Observations on the Report of the Independent Consultants on the GreenHat Default Recommendations

PJM Interconnection

May 10, 2019

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Contents

Introduction

In June 2018, GreenHat Energy, LLC, a financial trader in PJM Interconnection's Financial Transmission Rights (FTR) Market, defaulted on its obligations. The default requires PJM to reevaluate the structure of the FTR market and thoroughly assess potential modifications for its future success.

In October 2018, the PJM Independent Board of Managers commenced a third-party review of the default. The scope of the review included PJM's actions leading up to the default as well as recommendations for the future.

The Report of the Independent Consultants on the GreenHat Default (Independent Report) included findings and seven recommendations to improve credit risk policy and to provide better risk management tools.

Broadly, the recommendations are:

A. Advance credit/collateral best practices into the Tariff
B. Clarify the role of PJM as manager of risk in financial markets
C. Build a customer awareness beyond market procedures and rules
D. Implement technical practices for participant risk management
E. Bring on board and develop new expertise in risk management
F. Increase the frequency of long-term auctions
G. Make critical organizational changes

The Authors of the Independent report highlighted that PJM failed to establish robust participant risk-management tools and procedures and that there were market design flaws that gave GreenHat room to develop a massive portfolio without the posting of appropriate collateral.

In response, PJM and its members have created the Financial Risk Mitigation Senior Task Force (FRMSTF) to discuss and recommend tariff-related changes to risk mitigation and management in PJM. PJM management and staff have also undertaken other measures, outlined in the Appendix A: CEO Action Plan for Organizational Changes and Process Improvements, which was reviewed with the Markets & Reliability Committee on April 25, 2019, and is included in this report. Updates regarding those measures will be provided to the Members Committee and will not be part of the work undertaken by the FRMSTF.

In order to assist the FRMSTF in its mission, PJM staff has closely reviewed the recommendations of the Independent Report and offer observations and notes in the pages that follow. PJM staff believes these recommendations, coupled with the observations in this document and stakeholder feedback in response to the circulated framing questions, form a solid foundation for credible reform to the way financial market risk is mitigated and managed in the PJM marketplace.

Observations on the specific recommendations follow.

Recommendation A: Advance Credit/Collateral Best Practices into Tariff

Recommendation A1: Use the mark-to-auction values established in the more frequent auctions as the basis for "variation margin," charging as a current debt the value erosion between the purchase price and the current market value as determined by the latest auction.

Recommendation A1.1: This will help to capture the credit risk for all FTRs, not just near term FTRs, and reduce the current volatility of margining due to infrequent auctions.

PJM Observations:

PJM agrees with this recommendation. The "mark-to-auction" credit requirement endorsed by the members and approved by the Federal Energy Regulatory Commission (FERC) became effective April 4, 2019. The "mark-to-auction" credit requirement is calculated intra-auction and post-auction. PJM's current "mark-to-auction" process requires incremental collateral from FTR participants based on the valuation of positions in the most recent auction. In order to fully address the recommendation, we believe that FRMSTF and PJM Staff will need to examine a full "mark-to-auction" variation margining (i.e., incremental settlement) process.

Recommendation A2: Retain the 10 cent per MWh minimum charge, in addition to purchase price, as a form of "original margin" until such time as more precise measurements become available to determine original margin.

PJM Observations:

PJM agrees with this recommendation. The $0.10/MWh minimum charge was implemented on September 4, 2018 and is an important component of the initial margin calculation for FTR credit requirements.

Recommendation A3: Eliminate the FTR undiversified adder because it is uncorrelated to market risk.

PJM Observations:

PJM agrees with the general intent of this recommendation and its underlying findings – that historical performance on a path is not a good indicator of future performance, particularly given the possibility of "contingency" events, such as line outage or augmentation. By extension, the undiversified adder is a poor proxy to a more sophisticated forward-looking modeling of credit risk that might consider such contingencies. PJM intends to undertake an investigation and modeling of alternative risk models, the results of which will feed into the recommendation for tariff revision.

It is noted that any model that more accurately considers contingency events would, by extension, consider the sensitivity of an undiversified portfolio to individual contingencies, and margin appropriately, providing a better tool for the management of credit risk on such portfolios than a blunt tool like the "undiversified adder".

The figures in exhibit B demonstrate that there are are under collateralized with and without the undiversified adder.

Recommendation A4: Define a default as any participant that is unable to meet a monthly variation margin call within two business days. Specifically require that the default be declared promptly and without negotiation.

PJM Observations:

PJM Staff agrees with the recommendation. As soon as a participant fails to meet a margin call, it should have its trading rights removed and PJM should have the right to liquidate its position. As a practical matter, though, this liquidation cannot take place until the next FTR auction, and would require changes to our current tariff. The nuanced questions this recommendation raises are: What should be done if a participant is able to cure the default in the interim? Should actions to terminate the participant still proceed (presuming other investigation of the participant doesn't indicate reasons for termination)? This also raises a question regarding whether there should be further gradations of default. This topic needs to be discussed in further detail with the FRMSTF.

Recommendation B: Clarify the Role of PJM as Manager of Risk in Financial Markets

Recommendation B1: PJM should revisit its existing stakeholder process to better facilitate member-to-PJM directions and advances in financial market policies and procedures.

Recommendation B1.1: Seek an equitable and efficient process centered on the relevant expertise that each PJM member may bring.

Recommendation B1.2: Financial market member committees: voting attendees must be qualified member personnel, such as credit professionals, traders, or finance professionals, as appropriate for the committee duties.

Recommendation B1.3: The number of committees involved in rule-setting for financial markets should be strictly minimized to streamline decision-making and assure clear accountability.

