Operational Readiness for Data Centers

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Outline

- Based on Operational Readiness for IBR Integration
- Data Center Readiness Project
- Interconnection Requirements First Revision
- Projects Starting this Year

Operational Readiness at SRP (OpR)

- **Operational Readiness** is the capability for SRP to operate the future grid **safely**, **reliably,** and **cost-effectively** as variable resources are added
- **Operational Readiness Strategy**
  - Clearly and accurately represents what SRP needs to do to operate this new future grid
  - Address the **who**, **what**, **where** and **why** with an emphasis on systems, processes and tools

May 03, 2021

SRP to more than Double its Utility Scale Solar to 2,025 Megawatts by 2025

Salt River Project today announced plans to more than double its 2025 utility-scale solar commitment to now add a total of 2,025 megawatts (MW) of new utility-scale solar energy to its power system by the end of fiscal year 2025, driven in part by dedicated customer demand for new renewables. This is more than 1,000MW beyond SRP's original 2025 commitment of 1,000MW, announced in November 2018. As part of this 1,025MW solar increase, 450MW is enabled by an SRP commercial customer to meet its renewable energy commitments. All the renewable energy purchased is expected to be from solar energy developments built in Arizona or on the Navajo Nation and will ultimately be used by SRP commercial and residential customers.

"As we plan for our customers' increasing need for energy and their desire for a cleaner environment, solar energy is a key solution that is significantly growing our sustainable generation portfolio," said SRP's CEO and General Manager Mike Hummel. "Doubling solar purchases over the

Operational Readiness Projects Today

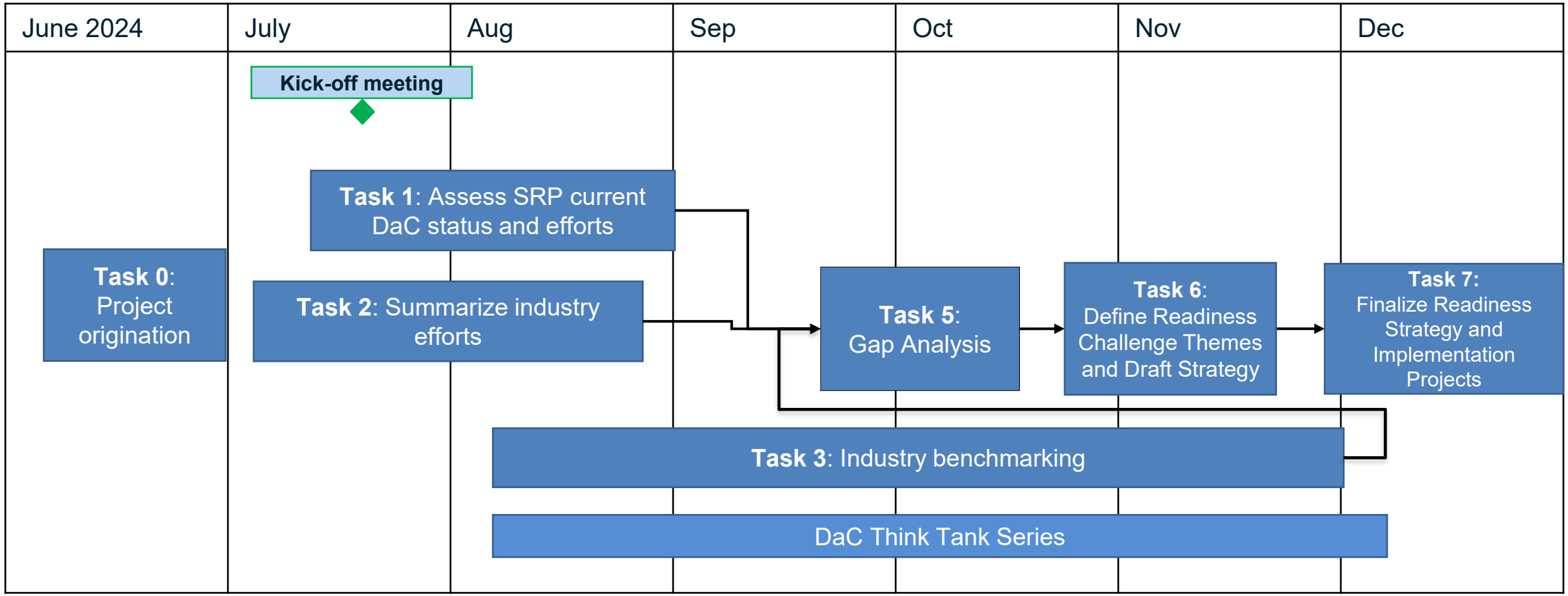
✓1A Bolster testing ✓ EMS Enablement ✓1C/D EMT modeling ✓2A/B PPA improvements ✓11 TGO/DOC coordination ✓12B System Protection ✓23 Interconnection requirements	 Fully Leverage New Resource Capabilities	3 / 4 / 13 Value stream analysis* Q4FY26 89%	10 TGO renewables desk Q4FY26 70%	12A Inverter tech standards (Inc Grid Forming)* Q4FY27 65%	24 IBR tech & performance requirements Q4FY26 80%	27 IBR modeling improvements* Q1FY27 50%
✓8A IBR data & comms ✓ 8B Displays ✓9 Intra-hour solar variability ✓18 System power quality & inertia ✓19 EIM process & tools ✓20 Software ecosystem ✓22 Control issues/mitigation	 Software & Situational Awareness	17 Control room IBR video wall Q4FY26 99%				
✓14 Fleet ramping capability analysis	 Economic Dispatch with Solar + Storage	25 Metrics, contract compliance & settlements* Q1FY27 83%				
✓21 Improve IBR deployment (PPAs)	 Enabling Projects	26 IBR training* Q2FY27 25%				
✓6/7 Solar forecasting tools & integration ✓16 CAISO load forecasting	 Advanced Forecasting Tools					
✓5 Flex reserves & governance ✓15 System variability analysis	 Risk Adjusted Reserve Requirements					

