

ERCOT Look-Ahead SCED ALSTOM Experiences and Solution

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ERCOT METF Meeting



Outline

- ALSTOM LA-SCED Customer Implementations
- LA-SCED Implementation Challenges
- ALSTOM Smart Dispatch R&D Development
- ALSTOM's New Developments in Real-Time Markets
- Open Discussion / Q&A

ALSTOM LA-SCED CUSTOMER IMPLEMENTATIONS

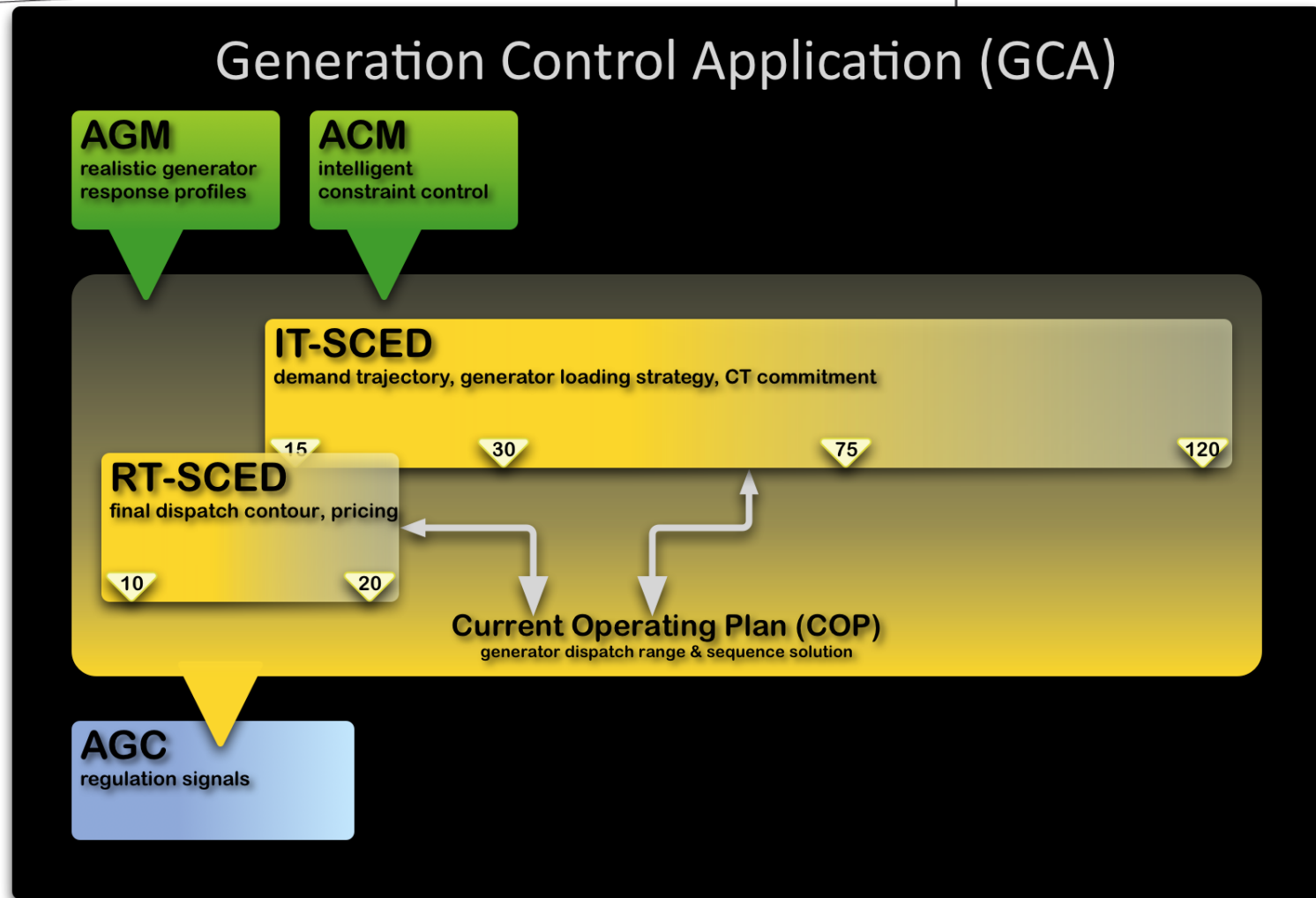
ALSTOM LA-SCED Customer Implementations

- PJM LA-SCED went-live on June 9th 2010
 - LA Commitment: 2 hour look-ahead fast-start unit commitment
 - LA Dispatch: coupled multi-interval SCED
- Midwest ISO LA-SCED
 - LAC focuses on fast-start unit commitment in production April 2nd 2012
 - Look-ahead Dispatch (LAD) is next phase
- ISO-NE LA-SCED
 - Commitment advisory passed operator testing Q1 2012
 - Commit fast-start unit, predict emergency conditions, DR activation, and transaction clearing prices
 - Production implementation phase begins Q2 2012
- SPP LA-SCED for Integrated Marketplace (go-live Q1 2014)
 - Pre-RTBM is a interval coupled LA dispatch to look ahead 2 hours for OOME recommendation
- Other LA-SCED projects that went live
 - North China Grid
 - Terna of Italy

PJM Real-Time Market Evolution

- 2001: 1st RT-UDS for energy only real-time market
- 2002: hourly Sprego market with co-optimization
- 2006: allow DR to participate Spin and Regulation markets
- 2008: perfect dispatch
- 2009: prototype of GCA (LA-SCED)
- 2010: IT-SCED/RT-SCED replaced LA-/RT-UDS
 - Multi-interval RT market and fast start LA commitment
- 2011: PRD prototype
