



Item 4.2: Real-Time Co-Optimization Implementation Update

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Technology and Security Committee Meeting

ERCOT Public

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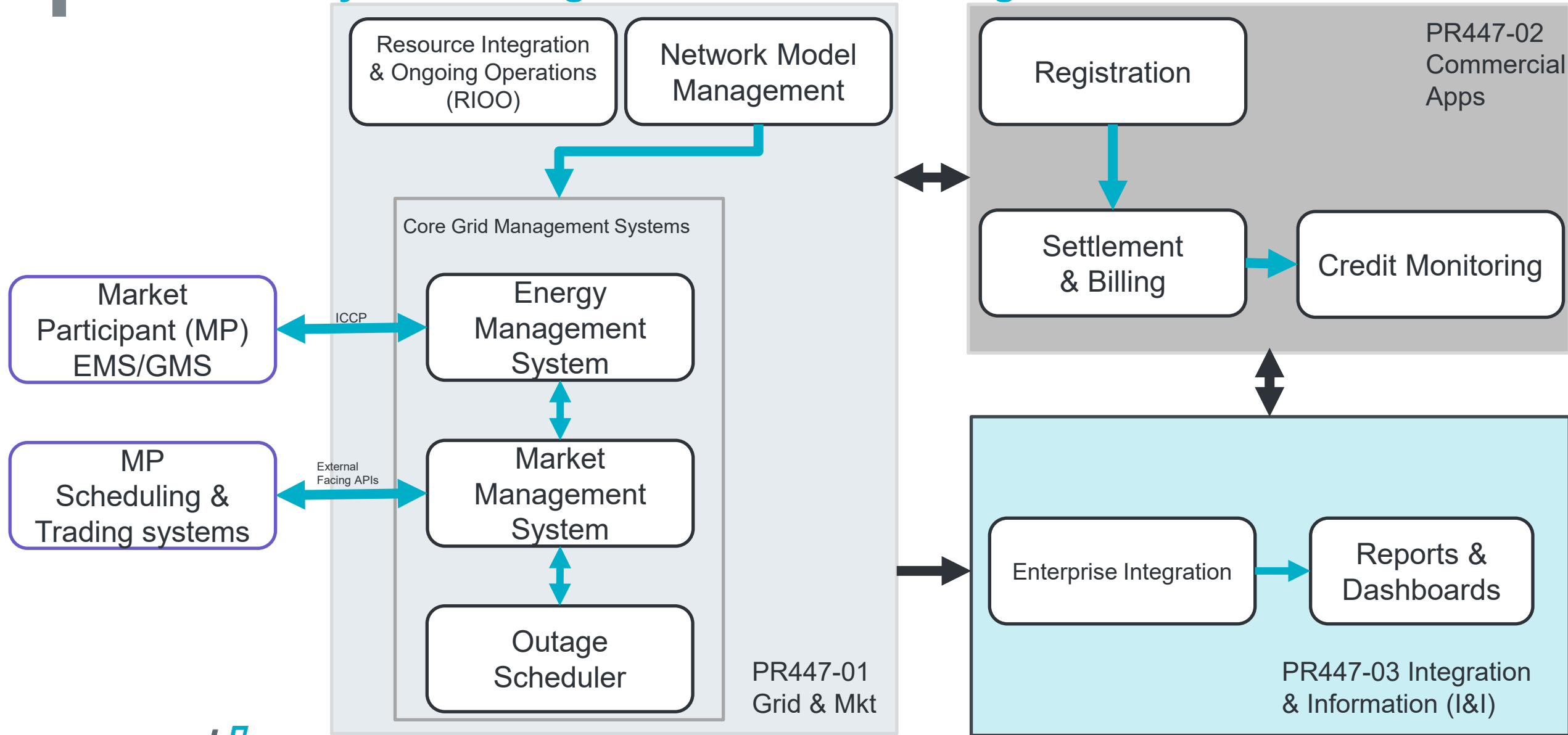
What is RTC+B+SOC