OpR has Enterprise-Wide Stakeholder Engagement

GENERATION | TRANSMISSION | DISTRIBUTION

Transmission & Generation Operations (AGC & PDO)		Distribution Operations
Resource Planning & Acquisition	Transmission Planning	Distribution Strategy
Supply & Trading	Project Management	
Generation	Apparatus & Standards	
Integrated System Planning		
Operational Technology Applications (EMS, ADMS)		
Protection, Communication & Control		
Power Quality		
Metering & Power Accounting		

Development of the SRP Data Center Readiness (DCR) Strategy

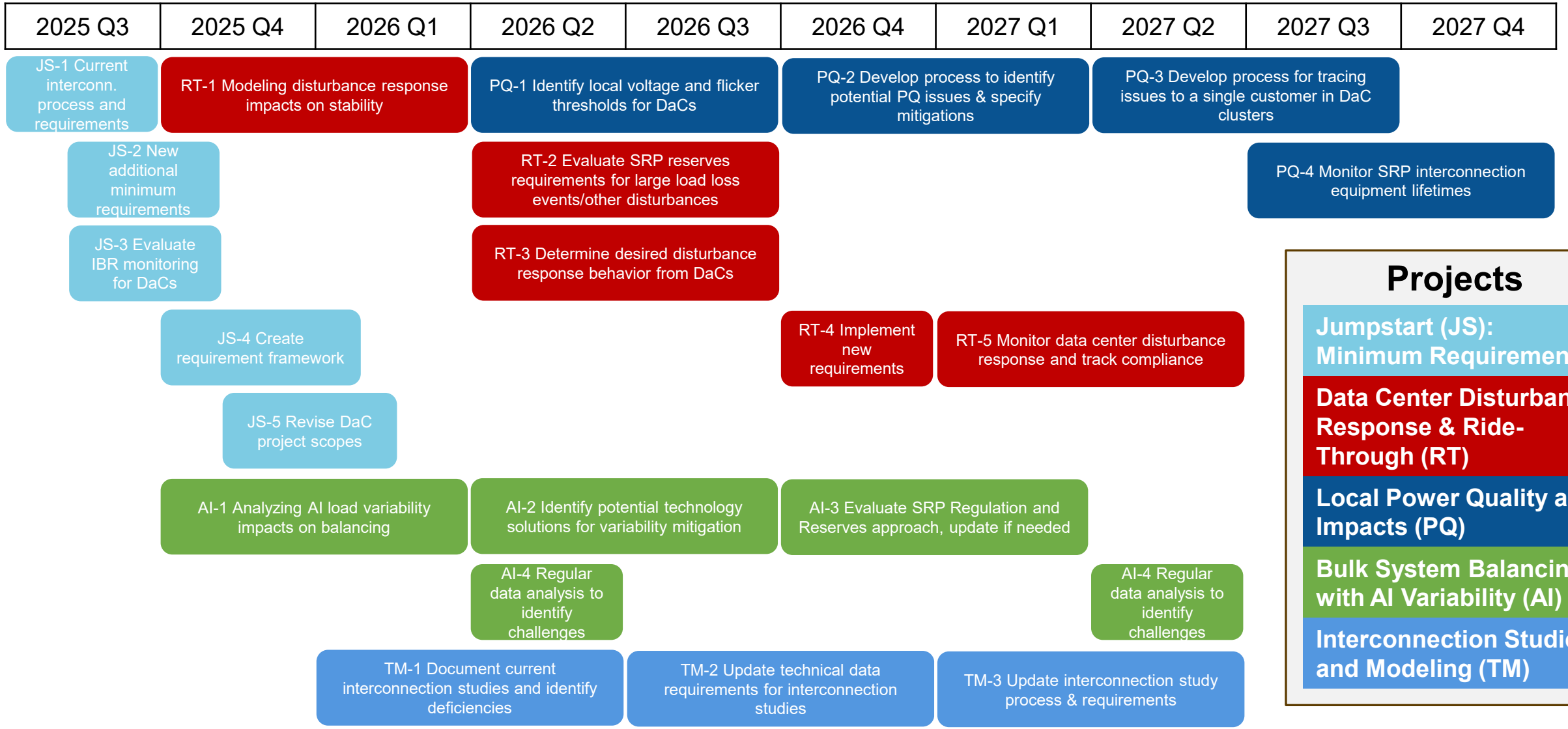


Developed with SOUNDGRID PARTNERS

Task 5: List of Gaps

Topic Area	*Gap*	
Power Quality Monitoring & Mitigation	1	Unclear if SRP has the right strategies in place for **PQ monitoring and mitigation**
	2	Tools for identifying and allocating responsibility for **local PQ issues**
Ride-through	3	No established industry standard or template process for coordinating **ride-through settings**
	4	Data Center customers **do not have to comply** with any utility industry standards, including NERC
	5	Data Center **internal facility equipment** can limit ride-through performance
Load Fluctuation Impacts	6	Unclear what size of Data Center load and operational behavior could cause **flicker, other PQ issues**
	7	Unclear if AI Data Center operations will cause NERC-reportable **ACE deviations**
	8	Unclear if AI Data Center operations **will impact or damage** SRP Power System equipment
Interconnection Process	9	Standard large customer interconnection process may not have sufficient **technical requirements**
	10	Documentation of **responsibility for SRP teams** during interconnection and once customer is in-service
	11	Unclear if **std interconnection process** will support future needs of Data Centers customers
Modeling	12	Current **load studies and modeling tools** may not identify PQ issues of Data Center operations
	13	Data Center customers likely not modeling the grid accurately in their **protection studies**