PJM Observations:

PJM Staff interpret these recommendations to be proposing that:

- all financial market-related matters be dealt with by a single committee
- the approval chain between the committee endorsing a rule change and Board approval should be "strictly minimized" to ensure decision-making on these matters is clear and not diluted as it passes through multiple committees
- voting members of the this committee should have professional experience relevant to the subject matter addressed by the committee

PJM staff sees strong logic in having a committee with specific focus on financial markets matters, to ensure these can be dealt with on a holistic basis (both product design and credit risk). We also see merit in ensuring that the *individuals* forming part of this committee possess expertise and experience relevant to its work. We do not see this in any way restricting the right of any stakeholder *organization* to participate in the work of the committee. This does invite the question of how to make a determination that a committee member possesses the relevant skills.

Experience from similar bodies would indicate that, once such an expectation is clearly articulated, organizations would tend to respect it. The FRMSTF should consider how eligibility should be determined and enforced.

We agree the approval chain of any new committee holistically addressing financial market matters could be streamlined.

Recommendation B2: PJM should work with FERC to establish appropriate flexibility in policies and rulemaking concerning financial markets.

Recommendation B2.1: Amend Tariff rules to make a parallel rule for FTR contracts, and other markets, to the provisions in Attachment Q for Peak Market Activity Transactions.

Recommendation B2.2: Amend rules to include within the definition of Material Adverse Change in Attachment Q an inability to meet any PJM margin call within two business days.

Recommendation B2.3: Provide rules that give PJM discretion to deal with unanticipated market emergency events.

PJM Observations:

PJM agrees that there should be stand-alone credit language for FTRs that is not entangled with the credit rules for other trading. PJM also agrees with the independent consultants' recommendation that PJM needs discretion to deal with unanticipated market emergency events.

Though not explicitly addressed in the recommendation, but consistent with the findings under Complication 3, PJM believes there is a need for a review of the current minimum participation and capitalization requirements. The current rules allow companies with few or no tangible assets to have access to the FTR market.

An observation made in the Independent Consultants' Report was that a thinly capitalized company was able to amass a large portfolio. Even if the mark-to-auction component of the FTR credit requirement were in place when GreenHat was acquiring positions, it would not have had the financial ability to meet the collateral call. Though improvements to the initial margin have been made, and will continue to be made, ultimately a member company's financial health will determine if margin calls in the future are viable.

Recommendation B3: As benchmark for progress with B1) and B2) - Examine the specifics and the cost/benefits of outsourcing to a credible outside provider the administration of all or part of the FTR market.

PJM Observations:

PJM agrees that use of an external clearing-house is an alternative that should be investigated, with findings presented through the stakeholder process.

Recommendation C: Build a Customer Awareness Beyond Market Procedures & Rules

PJM agrees that it needs to enhance its member awareness to better know its customer. PJM agrees that more process is required when applicants apply for membership to flag any potential bad actors in the market, and ongoing financial surveillance is required to rapidly detect changes in a market participant's financial health after it becomes a member. PJM has already begun to improve its internal practices by doing informal search queries on companies applying for membership. PJM will continue to utilize this process in the interim while it engages external experts to develop a more formal background-check process. Additionally, PJM will work with stakeholders to consider potential rules and procedures around denying or revoking membership on the basis of adverse background and limiting or terminating market activity based on evaluation of financial capacity and other risk factors.

While the Independent Consultants' Report focuses on background checks for new applicants, PJM believes, in order to be non-discriminatory, and for reasons of good risk management practice, existing members should also be required to maintain compliance with the same criteria.

Recommendation C1: Perform outsourced background checks for any member applicant, and should the applicant not be a public company, for the three most senior officers.

PJM Observations:

PJM agrees that it needs to improve its internal processes to increase awareness of who potential members are by performing background checks. However, PJM believes the scope of the background checks should go beyond just the company applying and its three most senior officers. PJM is currently engaging with financial institutions to become more educated on "know your customer" best practices.

PJM has also reached out to other ISOs and RTOs to learn more about the background checks they employ for new member applicants and existing members. We have learned that there are no prevailing practices across the ISOs and RTOs. Several ISOs are currently not performing any type of background check, while others have rudimentary checks and certification document requirements in place.

Beginning in November 2018, PJM started performing informal search queries on companies applying for membership. This informal review consisted of an internet search of the company, known affiliates and officers named on the application. In April 2019, PJM began using Lexis Nexis to perform more robust background searches. If any adverse information is identified, the findings are sent to senior management for further review and discussion for consideration of any potential action.

Under the current Operating Agreement, PJM must approve or deny a membership application within 60 days. This may need to be reevaluated. Other ISOs and RTOs have anywhere from three weeks to an unlimited time to approve or deny membership applications. Similarly, it may be worth differentiating between becoming a member of PJM and having trading rights to access the FTR market, with potentially different timeframes for each. The goal is to establish a standard that allows sufficient time for PJM to perform a due diligence process but which would not unnecessarily delay the application process.

Recommendation C2: Perform due diligence by confirming that an applicant for membership actually employs the systems and processes for risk management as represented.

PJM Observations:

Currently, PJM requires risk procedures for each FTR market participant. PJM will work with experts and the members to develop standards for participant risk procedures and certification of those procedures.

Recommendation C3: Provide explicit power for the rejection of a membership application should standards of good background and regulatory history not be met.

PJM Observations:

PJM agrees that it should have the ability to deny membership if an applicant poses a risk, based on the background check. Additionally, the right to cancel membership should be applicable to active members in the event the financial health of the company or other elements of the company change substantially, such that they could no longer pass the background and regulatory history check.

The Operating Agreement currently limits PJM's ability to deny membership based on any reason other than when an applicant does not complete the application within the 60-day timeframe, including based on adverse information. Additionally, PJM presently has limited authority to restrict market activity based upon risk factors. Addressing Recommendation C3 will, by necessity, require enhancement of these rules.