- **RTC (NPRR1007-1013)**
 - Current Real-Time Market (RTM) finds most effective set of Resources for providing Energy (but not Ancillary Services).
 - Real-Time Co-optimization would help find the most effective set of Resources for providing Energy & Ancillary Services.
 - Brings Operational and Economic Benefits - \$1.6B per year in energy cost reduction + more (see information in Appendix).
- **Batteries – Single Model for Batteries (NPRR1014)**
 - Switching Batteries from the current “Combo Model” to a “Single Model” in ERCOT core systems.
 - To implement “single-model” is to unify into single ESR.
 - Better Modeling and the ESR is represented as it is, as one Resource
 - Single set of telemetry; “bid/offer curve” submittal; Performance Monitoring; and Settlements
- **State of Charge Management (NPRR1204)**
 - Accounting for SOC (MWh) in Reliability Unit Commitment (RUC) and Security-Constrained Economic Dispatch (SCED).

****Links to additional materials on concepts of RTC, Single Model and SOC concepts available in Appendix.**

Key Takeaway: Co-optimize Ancillary Services in Real-Time; Accurate representation for Batteries; and Better accounting for ESR State of Charge.

Overview of System Changes – RTC+B+SOC Program



RTC+B+SOC Program Structure

Project	Total Budget	Actuals	Trend	Description
PR447-00 Program Control	\$13.9M	\$920,945	●	Includes Hardware \$6.7M, Software \$4.5M
PR447-01 Grid & Markets	\$24.9M	\$281,700	●	MMS/EMS/OTS/NMMS/RIOO/PI/OS/GridGeo
PR447-02 Commercial Apps	\$5.8M	\$304,534	●	S&B,CMM,Registration
PR447-03 Integration & Information (I&I)	\$5.3M	\$27,692	●	Middleware, dashboards, reports, data warehouse
Total	\$50.0M	\$1,534,871		

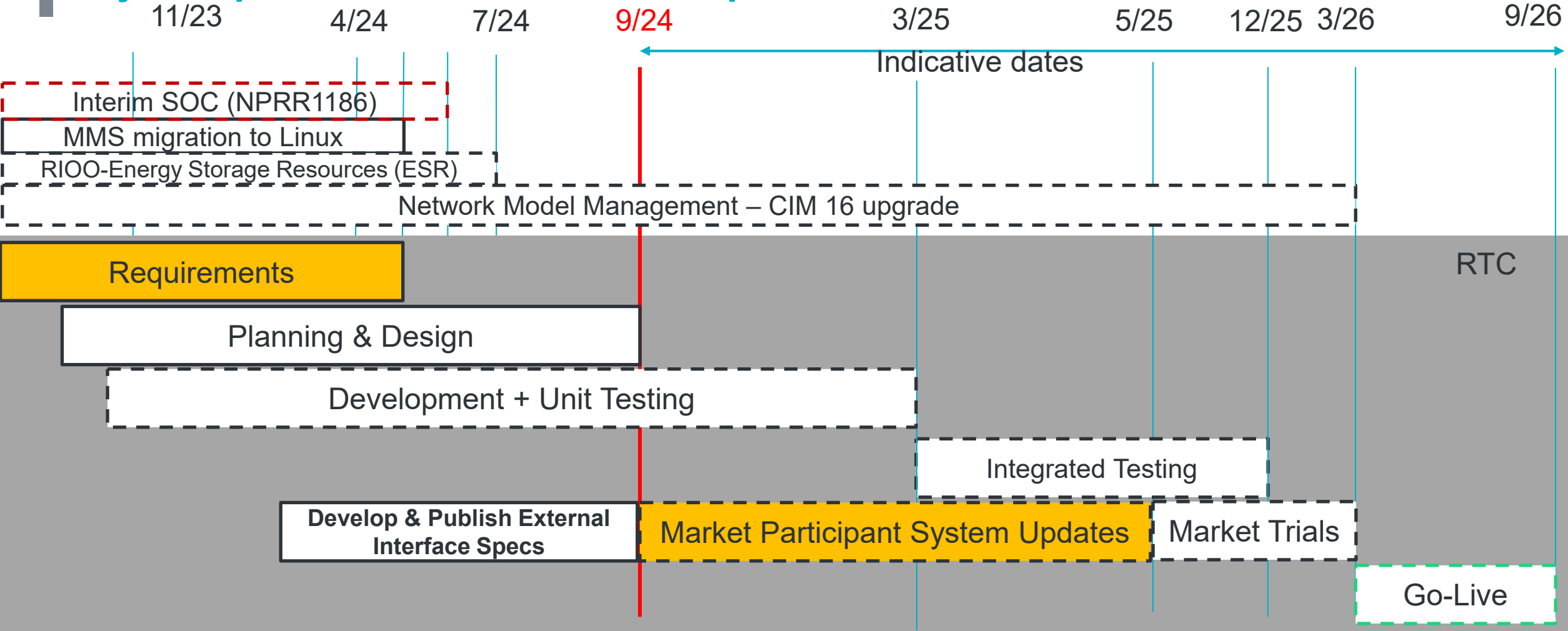
●	Not Tracking to Plan
●	At Risk
●	Tracking to Plan