- 2012/13: Shortage Pricing, FERC 745, FERC755, PRD will go live

PJM LA-SCED



PJM LA-SCED

- Initiated by recommendation from “Perfect Dispatch” Study
 - Reduce fast-start commitment and dispatch cost
- IT-SCED is a MIP Look-ahead Commitment Engine
 - Reduce fast-start unit commitment cost
- RT-SCED is a Multi-interval Look-ahead Dispatch Engine
 - Provide unit dispatch trajectory
 - Pre-ramp units
- Look-Ahead transmission constraint prediction
- Energy and Ancillary Services co-optimization
- Reduce real-time LMP volatility

PJM Savings From Perfect Dispatch and GCA

A screenshot of a web browser displaying a news release from PJM. The browser's address bar shows the URL: pjm.com/~media/about-pjm/newsroom/2012-releases/20120119-perfect-dispatch-news-release-2012.asf. The page features the PJM logo on the left and the words "NEWS RELEASE" on the right. Below the logo, it says "FOR IMMEDIATE RELEASE". The main heading is "PJM'S STRIVING FOR PERFECT DISPATCH NETS NEARLY \$200 MILLION IN SAVINGS" with a sub-heading "Savings almost equal to operating costs". The text of the release discusses savings from PJM Interconnection in 2011, mentioning a \$199 million saving, which is almost equal to operating costs, and accumulated savings of \$455 million since 2008. It also explains that combustion turbines are often on-stand-by and more expensive to run than previously scheduled generation.

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NEWS
RELEASE

FOR IMMEDIATE RELEASE

PJM'S STRIVING FOR PERFECT DISPATCH NETS NEARLY \$200 MILLION IN SAVINGS
Savings almost equal to operating costs