Task 6 & 7: Strategy and Implementation Plan



Projects

- **Jumpstart (JS): Minimum Requirements**
- **Data Center Disturbance Response & Ride-Through (RT)**
- **Local Power Quality and Impacts (PQ)**
- **Bulk System Balancing with AI Variability (AI)**
- **Interconnection Studies and Modeling (TM)**

DCR Jumpstart: Minimum Requirements

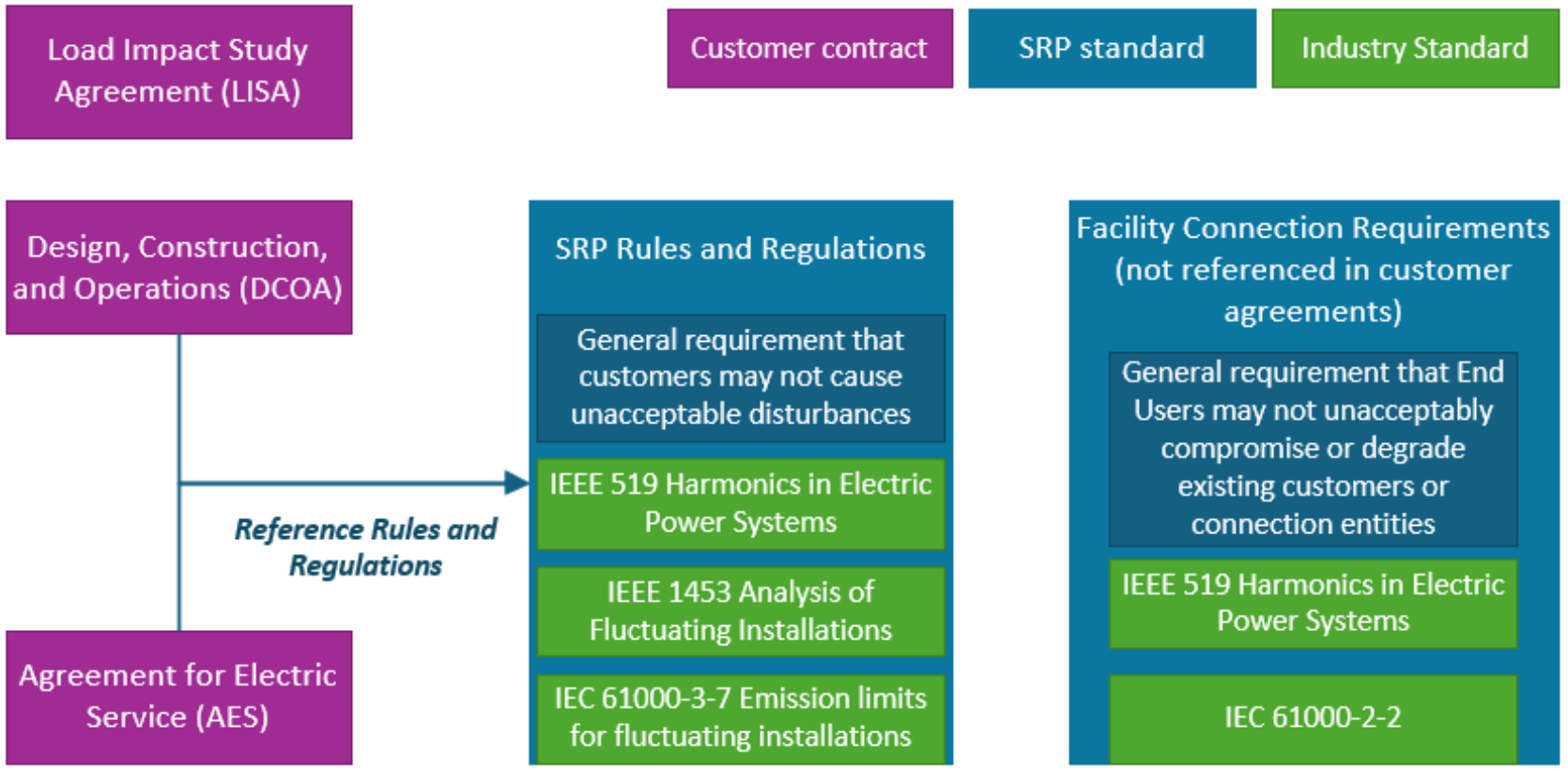
Project Manager/Lead Stakeholder: OpR

Participants: Econ Dev., ISP, PDE, SSP, SEM, TP, TGO, Dist. Perf., OTSS-GPC

Project Tasks	CY 25				CY 26			
	1	2	3	4	1	2	3	4
1. Summarize the **current interconnection process, requirements, and contracts** that apply to large data center customers today at SRP. Document any changes to requirements that may be implemented as part of the Large Business Customer Strategy project.								
2. Identify **relevant industry efforts** (EPRI, ESIG, NERC LLTF, ASU) that SRP is already involved in or should consider working with and integrate learnings back into data center readiness program efforts.								
