIFIC ISSUES

CAISO 2016 DRAM Participation

CAISO market participation was successfully enabled for DRAM in 2016

- DRAM awardees new to CAISO market participation
 - Uptick in resource time needed to respond to inquiries on participation requirements
 - Referring those inquiring to available training material, business practice manuals and Demand Response System user guide for specific PDR/RDRR requirements and processes

- Resource Adequacy processing timelines met in 2016 with higher level of coordination than expected
 - Impacted by Sub-Lap boundary changes and new Demand Response Providers

- Testing of RDRR's to meet DRAM contract obligation needs clarity
 - CAISO has tariff provisions which allows for coordination of an annual test
 - Requesting participants input to Operating Procedures to clarify specifics to RDRR testing
 - ✓ Operating procedures 5330 and 3220

DRP-IOU DRAM Specific Issues (SCE)

- ❑ DRPs, IOUs and the CAISO worked through many challenges to enable the DRAM Pilot
 - While performance needs to improve, the end-to-end process was successfully demonstrated, with RA MW delivered and dispatched.
- ❑ Rule 24: Click-through process is being developed / improved
 - SCE filed AL on 1/3/17 and received a few protests, awaiting a Draft Resolution
 - The AL and reply to protests stated that SCE would support most click-through features requested by the DRPs
 - SCE expects to implement Click-Through in 4th Quarter 2017
- ❑ Rule 24: Registrations
 - So far, number of available registrations has not been a limiting issue in SCE area
 - IOUs filed ALs on 2/7/17 requesting an increase in available registrations

DRP-IOU DRAM Specific Issue

- Registration of DRAM resources is far from estimated number
 - Current Registrations are around 1/3 of what was estimated to be needed for DRAM in 2017
- Resource IDs to support multiple contracts
 - Adding the complication when contract ownership transferred
 - Timing of obtaining available Resource IDs

Number of Rule 24 Registrations has not been a limiting factor for DRAM

DRAM contract Section 1.5(b): DRPs can submit a lower capacity than the contracted amount for a given month, provided that this is due to either (i) actions or inaction by the IOUs or the CAISO, or (ii) insufficient Rule 24 registrations under Conclusion of Law 10 in D. 15-03-042 being available to Seller, and the DRP can demonstrate commercially reasonable efforts they have undertaken to reach the contracted amount

Disconnect on reported capacity

- DRPs provide capacity amounts to the IOUs 60 days prior to the Showing Month (in accordance with Section 3.1(a)), which don't match the capacity amount they submit to the CAISO 45 days prior (in accordance with Section 3.1(b))

MISCELLANEOUS

CAISO Miscellaneous Observations

- More flexible DR program designs needed
 - Tailored to customer capabilities and aligned with grid attributes
 - Ability to combine multiple retail programs into wholesale DR resources

- More robust DR dispatching systems and algorithms
 - Incremental dispatch capability
 - More precise locational dispatch (sub-lap and sub-area)

- Telemetry
 - Telemetry as a service using existing advanced metering infrastructure
 - Explore alignment between transmission and distribution system telemetry requirements

Miscellaneous (SCE)

- ❑ Local RA Counting for DR resources (i.e. the 20-minute issue)
 - RA OIR and the CAISO TPP are currently addressing Local RA requirements for DR
- ❑ End-to-end Implementation of DR bifurcation
 - Showing DR resources in the Supply Plan
 - Impact on bidding requirements and potential penalties (e.g. RAAIM)
- ❑ The CAISO successfully implemented the SLAP re-alignment
 - This simplifies mapping of PDR/RDRR to Local RA areas
- ❑ Reports
 - Submitting the MW “crumbs” to the CAISO and CPUC. Is this currently being used and is it needed?
- ❑ Enforcement of Distributed Energy Resource Aggregation restrictions for PDRs and RDRRs
- ❑ Potential of unannounced RDRR testing by CAISO

Miscellaneous Issues

- Supply Plan
 - Supply Resource CBP is being counted towards SDG&E's RA compliance filing and are allocated to SDG&E as Demand Response Credits.
 - No Supply Plan has been submitted to CAISO on CBP PDRs.
 - Regulatory requirements for 2018 Bifurcation

PG&E: Miscellaneous

Supply Plan and Resource Adequacy

- For 2017, RA for DR programs were incorporated in the load forecast; and therefore, a Supply Plan was not submitted to prevent double counting
- Will this guidance hold for 2018?
- Need to understand how to obtain NQC from CAISO

Disconnect on RA Rules

- Disconnect on DA rules in RA
 - 2016 DRAM was day-ahead program
 - CAISO does not respect day-ahead-only RA
 - RSI 1a does not mitigate RUC issue in any way
- Disconnect on NQC
 - DRAM order sets NQC to be contracted value
 - DRAM contracted values are not per market resource
 - Seller therefore must assign contracted value across resources
- NQC mismatch for changing DR resources
 - CAISO observes NQC as only increasing, once set
 - DR resource “size” may increase and decrease by season
 - DR resource may complete change underlying locations
 - PMax as limiter for RAIM participation