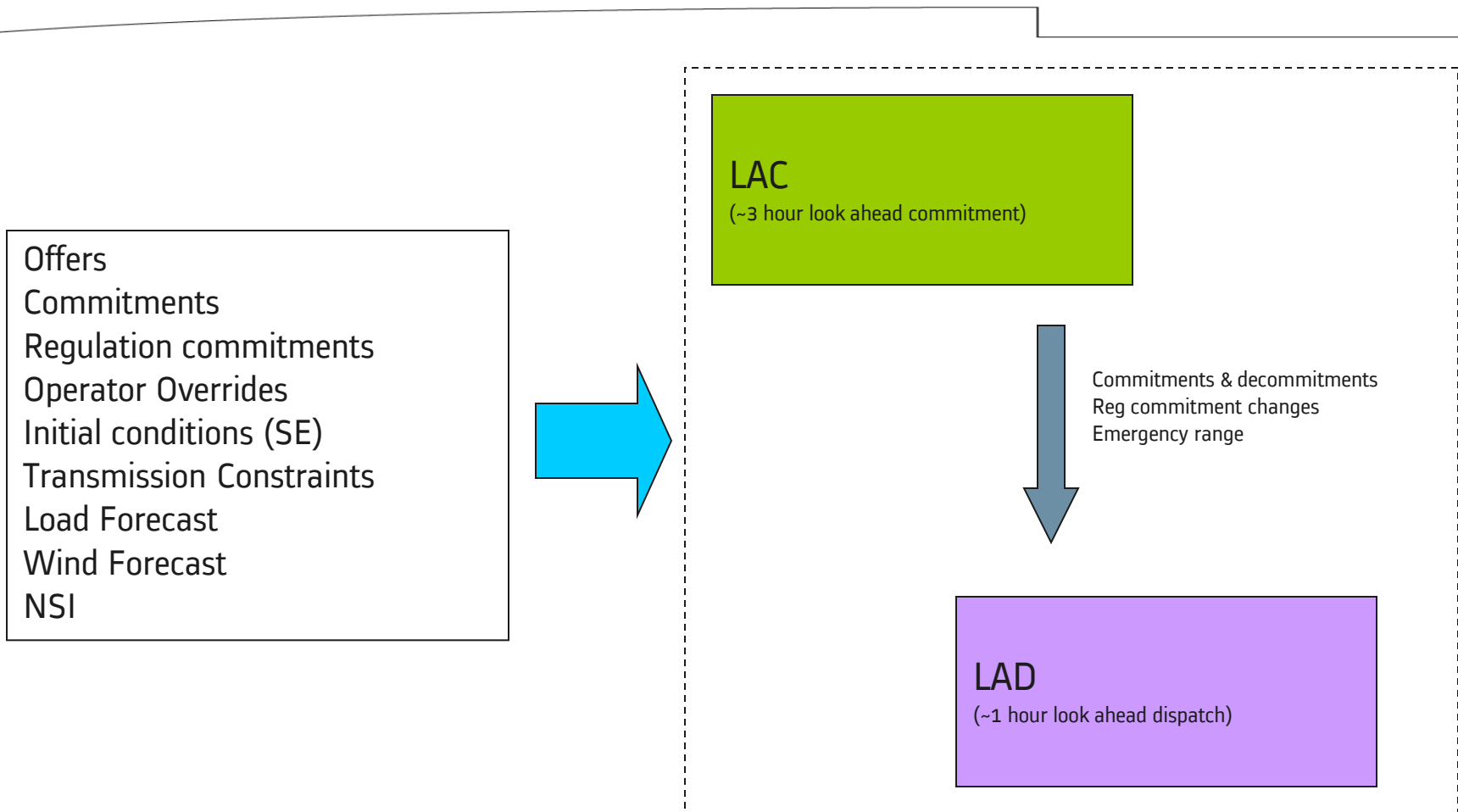
(Valley Forge, Pa. – Jan. 19, 2012) – [PJM Interconnection](#) saved \$199 million last year—an amount almost equal to its operating costs—by increasing efficiency in how generation is scheduled to meet electric demand requirements, particularly, the scheduling of more costly combustion turbines used to meet demand shortfalls. Accumulated savings since 2008 are \$455 million.

Combustion turbines, gas or oil-fired generators that use air combustion to produce power, are often on-stand-by to run in case needed because they can be brought on-line more quickly. However, the cost of having them available and running them are typically more expensive than previously scheduled generation.