3. Determine if **power quality and ride-through monitoring and oscillation detection** for IBRs can be effectively utilized for monitoring data center customers.								
4. Document any new data center concerns that were not identified in the data center strategy development and determine additional minimum requirements that should be implemented for customers immediately.								
5. Create a framework for **updating technical requirements** as they evolve and are refined by other focused data center readiness projects.								
6. Review proposed **data center readiness project scopes** and implementation schedule and revise based on Jumpstart learnings.								

Outcome	Interim requirements implemented to protect grid reliability while more comprehensive data center requirements are developed.

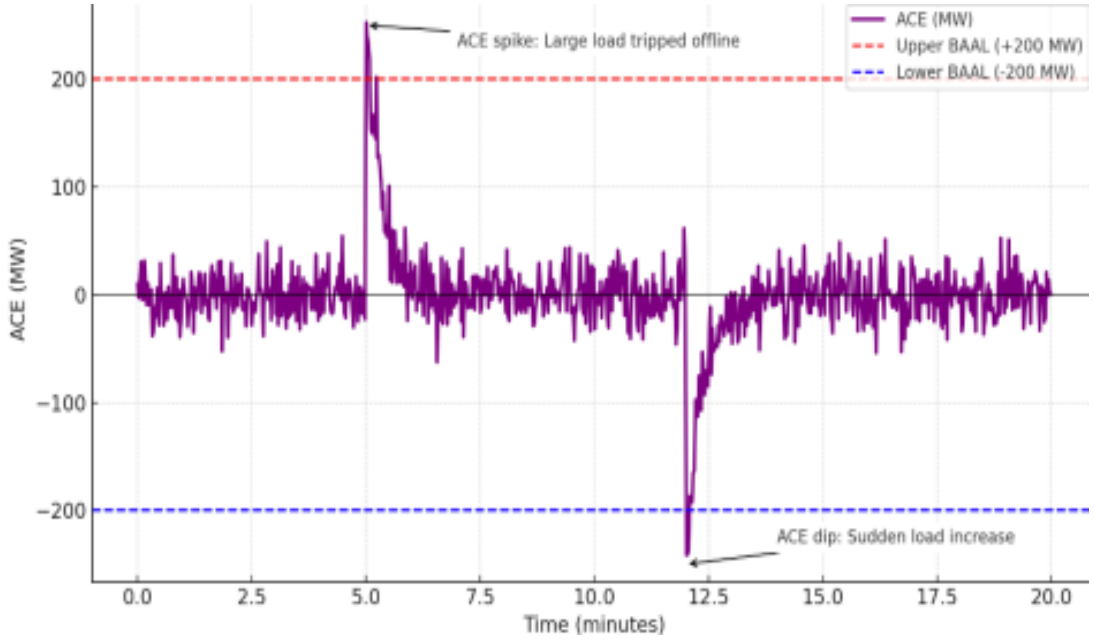
Surveying Customer Interconnection Requirements