Key Takeaway: Centralized Program Control structure with 3 project tracks.

• Actuals as of Feb 5, 2024



Major Dependencies in our critical path



Key Takeaway: RTC project plan firmed up by completing planning and design by 9/24.

*Interim SOC (NPRR1186) in remand by PUCT:
 • Pending approval



Review - Major Short-term milestones for Feb '24 T&S Committee Meeting

Task	Due by	Status
PR447-01 MMS Core applications Requirements	Complete	
PR447-02 CMM Requirements	Complete	
PR447-01 MMS Core Applications Requirements Updated w/ SOC (NPRR1204)*	Complete	
PR447-03 Gate to Planning on I&I Project	Dec 13, 2023	Complete
PR447-02 S&B Statements and Emergency Requirements	Dec 15, 2023	Complete
PR447-01 Battery Single Model – Test Model to vendor	Dec 15, 2023	Complete
PR447-01 MMS Vendor Development Begin (updated w/ SOC)	Jan 31, 2024	Complete
PR447-01 EMS Core Applications Requirements (ICCP, SCADA, LFC, RLC, SE, RTCA, TCM, DSA, VSA, etc.)	Feb 29, 2024	In-Progress
PR447-01 EMS Operator Training Simulator Requirements	Apr 30, 2024	In-Progress

*NPRR1204 approval in-progress:

- Dec 4, 2023 – TAC approval
- Dec 19, 2023 – Board approval
- Feb 1, 2024 – PUCT Approval

Major Short-term milestones for Apr '24 T&S Committee Meeting

Task	Due by
PR447-03 MMS – CMM Integration Requirements	Feb 16, 2024
PR447-01 EMS Core Applications Requirements (ICCP,SCADA,LFC,RLC,SE,RTCA,TCM,DSA,VSA, etc.)	Feb 29, 2024
PR447-03 Establish Remaining Planning Milestones for I&I	Mar 6, 2024
PR447-01 MMS Ancillary Service Manager Requirements	Mar 15, 2024
PR447-01 EMS – MMS Integration Requirements	Mar 21, 2024
PR447-00 Start Internal DEV Systems Build-out	Apr 5, 2024
PR447-01 Outage Scheduler Requirements	Apr 12, 2024
PR447-01 PI Requirements (first deliverables)	Apr 12, 2024
PR447-02 Registration (Siebel) Requirements	Apr 30, 2024
PR447-01 EMS Operator Training Simulator Requirements	Apr 30, 2024