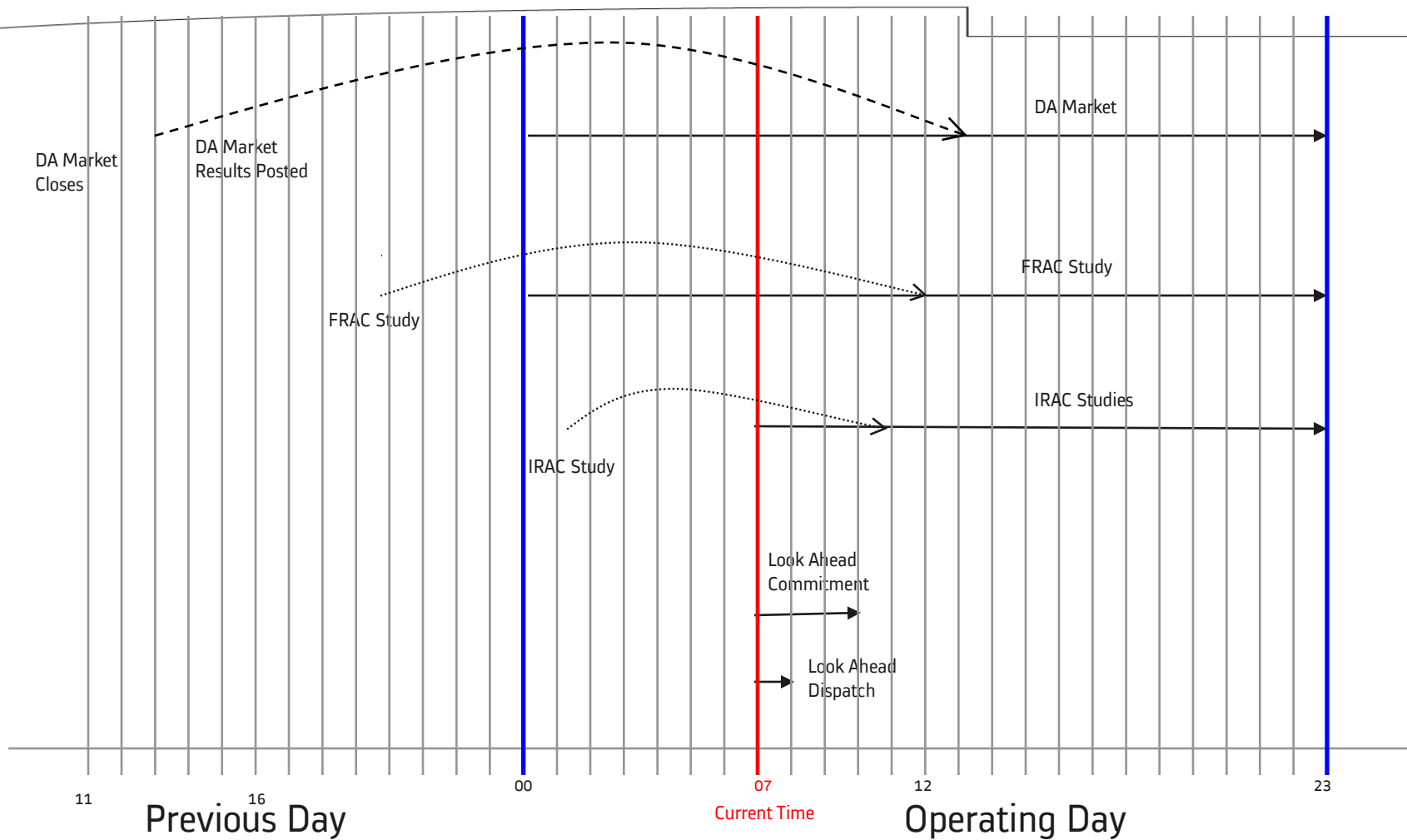
MISO Real-Time Market Evolution

- 2005: Launched Energy only Market
- 2009: Launched Energy and Ancillary Services Market
 - Energy and AS co-optimization in both DA and RT markets
 - DRR I and II, SER, etc.
- 2011: Look-Ahead Commitment in parallel operation
- 2012: Look-Ahead Commitment went live
- 2012: FERC 755, ELMP
- 2013: Look-Ahead Dispatch in plan

MISO LA-SCED



LAC & LAD Relative Timeline at PJM



MISO LAC Phase 1

- Focus on near short term period (~3 hours)
- Bridge gap between existing IRAC & real-time dispatch
- Application of advanced optimization algorithms to improve ear term commitment process
- 3 scenarios to study input data uncertainties
- Real time telemetry input and wind forecast
- Energy and Ancillary Services Co-optimization
- Sub-hourly granular study to address intra-hour issues
- Operator review and approval of commit suggestions