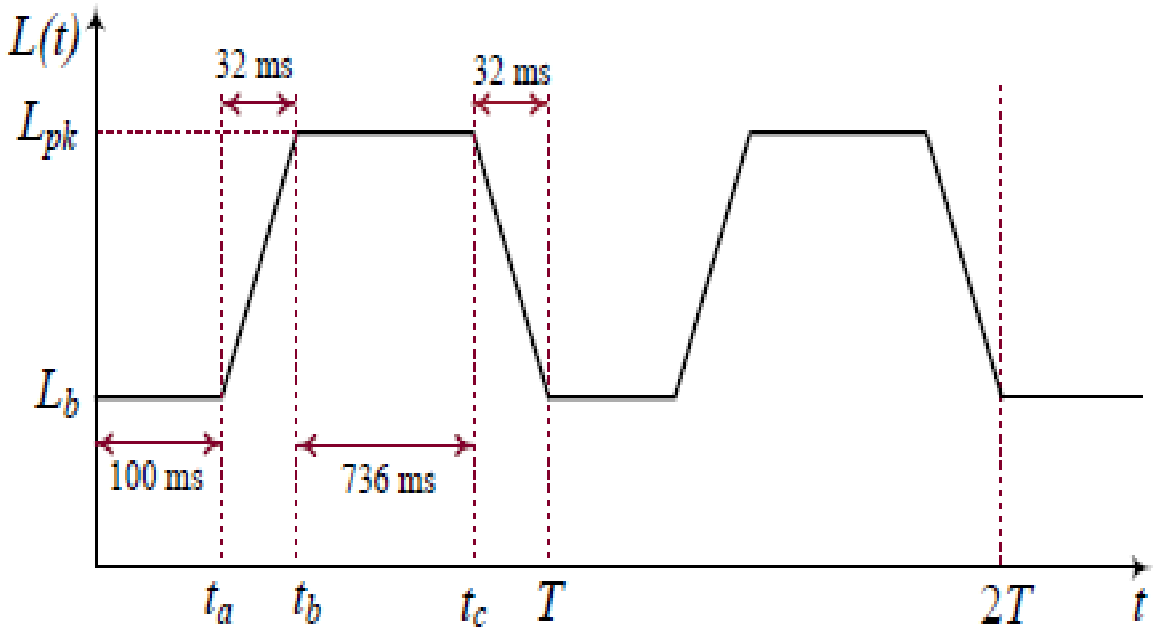
AES requires customers to be in compliance with the SRP Rules and Regulation

Section 6.1 - “SRP may refuse/disconnect service if Customer's equipment is designed/operated to disturb service to other Customers or constitute a physical/electrical hazard.”

Load Variability Impact on Reliability



ACE Variations Due to Large Loads (NERC)



Periodic Load Profile of a Typical AI-Based Data Center (RMS Energy)

Data Center Interconnection Requirements (1 of 2)

Requirement does not exist or is extremely insufficient

Requirement exists but may be insufficient or not monitored

Sufficient Requirement exists, is effectively enforced & monitored

Requirement	Previous	Today	Vision
Load Variability	No limits on operational ramping for customers	Guardrails on allowable ramp rates depending on ramp magnitude, non-binding customer load forecasts	Refined ramp rate limits & SRP balancing strategy; integration of customer load forecasts
Ride-Through (Voltage & Frequency)	No limits on customer disconnection and transfer to back-up power	Customers must coordinate protection and transfer settings with SRP	Ride-through standard specific to SRP system & impacts of data center disturbance responses are well understood
Power Factor	Minimum 0.85, SRP can request customer install corrective mitigation or pay for corrections if worse than 0.85	Work in progress to improve power factor	Require close to unity power factor at all times
Harmonics	Comply with IEEE Std. 519	Comply with current IEEE & IEC standards. Customers are required to conduct a harmonics analysis and flicker study and provide results to SRP and install a meter that measures individual harmonics and total harmonic distortion.	Jumpstart requirements align with most comparable utility interconnection requirements reviewed. Local Power Quality monitoring project will determine if different requirements are needed.
Voltage Disturbances, Flicker	Customer loads may not cause unacceptable voltage fluctuations, distortions to SRP system or other customers. SRP may require corrective equipment to be installed at Customer cost. Comply with IEC 61000-3-7 and IEEE Std. 1453		