Market activity is typically limited under the following conditions:

- A member is pending withdrawal
- A member has not paid its annual dues
- A member has an outstanding collateral call

PJM looks forward to working with stakeholders to clarify the criteria to be used to deny membership, restrict market activity and cancel membership.

Recommendation C3.1: Create an internal appeal mechanism in order to address any claims of any undue discrimination swiftly without unnecessarily involving FERC.

PJM Observations:

PJM agrees that an appeal mechanism should be established to address any claims of undue discrimination by new applicants who have been denied membership to PJM, or existing participants whose trading rights have been revoked. Currently, the only redress is to file a complaint with FERC. PJM looks forward to working with members to identify the right body to deal with appeals.

Recommendation C4: Update the financial qualifications of participant companies at least annually and clarify PJM's rights to act on a member's failure to meet those requirements.

PJM Observations:

Currently, members are required to provide annual financial statements as part of the annual certification process. PJM agrees that members should continue to be required to update their financial qualifications at least annually and that PJM should have the right to act if a member fails to meet those requirements. Additionally, PJM believes that customer awareness for active members goes beyond just the financial health of an organization. Ongoing customer awareness will also require PJM to perform background checks on existing members to ensure they stay in good standing.

Recommendation D: Implement Technical Practices for Participant Risk Management

Fundamental gaps in market surveillance contributed to the GreenHat default. PJM staff has already expanded its focus to include enhanced assessments for market participant behavior. This scope will continue to expand to include periodic internal reporting and improved communication with the Independent Market Monitor. This expanded scope from markets staff will ensure outliers in the FTR market are identified earlier and addressed, when necessary.

Recommendation D1: Clarify with the IMM any PJM expectations regarding participant risk management of (some) participant behaviors and reporting such with PJM.

Recommendation D3: Create internal participant risk-management reports that are reliably generated on a periodic basis according to the frequency of opportunities for participants to change portfolio positions.

PJM Observations:

PJM Staff accept and acknowledge the failure to employ important methods to effectively monitor FTR participants for unacceptable risks. Since June 2018, staff has been closely tracking FTR market activity in regards to megawatt-hour concentration levels by location, trading volumes and market-pricing trends for all participants. Benchmarking and sharing data, internally and with the Independent Market Monitor (IMM), is a priority now and moving forward.

Markets staff has started to track this data and develop several reports to assess FTR market participant behavior, including, but not limited to:

- Megawatt-hour concentration and position by location
- Megawatt-hour and bid price activity by FTR period
- FTR auction clearing price vs. DA settlement price by location
- Projected changes in value to existing portfolios

In addition to the above "after-the-fact" market surveillance, staff have also started two additional tracks to create a predictive analytic work stream, examining:

1. Bidding behavior analytics
2. Secondary FTR portfolio assessments

Through studying bidding behavior analytics over time, PJM staff aims at creating algorithmic screenings to identify anomalous events in an FTR auction. Secondary FTR portfolio assessments could be considered a "second opinion" of FTR market-clearing prices (projected future congestion prices), utilizing a separate production cost simulation software to forecast future LMPs, given a forecast set of conditions including fuel costs, transmission topology, and so on. Both sets of FTR valuations could be compared to determine if substantial outliers exist, prior to the approval of an auction.

PJM will continue to look for advancements in assessing market participant behavior through the stakeholder process, with the IMM and independent industry experts. PJM will also look at the development of a set of non-confidential risk statistics that can be published to market participants.

Recommendation D2: Establish position limits for FTRs.

PJM Observations:

PJM agrees with the establishment of position limits, and is presently seeking to engage external market surveillance expertise from the financial markets to advise on development of an appropriate methodology.

Recommendation F: Increase Frequency of Long-Term Auctions

Recommendation F1: Include Long Term FTRs in monthly or at least bi-monthly auctions.

Recommendation F2: Convene a committee of FTR traders with PJM Credit & Operations to explore new approaches to make more frequent long-term auctions both more efficient to run and as liquid as possible.

PJM Observations:

PJM staff agrees that a lack of transparency gave GreenHat some benefit of the doubt during problem analysis. Specifically, forward price signals from long-term FTR auctions have proven to be insufficient to provide mark-to-auction (MTA) price information to assess the change in value of long-term portfolios.

PJM understands the credit risk benefit that more frequent FTR auctions would provide, in terms of being able to conduct the mark-to-auction process on a more frequent basis. PJM intends both to examine the scope and tenure of the products made available in each auction and re-examine available technological solutions (an exercise that has been periodically undertaken in the past).

In 2008, the FTR long-term market was created to better manage basis risk associated with multi-year retail load obligations and enhance liquidity and hedging flexibility among all market participants. Given the limitations and risks highlighted by the GreenHat default, the structure of the FTR long-term market and associated activity in the annual market should be fully reevaluated.

PJM staff recognizes that there are existing IMM recommendations associated with long-term auctions. Additionally, staff recognizes that the value of the long-term market was discussed through the majority of 2018. The stakeholders reached consensus on removing the three-year long-term FTR product and improvements to the long-term model to better account for available transmission capability available for sale. PJM remains open to discussing further advances to the long-term market structure to ensure the long-term auctions run as efficiently as possible and to ensure mitigating as much risk as possible in regards to the change in value of future positions.

Recommendation F3: With expert help, conduct a general review of the FTR market and other PJM markets, to evaluate the risks and rewards of potential structural reforms.

PJM Observations:

PJM agrees that a general review of the FTR market is necessary to evaluate the risks and rewards of potential structural reforms. Such a review must include an acknowledgement of one theme that is not underscored in the report, namely the fundamental purpose of the FTR product and its evolution over time — specifically, the relevance of FTRs to long-term point-to-point physical transmission service in the PJM LMP market. The point-to-point nature of transmission rights was (at the beginning with FTRs and remains today with ARRs and FTRs) a critical component of the LMP market design.