MISO Savings from LAC

MISO Press Release Issued April 3, 2012

The screenshot shows a web browser window displaying the MISO website. The address bar shows the URL: <https://www.midwestiso.org/AboutUs/MediaCenter/PressReleases/Pages/Look-AheadTool.aspx>. The MISO logo is in the top left, and a search bar is in the top right. The navigation menu includes Home, About Us, What We Do, Stakeholder Center, Markets and Operations, Planning, Training, and Library. The left sidebar contains a list of links under 'About Us', with 'Media Center' highlighted. The main content area features a breadcrumb trail: Home > About Us > Media Center > News > Look-Ahead Tool Improves Efficiencies, Reduces Costs. The article title is 'Look-Ahead Tool Improves Efficiencies, Reduces Costs'. A sub-headline reads '\$2 million in benefits estimated for stakeholders'. The release date is April 3, 2012, and the media contact is MISO Media: 317-432-4507. The text describes the implementation of the Look Ahead Commitment (LAC) Tool, its benefits for efficiency and cost reduction, and quotes MISO President and CEO John R. Bear and Vice President of Operations Richard Doying.

https://www.midwestiso.org/AboutUs/MediaCenter/PressReleases/Pages/Look-AheadTool.aspx

MISO

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Look-Ahead Tool Improves Efficiencies, Reduces Costs

\$2 million in benefits estimated for stakeholders

For Immediate Release
April 3, 2012

Media Contact
MISO Media: 317-432-4507

Carmel, Ind. – Following approval from the Federal Energy Regulatory Commission (FERC), MISO implemented a new Look Ahead Commitment (LAC) Tool this week for its power grid operators which will improve operational efficiencies and reduce the cost of wholesale power. The LAC Tool more efficiently plans near-term resource commitments in the Real-Time Market. By conservative estimates, the tool is expected to save upwards of \$2 million per year to the region, which covers 11 states and Manitoba, Canada.

"This is great news for MISO members and others in our region. We are excited to introduce the LAC tool to help deliver energy more efficiently and reliably. I am glad FERC recognizes the benefit of the LAC tool to MISO members and their consumers," said MISO President and CEO John R. Bear.

MISO developed the LAC Tool after extensive analysis of the current process used in real-time for the commitment of resources to produce energy. The tool displays on the control-room operator's instrument panel, giving the operator access to new operational information. The "smart-thinking" application will help decision making and provide new ability to take fast actions that will keep power flowing efficiently. MISO's Independent Market Monitor (IMM) has consistently identified a look-ahead capability as a means of improving the commitment of fast-start resources such as gas turbines.

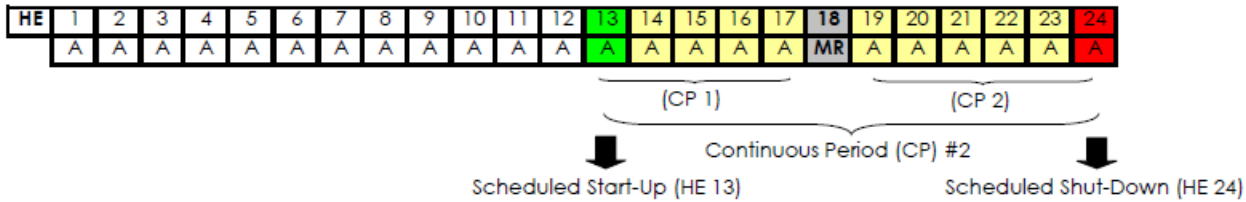
"MISO members will benefit from operational and market efficiency as result of the Look Ahead Commitment Tool. The current Intra-Day Reliability Assessment Commitment process is less efficient for near real-time resource commitments and often must be done manually. The LAC Tool is a new online process. We will be able to better identify upcoming changes and more efficiently commit resources to meet those needs," said Richard Doying, Vice President of Operations.

About MISO

MISO ensures reliable operation of, and equal access to high-voltage power lines in 11 U.S. states and the Canadian province of Manitoba. MISO manages one of the world's largest energy markets, with more than \$23.6 billion in energy transactions annually. MISO was approved as the nation's first regional transmission organization in 2001. The non-profit 501(C)(4) organization is governed by an independent Board of Directors and is headquartered in Carmel, Ind., with operations centers in Carmel and St. Paul, Minn. Membership is voluntary.