Data Center Interconnection Requirements (2 of 2)

Requirement does not exist or is extremely insufficient

Requirement exists but may be insufficient or not monitored

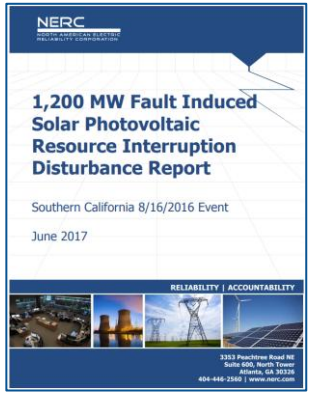
Sufficient Requirement exists, is effectively enforced & monitored

Requirement	Previous	Today	Vision
Monitoring Equipment	SRP PQMs are typically installed at the SRP substation XFMRs for large customers	PQM and PMU installation at Customer XFMR required	PQ monitoring and Oscillation monitoring projects will enhance these requirements if needed
Load Models	Customer provides forecasted monthly capacity & high-level load composition details, representative daily load profile	Representative load profile for data centers; Customer provides dynamic models to support EMT, transient, short circuit studies. Any material changes will be required to be shared w/SRP & accompanied with an updated model	Customer requirements will be updated with the outcomes of the Load Modeling & Interconnection Process project work

The Road to Developing Interconnection Requirements

Utility Scale IBRs

2016+

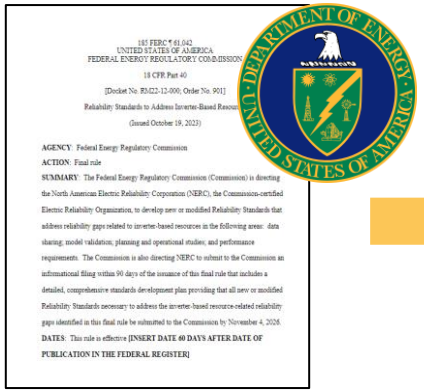


NERC Reports

2022

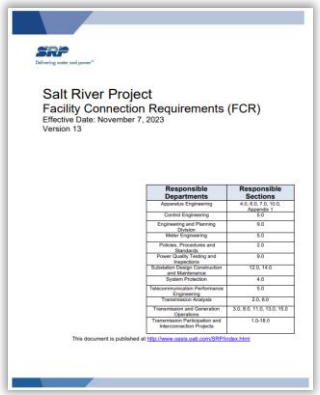
IEEE 2800

2023-2026



FERC Order 901

2024



SRP Requirements

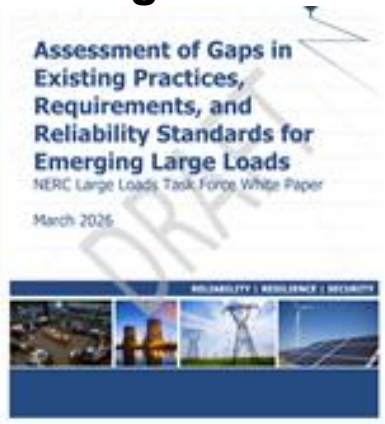
Data Centers

Unknown timeline for industry requirements

2025

NERC Report: 1500 MW Load Loss Event

Coming March 2026



Whitepaper: Risk Assessment and Requirements

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SRP Requirements

Project Scopes and Sequencing

CY25 Q4	CY26 Q1	CY26 Q2	CY26 Q3	CY26 Q4	CY27 Q1	FY27 Q2

Jumpstart Project: Sprint effort, large load requirements

Ride-through and Disturbance Response (RT): System analysis of load loss impacts to establish disturbance response and load modeling requirements for data center customers to prevent undesirable behavior. System analysis to identify oscillation risks to SRP synchronous generation fleet from large load operations.