One of the underlying principles for an LMP-based market architecture is that forward contracting (including self-supply and bilateral transactions) should form the bulk of trades settled in the LMP market, so that spot trading (including the Day-Ahead and Real-Time Markets) can provide a viable, competitive option for market participants to cover their residual needs. Forward contracting, self-supply and bilateral transactions are important because they are the most effective mechanisms for market participants to manage their risk over the long term.

The short-term, hourly spot market is volatile by nature, and therefore, riskier to rely upon as the primary source for sales and purchases by market participants. Forward contracting, self-supply and bilateral transactions rely on and must specify the supply resource or the location at which a transaction occurs. Therefore, the property right represented by the point-to-point definition of congestion rights (i.e., ARRs and FTRs) is necessary for market participants to hedge their exposure to locational price differences between the locations of their forward contract, self-supply or bilaterally contracted supply and the locations of their load obligations.

Today, roughly 75 percent of load supplied in the Day-Ahead Market is through self-supply or bilateral transactions. A fundamental purpose of the FTR auction is to facilitate forward-price transparency and discovery in order to enhance the efficiency of hedging unknown congestion costs associated with the point-to-point physical delivery of energy across the transmission system. Discussions on advancements to better manage risk or to enhance general efficiency of the FTR auctions should include an acknowledgement of this intended purpose.

Appendix A: CEO Action Plan for Organizational Changes and Process Improvements

Recommendation E: Bring On-board and Develop New Expertise in Risk Management

Recommendation G: Make Critical Organizational Changes

Andy Ott shared these action plans with the Members Committee on April 25, 2019. He will update the Members Committee as the plan is implemented. The FRMSTF will not undertake the activity associated with these Independent report recommendations.

Organizational Changes

- Add Chief Risk Officer
- Enhance skill sets in Credit department
- Markets Risk Modeling Department
- Market Analytics and Surveillance Department
- Law, Compliance and External Relations Division realignment to improve communication and coordination
- Establish Risk Oversight and Markets Surveillance Committee (chaired by CRO, includes executive level representation from Finance, Markets and Legal)

Process Improvements

- Improve communication throughout all interactions with stakeholders. Promote employee training to improve active listening skills and emphasize communications to better understand stakeholder positions and interests.
- Establish clearer escalation guidelines and improve communication to the Executive Team
- Engage an external consulting firm to evaluate PJM's product offerings and functional area skill sets and business processes, identify any gaps that exist and provide recommendations for a long-term plan to enhance corporate credit and risk management.
- Complete an external review of market operations procedures – modeled after system operations RCA procedures – to identify risks and ensure that market operations processes include best practices from other regions and industries.
- Establish process for Risk Oversight and Markets Surveillance Committee to review and approve market participant/membership applications
- Review Executive Team communication practices and take steps to improve them.
- Establish Market participant surveillance process and coordinate with Monitoring Analytics on their Market participant surveillance process improvements. Ensure ongoing collaboration
- Enhance regularly reporting process to Executive Team to include the following:
    - Market participant positions, risk profiles, collateral, collateral requirements, trends and significant events

Appendix B: Exhibits Supporting Observations

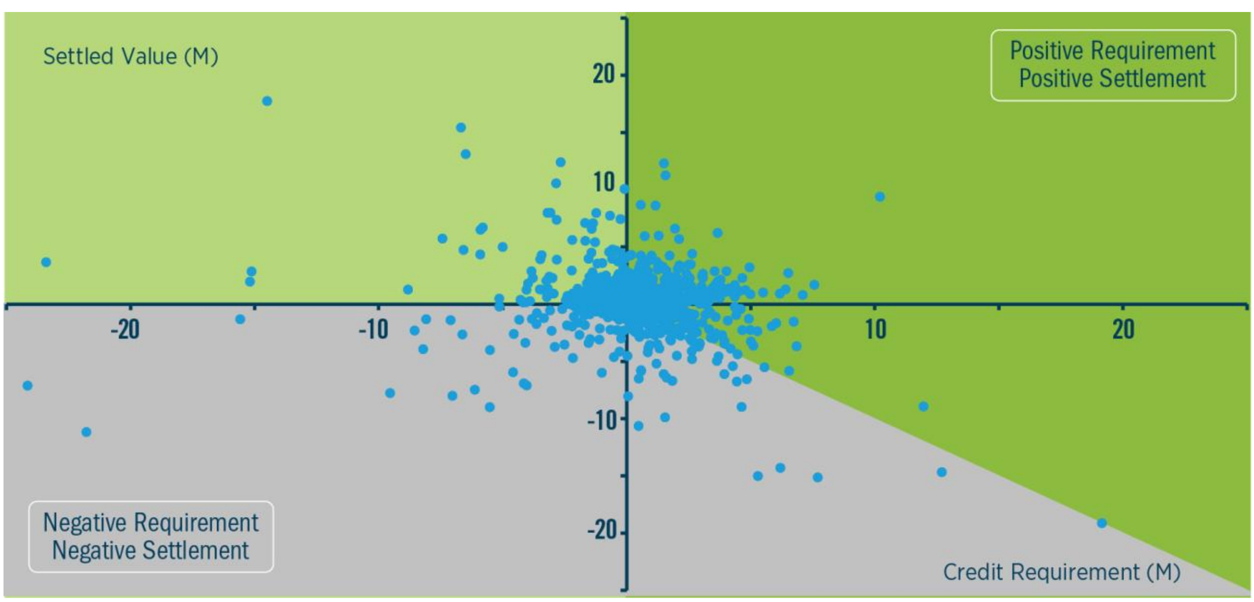
Figure 1 shows the credit requirement versus the settled amounts for participants, where the credit requirement calculated is the path-specific logic (historical marking with Regional Transmission Expansion Plan [RTEP] upgrade considerations) inclusive of the undiversified adder.