Appendix

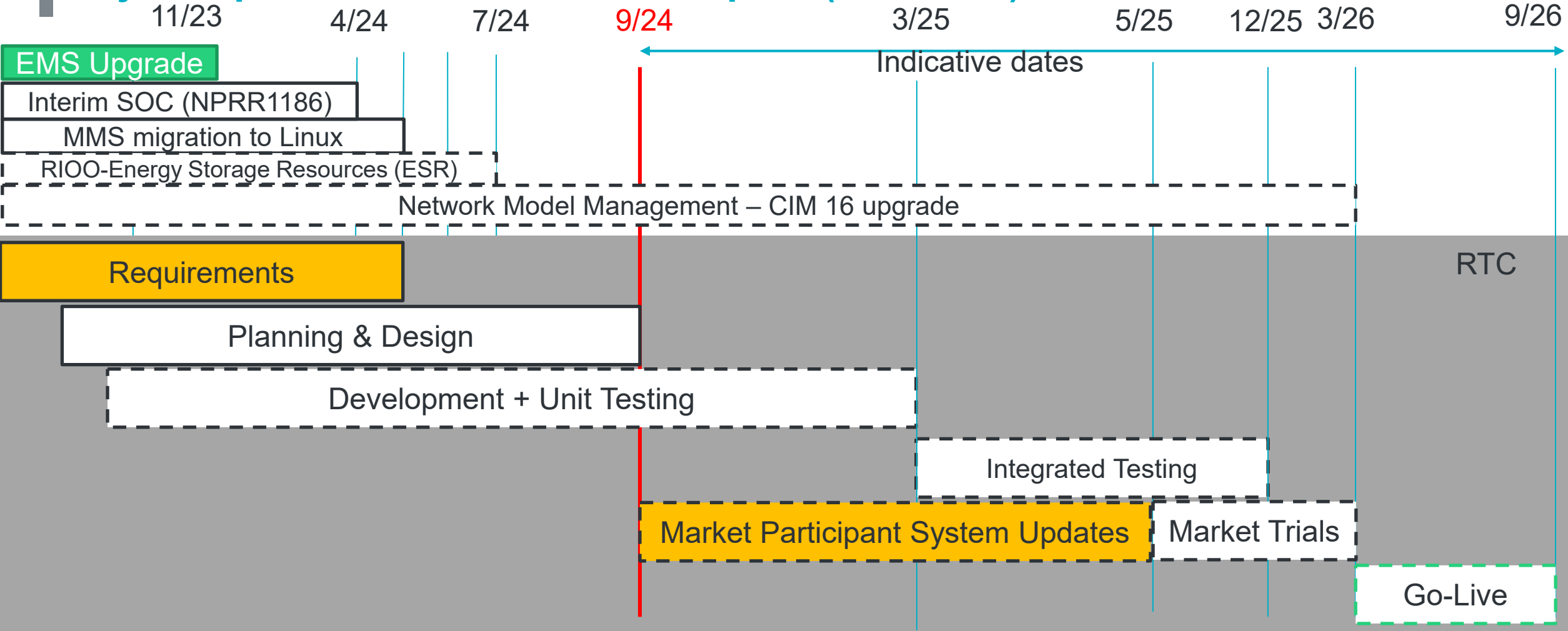
Links to educational material on the mechanics of RTC, Single Model and State of Charge:

- [RTC Updates to Reliability and Markets Committee - Overview of market design concepts & benefits](#)
- [RTCBTF - Refreshers on RTC Key Principles, Single Model and SOC](#)

Links to associated key documents:

- [RTC Key Principles](#)
- [NPRR1186 Interim SOC - Key Documents](#)
- [NPRR1204 SOC Considerations with RTC - Key Documents](#)