MISO Make Whole Payment Example



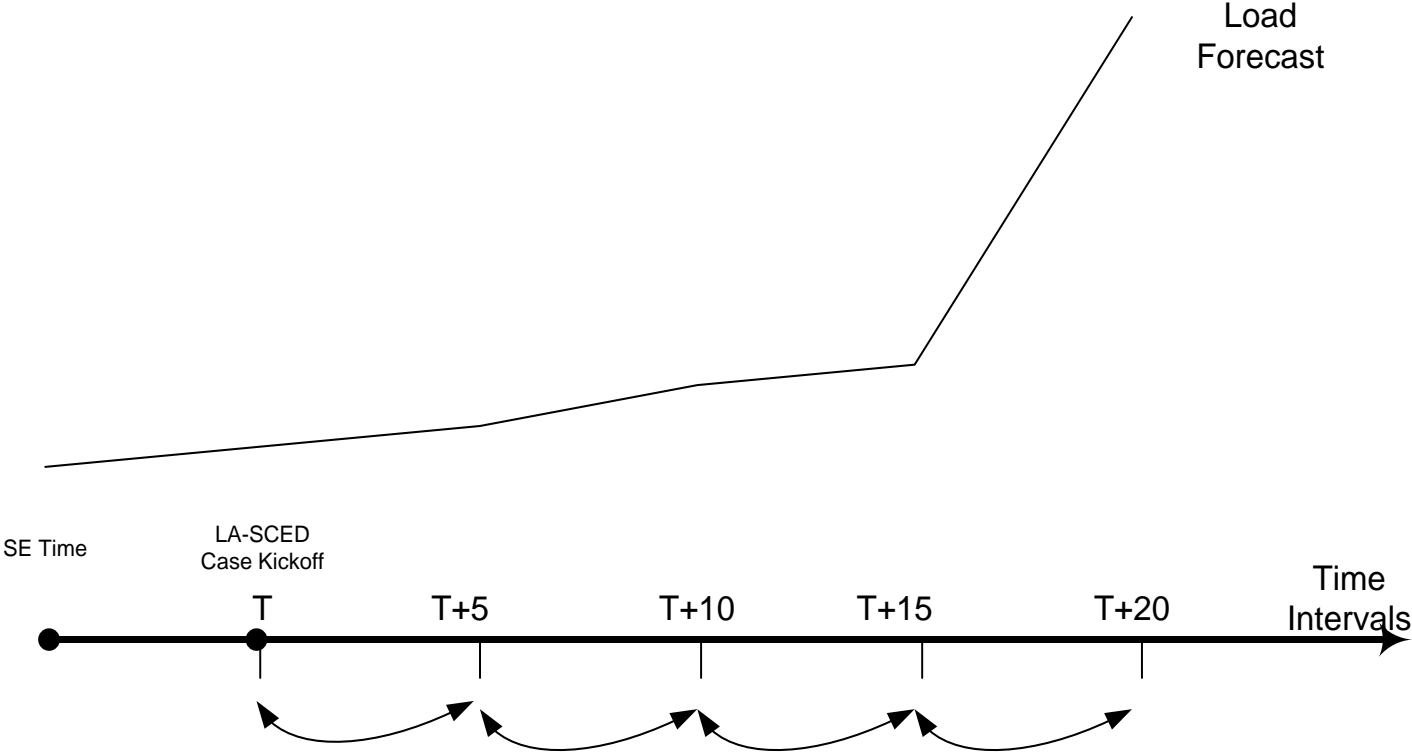
Real-Time Market (Real-Time RSG Make Whole Payment for CP #1)