How to read the figures:

- A positive credit requirement value indicates that based on the calculations, the portfolio would have had a credit requirement for that month.
- The shaded gray section indicates those monthly portfolios that had a lower credit requirement value than settled value.
- The darker green shaded section indicates those portfolios that had a credit requirement value but had a profitable portfolio.
- The lighter green section indicates those portfolios that had a negative monthly requirement value and were profitable.

Prior to the implementation of the per megawatt-hour requirement, the credit requirements for many portfolios were less than the settled value.

Figure 1. Credit Requirement vs. Settlement Path-Specific Only



Upon the implementation of the $0.10/MWh credit requirement, portfolio requirements shifted to at least being greater than zero; however, there are still portfolios that have a lower credit requirement than the settled value of the portfolio Figure 2. At the same time, there are portfolios that still have higher credit requirements than the settled value of the portfolio.

Figure 2. Credit Requirement vs. Settlement Path-Specific and Per-MWh

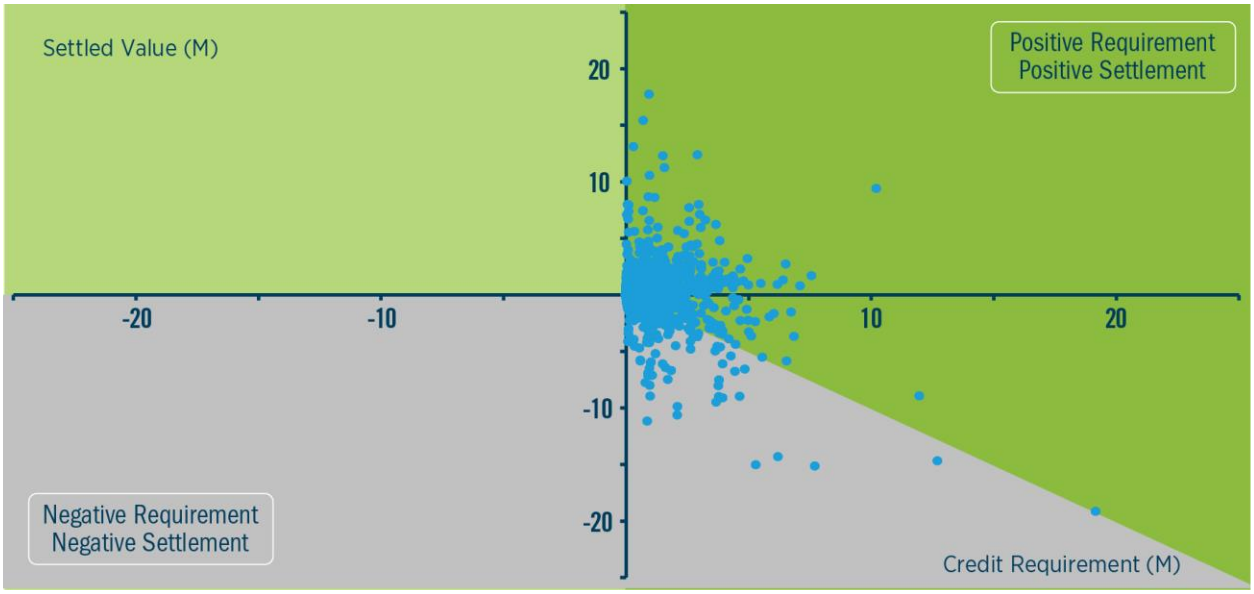
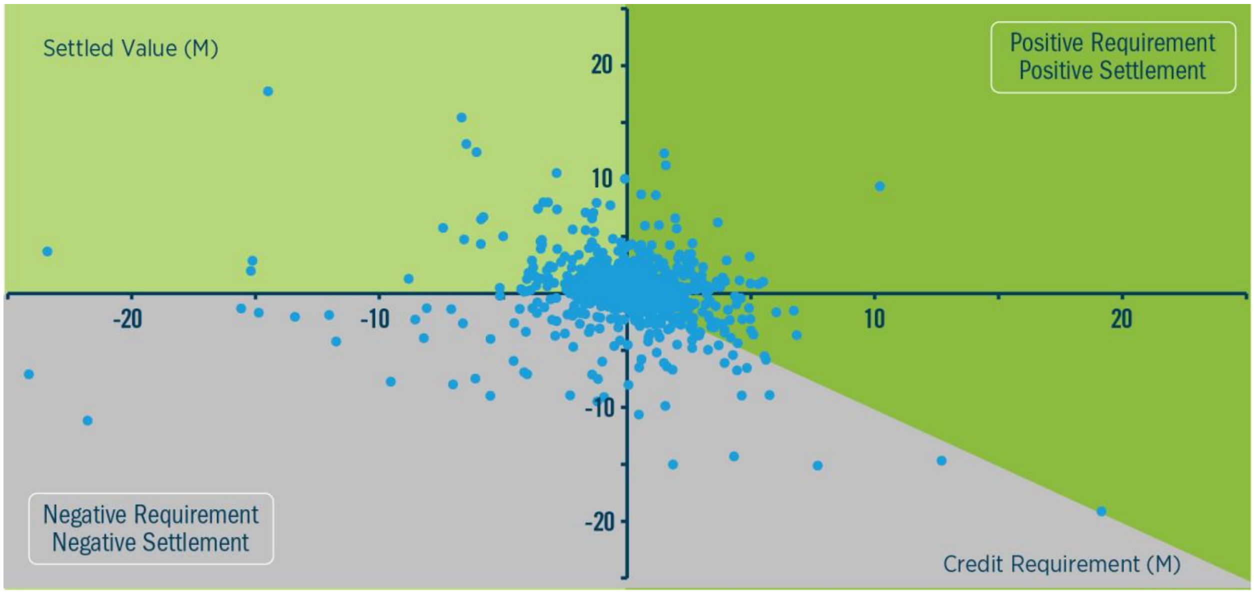


Figure 3 considers the credit requirement based on path-specific (historical marking with RTEP upgrade considerations) but excludes the undiversified adder. There are some portfolios that shift from having a requirement greater than the settled value to having a requirement less than the settled value of the portfolio. However, there are also some profitable portfolios that shift from having a positive credit requirement value to a lower or negative credit requirement.

