Slice-of-Day Showing Tools and Validation Logic

RA Reform Workstream 1

8/3/2022

24-Hour Slice Framework Tools

RA Resource Master Database (from Appendix A)

- Contains a list of all resources (within the CAISO) eligible to sell RA, their resource ID, their maximum RA capacity, and hours of availability within a 24-hour window
- For solar and wind, identifies the profile associated with the resource.
- For storage, includes the charging efficiency and maximum continuous energy
- For hybrid and co-located resources, includes configurations to describe capabilities
- Contains data for each month
- Information is public and available to inform trading and resource portfolio development

LSE Requirement Database (from Appendix A)

- This will populate the LSE allocation tab used in the LSE compliance showing
- Contains the official requirements of each LSE (hourly load + PRM), by month, for all 24 hours
- Is used by each LSE to determine its monthly 24-hour showing requirement
- Is used by the Commission to ensure each LSE meets its monthly 24-hour showing requirement
- Is developed by the Commission in communication with the CEC after the CEC finalizes the monthly, 24-hour load shape for each LSE
- Database is non-public. Each LSE has access to only its requirements; the Commission has access to all data

LSE Showing Tool (from Appendix A)

- Spreadsheet tool used by each LSE to submit their monthly, 24-hour showing to the Commission
- Contains a standard format for listing the resources in an LSE's portfolio including the resource ID found in the Master Database, their MW quantity associated with the must-offer requirement, and the capacity used in each of the 24 hours of the showing
- The tool should include pass/fail logic identical to the Commission Verification Tool, so LSEs know in advance if they will pass Commission verification
- This showing may also be used to provide CAISO the information it will need to determine the must-offer requirements of all resources, and the correct RA capacity values to use when performing their single-hour deficiency test

Commission Verification Tool (from Appendix A)

- The tool is designed to use the data submitted through the LSE Showing Tool
- The Commission uses the data submitted by the LSE in its showing, in conjunction with the RA Resource Master Database, which will include solar and wind profiles to determine if an LSE passes the 24-hour RA requirement in each month
- The tool contains basic logic to ensure the showing is consistent with the capabilities of the resources submitted, that sufficient capacity has been brought to meet the LSE's requirement in all 24 hours, and that sufficient excess capacity has been shown to meet the capacity requirements for storage
- LSEs must pass all 24 hours, all logic tests, and the excess capacity requirement to pass the showing
- The tool notes any hour(s) of failure along with the maximum capacity shortfall within the 24 hours

Slice-of-Day Showing Validation Logic

Resource Tests (1/2)

- Wind/Solar/Imports/DR
  - Showing in each slice <= appropriate hourly ELCC shape
- Geothermal/Biomass/Hydro/Thermal
  - Showing in each slice <= NQC (or appropriate shape if we're doing capacity exceedance shapes for everything)
  - Showing within daily availability hours
    - First hour available <= Showing hour <= Last hour available
  - Shown hours <= Maximum daily run hours
    - (Number of hours showing >0 MW) <= Maximum daily run hours
- Single-cycle storage
  - Showing in each slice <= NQC
  - Shown MWh <= Maximum continuous energy (Storage MWh)
- Multi-cycle Storage (if available)
  - Showing in each slice <= NQC
  - Shown continuous MWh <= Maximum continuous energy (Storage MWh)
  - Total shown MWh <= Storage resource maximum daily MWh
    - Pmax*(hours available per day/cycle length)
    - Cycle length = (1+1/storage efficiency)
  - "Downtime" hours immediately prior to storage showing block to support charge capacity
    - Shown "downtime" hours prior to showing block >= (Shown block MWh/storage efficiency)/Pmax

Resource Tests (2/2)

- "**Paired**" (**storage only charges from associated renewable under normal circumstances**)
  - "Paired" showing should be bifurcated for ease of validation even if single resource ID
  - Gross level validations:
    - Total MWh shown + storage efficiency losses <= total daily MWh of renewable portion
    - Sum of "Paired" showing in each slice <= interconnection limit
  - Component level validations:
    - Storage component shown within storage capabilities (see storage validation)
    - Renewable component showing must have storage MWh and efficiency losses removed from appropriate shape
      - Renewable component showing in each slice <= appropriate shape
      - Renewable component total shown MWh + storage charging requirements <= appropriate shape MWh

LSE Portfolio Tests

- Sum of each slice showing >= reliability requirement in each slice
- Sum of slice showings + excess capacity for storage >= sum of reliability requirements
  - Excess capacity for storage is sum of each storage showing MWh/Each resource storage efficiency
- Non-slice-of-day
  - MCC bucket tests as appropriate
  - Flex RA tests as appropriate
  - Local RA tests as appropriate

Aggregated Portfolio Tests (all LSEs)