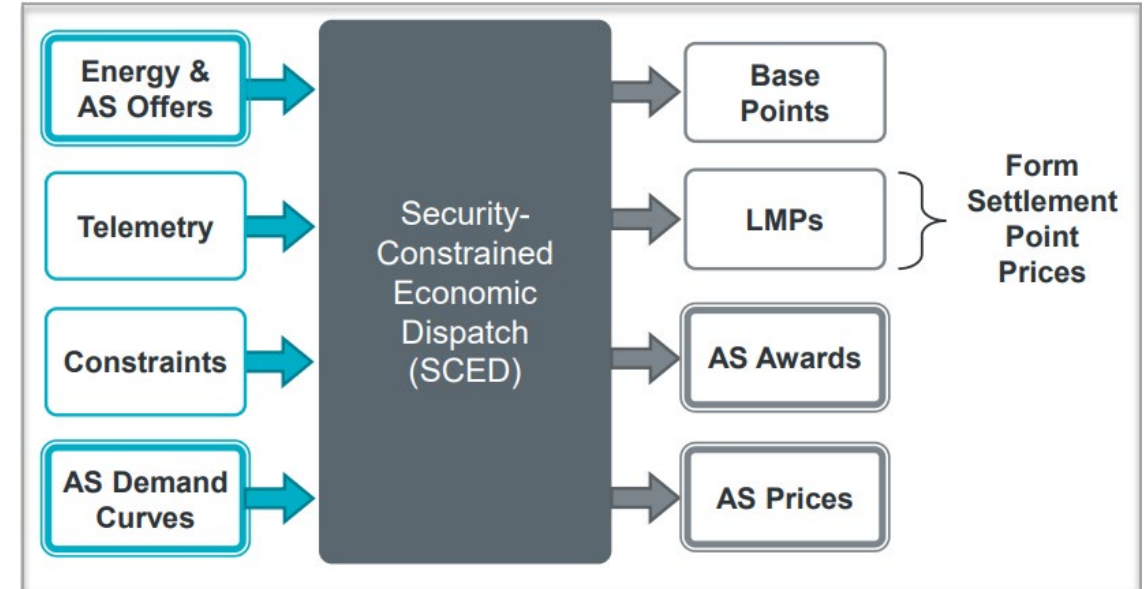
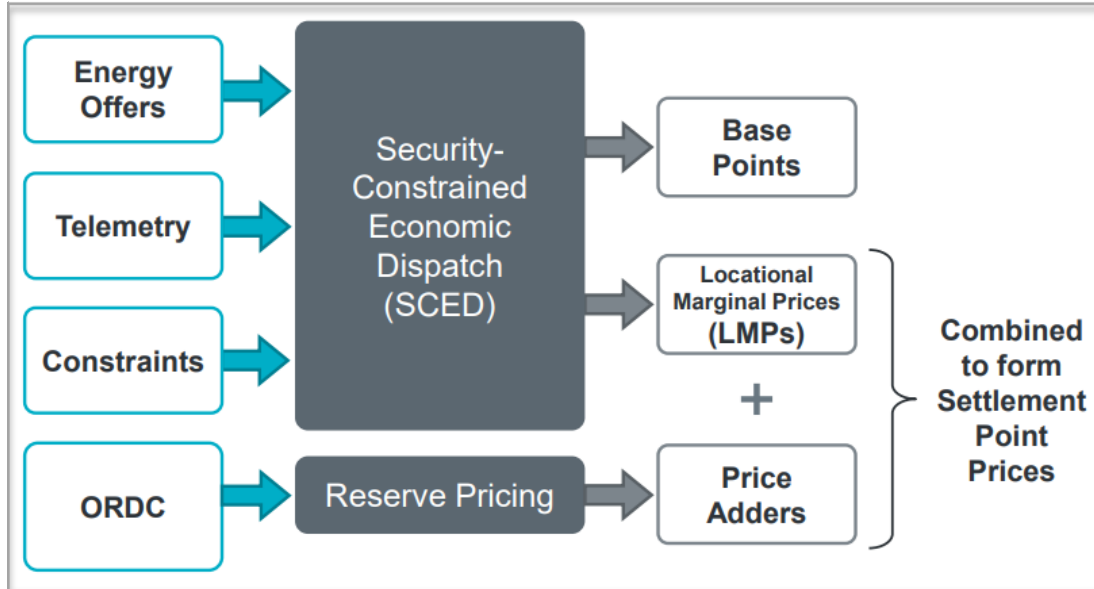
Major Dependencies in our critical path (Dec 2023)



Key Takeaway: RTC project plan firmed up by completing planning and design by 9/24.