Bulk System Balancing with Variable Large Loads (BA): System visibility and balancing strategy that allows SRP to monitor and enforce data center active power variability and evaluate reserves practices to maintain system reliability and accommodate load variability.

Monitoring of Local Impacts (LI): A monitoring strategy for power quality, ride-through, power factor, and other local operational concerns for large customers that creates standard procedures and identifies SRP teams responsible for monitoring and enforcing performance requirements.

Draft project schedules, open to changes due to prioritization and resource constraints

Oscillation Monitoring and Detection (OM): Development of a PMU-based monitoring strategy for detecting oscillations at large load customers, nearby synchronous generators, and throughout SRP's system. Development of procedures for regular data analysis and operator response.

Customer Interconnection Requirements & Process Documentation (IP): Integration of learnings from other projects into updated customer requirements and SRP study process; documentation of large customer interconnection process.

thank you!

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BACKUP SLIDES

Mechanisms for Implementation Considered

Option	Document	Pros	Challenges
1	Stand-alone BPM that is referenced in DCOA or AES	• Focused BPMs are easier for SRP to update as requirements change & would be enforceable retroactively	• Some AES update terms require board approval, unclear if this will be needed • BPMs typically posted on OASIS, inconsistent with locations of other customer materials
2	Add new section with Operational Requirements to template DCOA Exhibit F	• Doesn't create a new place customers have to look for requirements • Utilizes existing exhibit referenced for capacity limitations and other operational reqs	• Embedding requirements in contracts makes them static, not easy to update as changes are needed in future or enforce retroactively • Groups responsible for enforcing operational requirements don't (generally) have access to DCOA or other agreements.
3	Large Load/Data Center requirements are added to Facility Connection Requirements, FCR is implemented in AES/DCOA	• Could allow for easy updates when FCR is opened for review annually • Aligns with location of comparable utility load reqs and NERC recommendation for inclusion in Interconnection Requirements	• Would need close review of all other existing load requirements that would be applicable to customers

Relevant Industry News – NERC Alert issued

- **NERC Alert Level 2 Large Loads.pdf**
- September 9, 2025 NERC Alert distributed with 97 questions. Responses due in January 2026
  - ✓ **Recommendation 1:** Clear facility design & performance criteria in interconnection requirements
  - ✓ **Recommendation 2:** Establish comprehensive interconnection & system wide study process (steady state, dynamic, and short circuit)
  - ✓ **Recommendation 3:** Enhance load commissioning activities & establish comprehensive commissioning process for large loads
  - ✓ **Recommendation 4:** Establish operating protocols and necessary communication infrastructure to support ongoing operations after COD.
  - ○ **Recommendation 5:** Identify & implement process to include large loads in long term planning and near-term forecasts.

✓ Full coverage by Data Center Readiness (DCR) program
✓ Partial coverage by DCR program
× Not in current DCR program scope
○ Covered in other SRP efforts

Industry Working Groups Supporting Data Center Readiness

- A key part of Data Center Readiness is ensuring SRP is participating in industry activities to implement best practices for managing growing data center loads
- Jumpstart has assigned representatives to the most relevant work

Industry Forum	Summary
EPRI DC Flex Strategic Advisory Committee	Project aiming to demonstrate how data centers can support and stabilize the grid and improve interconnection and efficiency.
NERC Large Load Task Force (now a Work Group)	Task force under Reliability and Security Technical Committee (RSTC) to better understand impacts (risks) of large loads.
NATF Reliable Addition of Large Datacentric Loads (RALDL)	An industry coordination effort to develop best practice guidelines for Data Centers which intends to publish in November 2025.
ESIG Large Loads Task Force Working Groups	Composed of 8 working groups to focus on grid impacts, challenges, and solutions of large loads. DCR Jumpstart reps assigned to Interconnection Process, Interconnection Requirements, and Modeling working groups