- For each resource:
  - Sum of each hourly showing <= to relevant shape or NQC
    - Failures should be truncated in aggregated showing tests
  - Shown hours <= daily hour limit
- Aggregated:
  - Aggregated showing in each slice >= reliability requirement in slice

Tool Examples From Previous Workshops

RA Resource Master Database

Resource Name	Technology	Capacity (MW)	Maximum Daily Run Hours	Storage Efficiency	Maximum Continuous Energy	First Available Hour (HE)	Last Available Hour (HE)	Profile	Hybrid Renewable MW	Hybrid Battery MW	Hybrid Battery MWh	Hybrid Interconnection
Resource 1	BIOMASS	15	24			1	24					
Resource 2	SUN	31.36	24			1	24	Riverside East PV				
Resource 3	Solar Battery Hybrid	100	24			1	24		120	100	500	100
Resource 4	WIND	10	24			1	24	Altamont				
Resource 5	LESR	10	11	0.8740	40	1	24					
Resource 6	WATER	19.024	24			1	24					
Resource 7	WIND	30.52	24			1	24					
Resource 8	GEOTHERMAL	85	24			1	24					
Resource 9	NATURAL GAS	200	11			1	24					
Resource 10	DR	0.7	4			18	22					
Resource 11	LESR	20	11	0.8740	80	13	22					

CPUC LSE Showing Validation

- CPUC RA staff will use the resource database to validate the showing
  - Resources must be shown within capability
  - Hourly requirements must be met or exceeded
  - Excess capacity must be shown to cover shown battery capacity

LSE Showing CPUC Validation Example

Storage Charge Capacity Req:	915	MW-hours
RA Capacity Showing Check:	Pass	
Storage Excess Capcity Check:	Pass	
Showing Mechanics Check:	Pass	

	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
RA Requirement (MW)	976	928	903	900	938	1,017	1,060	1,066	1,097	1,141	1,195	1,254	1,348	1,444	1,519	1,568	1,592	1,593	1,581	1,534	1,436	1,288	1,169	1,074
Total Supply (MW)	**1,169**	**1,156**	**1,143**	**1,136**	**1,123**	**1,111**	**1,250**	**1,297**	**1,417**	**1,470**	**1,485**	**1,482**	**1,487**	**1,541**	**1,546**	**1,598**	**1,628**	**1,668**	**1,584**	**1,588**	**1,443**	**1,364**	**1,205**	**1,207**
Short (Long) MW	(193)	(228)	(241)	(236)	(184)	(94)	(190)	(232)	(320)	(328)	(290)	(228)	(139)	(97)	(27)	(30)	(36)	(76)	(3)	(54)	(7)	(76)	(36)	(133)

Resource Name	Resource Type	Shown MW
Resource 1	HL IMPORT	150
Resource 2	BIOMASS	15
Resource 3	SUN	31.36
Resource 4	SUN	17.92
Resource 5	SUN	15.68
Resource 23	WIND	33.12
Resource 24	WIND	24.48
Resource 25	GEOTHERMAL	85
Resource 26	GEOTHERMAL	85
Resource 28	WATER	129.6
Resource 29	WATER	407
Resource 30	NATURAL GAS	47
Resource 31	DR	0.7
Resource 65	LESR	20
Resource 66	LESR	10
Resource 67	LESR	50
Resource 68	LESR	100
Resource 69	LESR	10
Resource 70	LESR	10

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Resource Shown Within Capabilties?	Correct Profile Used?
HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24		
0.00	0.00	0.00	0.00	0.00	0.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	0.00	0.00	Yes	Yes
15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.09	6.25	19.20	25.77	27.92	28.30	28.32	28.08	27.70	26.51	22.64	12.77	2.01	0.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.05	3.57	10.97	14.73	15.95	16.17	16.18	16.05	15.83	15.15	12.94	7.30	1.15	0.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.04	3.12	9.60	12.89	13.96	14.15	14.16	14.04	13.85	13.25	11.32	6.39	1.00	0.00	0.00	0.00	0.00	0.00	Yes	Yes
15.68	14.34	13.05	12.32	10.99	9.81	8.65	7.31	6.62	5.46	4.88	4.28	4.74	5.69	6.54	7.85	9.76	11.28	13.07	15.45	15.87	15.13	14.56	14.68	Yes	Yes
11.59	10.60	9.65	9.10	8.12	7.25	6.40	5.40	4.90	4.04	3.61	3.16	3.50	4.20	4.84	5.80	7.21	8.33	9.66	11.42	11.73	11.19	10.76	10.85	Yes	Yes
85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	Yes	Yes
85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	Yes	Yes
129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	129.60	Yes	Yes
407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.70	0.70	0.70	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00	20.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	50.00	50.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	Yes	Yes
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	Yes	Yes