Today's market vs RTC



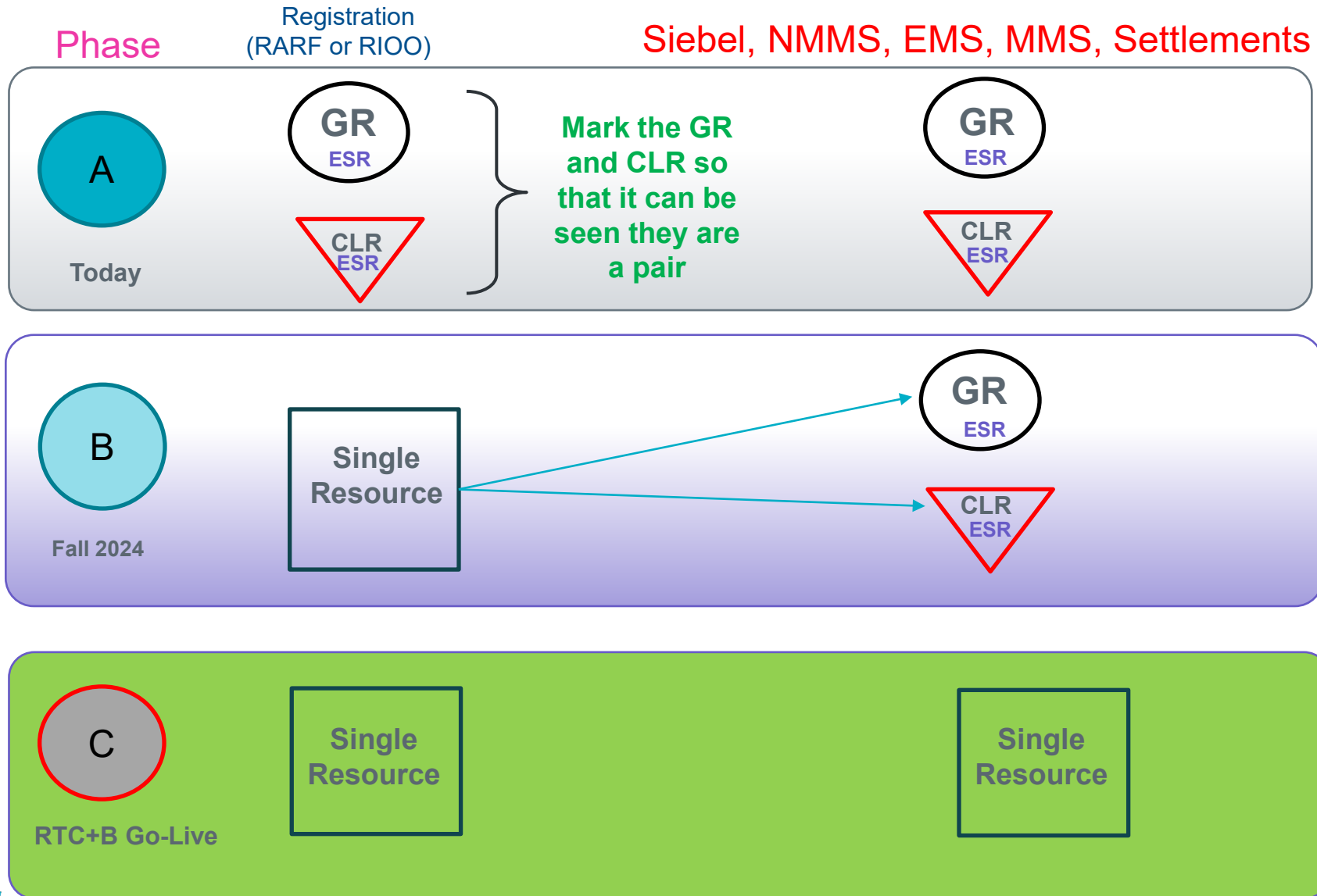
- Today's market:
 - Is designed to reflect scarcity through a process that is outside of the optimization.
 - Cost of AS is reflected in the form of Price Adders, not factored into LMP.
 - The ORDC sets the value of ERCOT System reserves.

- RTC:
 - Is designed to reflect scarcity within the optimization.
 - Cost of AS is factored directly into LMPs
 - Instead of using ORDC, individual AS Demand Curves (ASDCs) for each AS product (Non-Spin, Reg-Up, RRS, ECRS).
 - Helps better distinguish and prioritize between various AS products.
 - Eliminates need for Supplemental Ancillary Services Market (SASM), co-optimized RUC and RTM will fulfill this role.