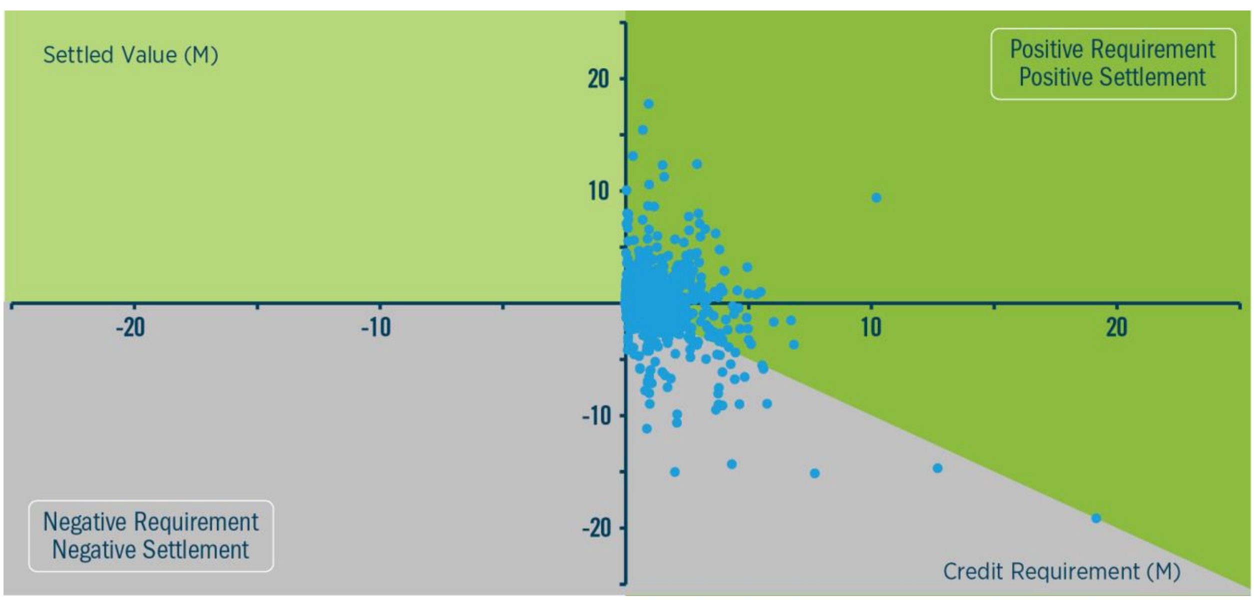
This would indicate that the undiversified adder, in conjunction with the current path-specific requirement is still helping to cover some negative valued portfolios, but that removing the undiversified adder may result in a lower requirement for those who have a profitable monthly portfolio.

Figure 3. Credit Requirement vs. Settlement Path-Specific Only — Excludes Undiversified



In Figure 4, the same plot is shown with the $0.10/MWh calculation, but this time it considers the path-specific value excluding the undiversified adder. The conclusions remain the same as without the per-MWh calculation.

Figure 4. Credit Requirement vs. Settlement Path-per MWh — Excludes Undiversified



Appendix C: Risk-Management Workshop and Additional Observations

On August 14, 2018, PJM hosted an FTR risk management workshop facilitated by Dave Anders, PJM Director of Stakeholder Affairs. Workshop participants included experts in energy markets and risk management in addition to representatives from the IMM and from PJM's Markets, Finance and Law Departments. Below are recommendations for credit risk and markets stemming from the workshop.

Credit

1. Consider increasing FTR market minimum participation requirements.
2. Allow PJM discretionary collateral call authority on a broader basis and for all market participant activity.
3. Establish position/concentration limits.
4. Incorporate a liquidity margin into FTR credit requirements to reflect a portfolio's risk and costs of being liquidated in the event of default.
5. Examine prevailing and counterflow netting in credit requirements, and potentially:
    a. Limit netting to prevailing and counterflow positions geographically close, such as within the same zone.
    b. Eliminate all netting of prevailing flow and counterflow positions.
6. Consider a path-specific counterflow adder instead of a counterflow adder based on net portfolio.
7. Consider if an adder margin should be included in the path-specific and mark-to-auction component credit requirements to address the potential for additional FTR portfolio valuation volatility.
8. Review alternatives for risk management transfer to an external party.

Items 1-4 and 8 were also included in the Independent report. With regards to items 5-7, PJM believes these items may be better addressed with improved, forward-looking risk modeling that considers potential contingency events, and looks at each participant's FTR holdings on a portfolio basis.