HE	"Market Value"			Cost				Net	Make Whole Payment
	Actual or Alternate Meter	LMP	Revenue	Startup	No Load	Incremental	Total		
13	176	\$91.17	\$16,045.92	\$0.00	\$100 .00	\$12,792.45	\$12,892.45		\$0.00
14	176	\$91.82	\$16,160.32	\$0.00	\$100 .00	\$12,792.45	\$12,892.45		\$0.00
15	176	\$90.21	\$15,876.96	\$0.00	\$100 .00	\$12,792.45	\$12,892.45		\$0.00
16	176	\$89.04	\$15,671.04	\$0.00	\$100 .00	\$12,792.45	\$12,892.45		\$0.00
17	176	\$96.30	\$16,948.80	\$0.00	\$100 .00	\$12,792.45	\$12,892.45		\$0.00
Totals:			\$80,703.04	\$0.00	\$500.00	\$63,962.25	\$64,462.25	\$6,240.79	

Real-Time Market (Real-Time RSG Make Whole Payment for CP #2)

HE	"Market Value"			Cost				Net	Make Whole Payment
	Actual or Alternate Meter	LMP	Revenue	Startup	No Load	Incremental	Total		
19	176	\$90.98	\$16,012.48	\$0.00	\$100.00	\$12,792.45	\$12,892.45		-\$2,695.24
20	143	\$72.47	\$10,363.21	\$0.00	\$100.00	\$10,708.28	\$10,808.28		-\$2,695.24
21	135	\$48.49	\$6,546.15	\$0.00	\$100.00	\$9,541.80	\$9,641.80		-\$2,695.24
22	135	\$41.02	\$5,537.70	\$0.00	\$100.00	\$9,541.80	\$9,641.80		-\$2,695.24
23	135	\$28.93	\$3,905.55	\$0.00	\$100.00	\$9,541.80	\$9,641.80		-\$2,695.24
24	135	\$27.64	\$3,731.40	\$0.00	\$100.00	\$9,541.80	\$9,641.80		-\$2,695.24
Totals:			\$46,096.49	\$0.00	\$600.00	\$51,667.93	\$61,267.93	-\$16,171.44	