Operational & Economic Benefits of RTC

- Operational Benefits – The reliability benefits of RTC derive from our ability to:
 - Replace and replenish Ancillary Services every 5 minutes;
 - Effectively manage Resource-specific capabilities that can change rapidly and significantly in Real-Time and the hours leading up to Real-Time;
 - This includes Energy Storage Resources (ESRs), but is applicable to all Resource types (thermal, renewable, and demand-side Resources).
 - Dynamically adjust Ancillary Service quantities all the way up to Real-Time as uncertainties on the grid change over the day;
 - Better manage and reduce transmission congestion without sacrificing on our Ancillary Service needs;
 - Prioritize Ancillary Services to preserve the most critical capacity (i.e., capacity that can respond to frequency deviations) in cases where grid conditions become scarce; and
 - Automate many process that must be managed manually by Control Room staff today.
- Economic Benefits – These reliability benefits also equate to economic benefits for the end-use customer.
 - The Independent Market Monitor (IMM) released a report in 2018 that included its evaluation of the impacts of RTC on the ERCOT market.
 - Using 2017 as their simulated operating year, they found:
 - A \$1.6 billion reduction in total energy costs, which equates to a ~\$4/MWh reduction in price;
 - An \$11.6 million reduction in production costs to serve load;
 - An improvement in reliability due to a reduced overloading of transmission constraints and a reduced use of the Regulation Up Ancillary Service equating to \$4.3 million;
 - A \$257 million reduction in congestion costs; and
 - A \$155 million reduction in Ancillary Service costs.
 - As with the reliability benefits, these cost benefits are also likely increasing over time.

ERCOT Evolution for Battery Energy Storage Resources



ERCOT Evolution for State of Charge Considerations

- Interim Period SOC changes (**NPRR1186**), will still use the “Combo” battery model:
 - Introduces AS duration requirements in DAM.
 - Defines new COP fields for SOC minimum, maximum and planned target, to be used by RUC studies to determine ESR-GR capacity available to meet Load Forecast after satisfying ESR COP AS responsibilities. Also reflected in Real-Time HASL calculations.
 - Implements refinements to the ERCOT “SOC accounting-monitoring-expectations” approach. Provides clarity on how much SOC is required for each AS responsibility and how ERCOT will check to see if the SOC is adequate for the AS responsibilities.
- RTC+B SOC changes (**NPRR1204**), will use the new “Single” battery model:
 - **Day-Ahead Market (DAM)**
 - No SOC accounting.
 - Keeps Interim Period (NPRR1186) changes for tracking AS duration requirements in DAM.
 - **Reliability Unit Commitment (RUC)**
 - Include additional SOC accounting related constraints.
 - For every given hour, ensure there is sufficient Energy (SOC MWh) available in ESRs to sustain the MW dispatch for Energy and AS (for their respective durations), and validate this against COP minimum and maximum SOC values (introduced in NPRR1186).
 - The study/simulated dispatch for Energy and AS for a given hour are such that the resulting SOC accounting for the end of the hour will be equal to the planned hour-beginning SOC (COPs) for the next hour.
 - **Real-Time Market (RTM) – Security-Constrained Economic Dispatch (SCED) to:**
 - Perform Telemetry validations to make sure current SOC is within bounds of minimum and maximum SOC.
 - Incorporate SOC related constraints such that there is sufficient Energy to sustain the MW awards for Energy (base-points) and AS for their respective time duration, without violating telemetered minimum and maximum SOC bounds.

Acronyms used in this slide deck

CIM	Common Information Modeling
CMM	Credit Monitoring & Management
DSA	Dynamic Stability Analysis
ECRS	ERCOT Contingency Reserve Service
EMS	Energy Management System
ESR	Energy Storage Resource
GMS	Generation Management System
I&I	Integration and Information
ICCP	Inter control Center Protocol
LFC	Load Frequency Control
MMS	Market Management System
MP	Market Participant
NMMS	Network Model Maintenance System

Acronyms used in this slide deck

Non-Spin	Non-Spinning Reserve Service
OS	Outage Scheduler
OTS	Operator Training Simulator
Reg-Up	Regulation Up Service
RIOO	Resource Integration and Ongoing Operations
RLC	Resource Limit Calculator
RRS	Responsive Reserve Service
RTC	Real-Time Co-Optimization
RTCA	Real-Time Contingency Analysis
S&B	Settlements & Billing
SCADA	Supervisory Control and Data Acquisition
SE	State Estimator
SOC	State of Charge
VSA	Voltage Stability Analysis