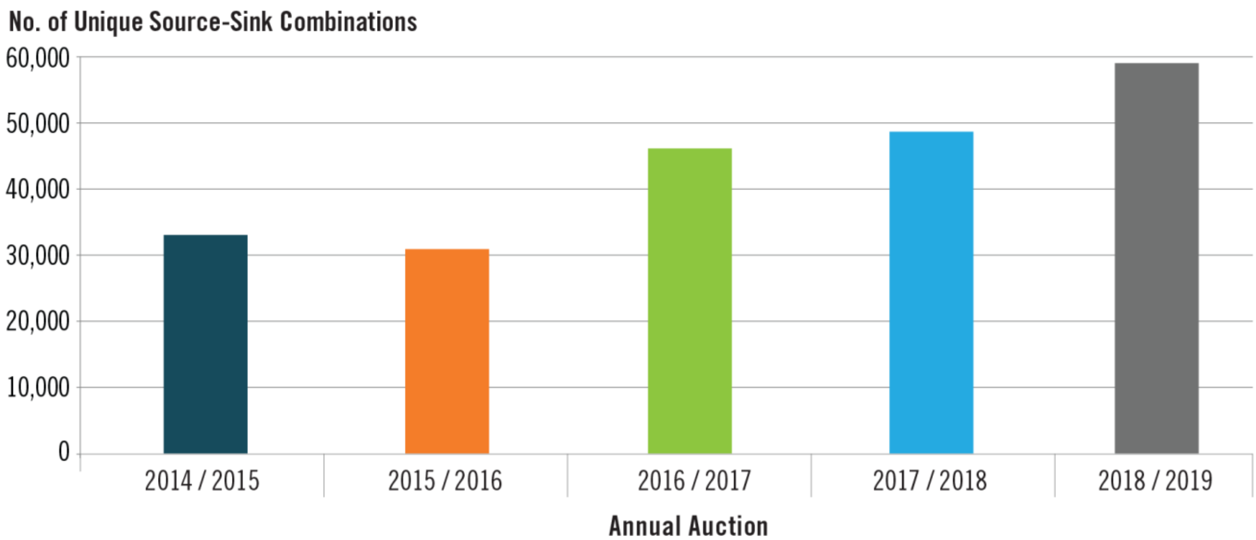
Markets

1. Discuss whether the benefits of long-term FTRs support the potential risks of long-term FTRs.
2. Consider revising the eligible FTR bidding points, such as:
    a. Eliminate FTR option product
    b. Eliminate load nodes
    c. Remove at-risk generators from availability in the FTR model
    d. Align with up-to-congestion biddable points
3. Review the possibility of conducting more frequent FTR auctions

Items 1 and 3 under the Markets section above are discussed in the body of this report, however item 2 was not discussed in the Independent report. Currently, the FTR market allows market participants to bid or offer at locations including generator pricing nodes, interfaces, zones, hubs, and aggregates.

Valid FTR obligation paths for the 2019/2020 Annual Auction exceeded 1.7 million total possible combinations. Additionally, activity at individual load busses is allowed solely in the one-month forward auction periods, increasing potential combinations to more than 23 million (see Figure 5). The size of these potential combinations add significant complexity to the marketplace, making it more difficult to analyze and predict future values and positions.

Figure 5. Unique FTR Source-Sink Bid Combinations



These eligible bidding points should be revisited to determine whether market activity exists that is not contributing to the goal of the FTR auction process. If a correlation between those locations and low competition and high volatility in price discovery exists, removing such locations should be considered.

Removing biddable point locations on physical paths that do not contribute to efficient hedging (i.e. price transparency and price certainty) would better align the use of FTRs with anticipated, physical, transmission system usage in the Day-Ahead Market. Furthermore, removing such biddable points will greatly reduce complexity in the market and allow PJM to better understand and analyze what is happening in the market place.

Figure 6 illustrates the 2018/2019 cleared megawatt total for GreenHat. As shown, FTRs sourcing (bottom of x-axis) and sinking (top of x-axis) at generator busses account for roughly 75 percent of the portfolio for 18/19 effective period.

Figure 6. 2018/2019 GreenHat Portfolio Net MW Make Up

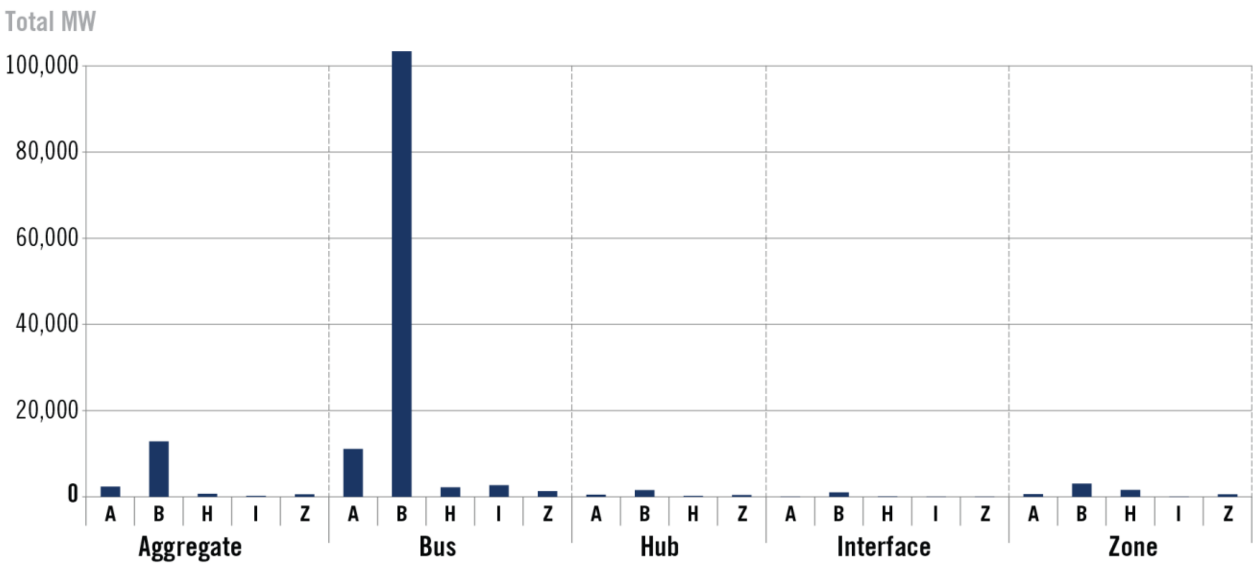
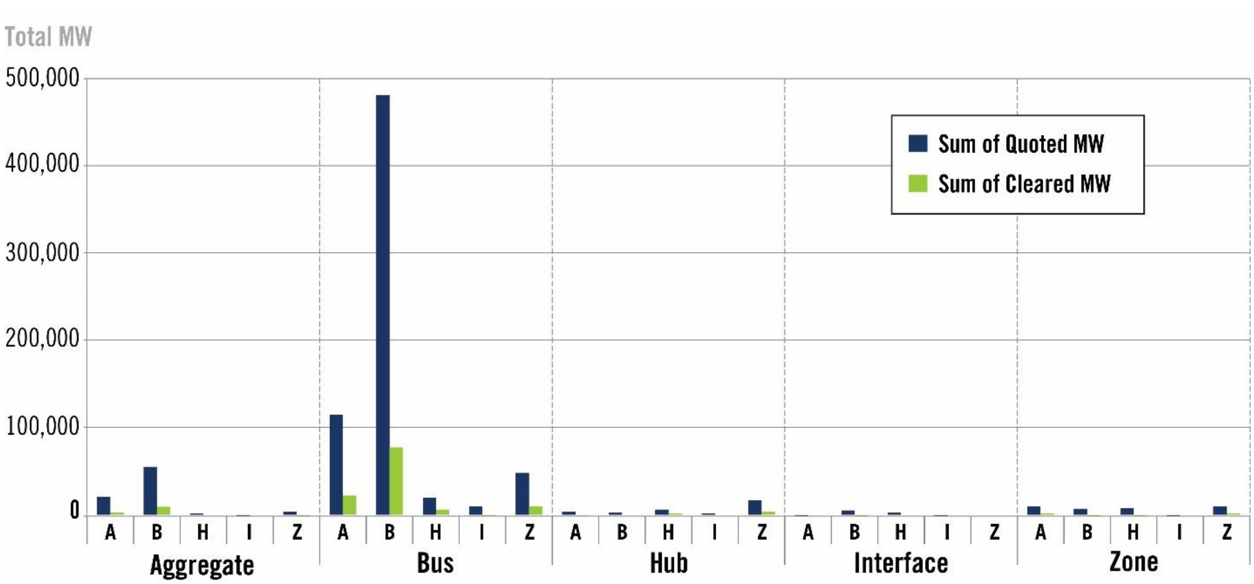