Resource Pre-Ramping in Time-Coupled LA-SCED



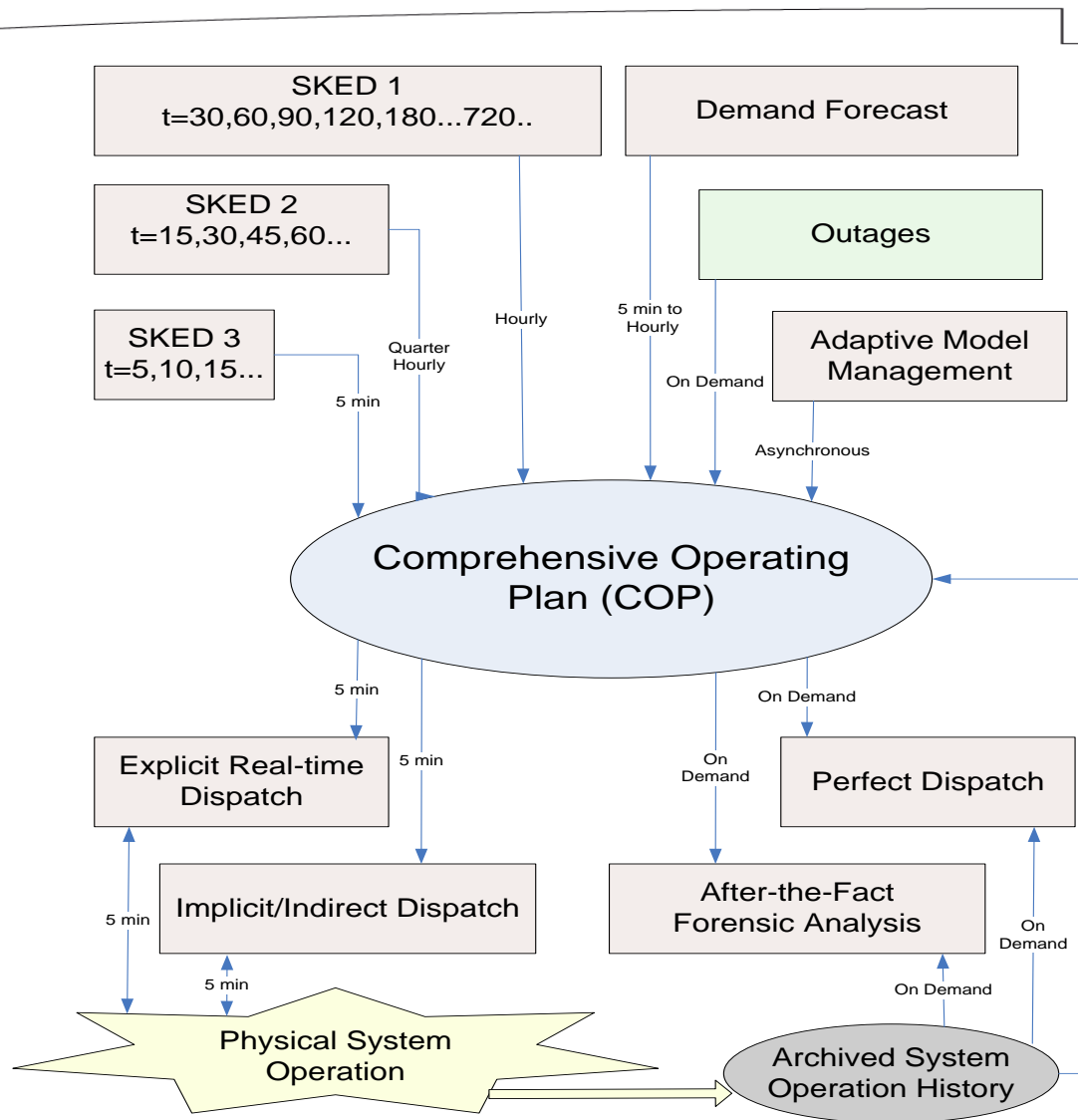
LA-SCED IMPLEMENTATION CHALLENGES

LA-SCED: Summary of Implementation Challenges

- Uncertainties of future operating conditions
 - Load forecast error
 - NSI uncertainty
 - Wind forecast errors
 - Discrepancy between outage schedules and the actual occurrence
- LA commitment and dispatch justification
 - Operators need to quickly understand the reasons for fast-start commitment and out-of-merit dispatch
- UI design
 - Efficiently presenting information obtained from large amount of data
- Time coupled multi-interval dispatch and pricing
- Cross hourly boundary and day boundary

ALSTOM SMART DISPATCH R&D DEVELOPMENT

ALSTOM Smart Dispatch Overview



ALSTOM LA-SCED Optimization Engine

- LA-SCED is a Mixed Integer Programming (MIP) / Linear Programming (LP) based optimization application which includes both unit commitment and unit dispatch functions. LA-SCED can be easily configured to perform scheduling processes with different heart beats and different look-ahead time.
 - Far Look-Ahead Unit Commitment
 - Incremental commitment for next 6-12 hours with hourly intervals
 - Short-Term Look-Ahead Scheduling
 - Look ahead 2-4 hours with 15-minute intervals
 - Both commitment and dispatch
 - Real-time Dispatch and Pricing
 - Dispatch and pricing for next hour with 5-minute intervals

ALSTOM RT/LA Product Features

- Fully support Energy and AS co-optimization
 - Scarcity pricing
- Support various resource types, including storage, DRs, wind, Combined Cycle, etc.
- Look-Ahead network topology processing and constraint prediction
- Information driven Operator UI
- Configurability
 - Commitment/Dispatch/Pricing
 - Single Interval/Multi-interval time coupled /multi-interval non-time coupled
 - Study period and interval duration

ALSTOM'S NEW DEVELOPMENTS IN REAL-TIME MARKETS

Alstom's New Developments In Real-Time Markets

- Model Demand Responses and Distributed Energy Resources
 - MISO DRR Type 1 and Type2
 - PJM Price Responsive Demand
 - Pilot Projects with Duke, NiceGrid, etc.
- Wind & Renewables Integration
 - Dispatchable Intermittent Resources
- Model Storage Resources
 - MISO Stored Energy Resource (SER)
- FERC Order 755 – Regulation Payment for Performance
 - Working with PJM and MISO, target production Q4 2012
- MISO Extended LMP
- ISO-NE Adaptive Transmission Rating
- Load following product / ramp product

Q&A

THANK YOU!