Figure 7 illustrates the most recent annual auction bid locations, by quoted and cleared megawatt total. As shown, FTR sourcing (bottom of x-axis) and sinking (top of x-axis) at the node level are the most utilized.

Figure 7. 2019/2020 Annual Auction R1 Bid Locations



FTR Options

PJM currently offers two types of FTR products, Obligations and Options. Obligations can be a liability, but the hourly economic value of an FTR Option is zero (neither a benefit nor a liability) when the designated path is in the direction opposite to the congested flow. (The Day-Ahead Congestion Price at the source point [point of receipt] is higher than the Day-Ahead Congestion Price at the sink point [point of delivery].) The clearing price of an FTR Option will always be greater than or equal to the clearing price of an FTR Obligation for the same path. Only a subset of paths are available for Option bidding in the monthly and annual FTR auctions. Options are not available in the long-term auctions. Given the current use of the Option product, the added complexity of analyzing the Option product, and the added computation time for determine winning quotes in the auction software, PJM staff is currently studying and assessing the value added of the FTR Option product.

Bilateral Market Advancements

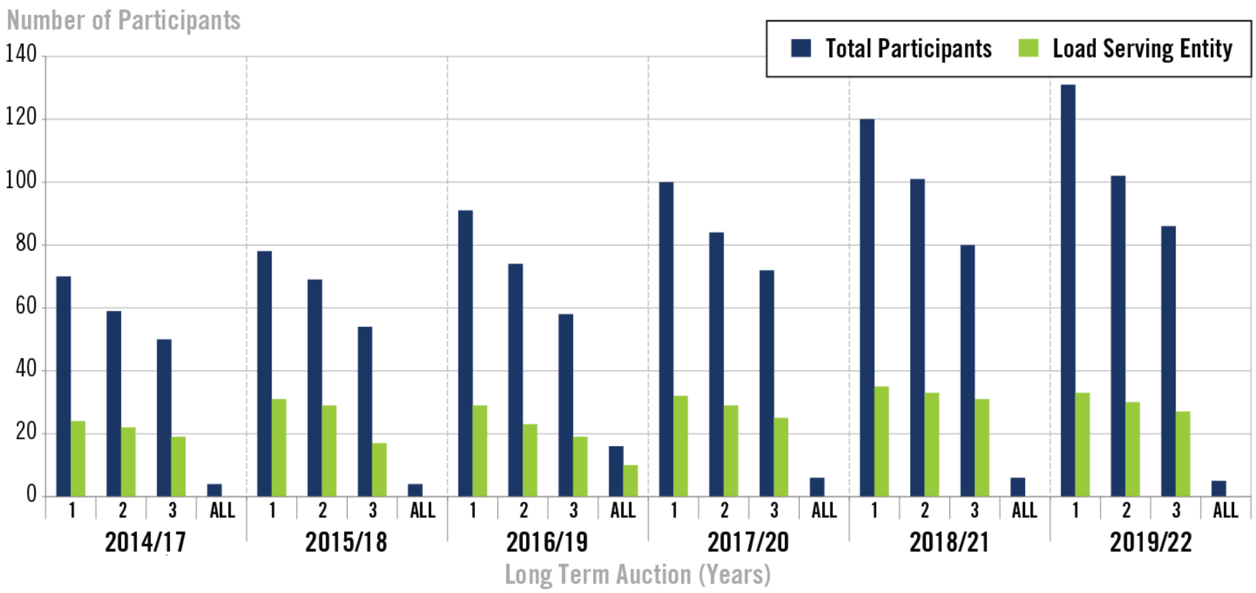
PJM staff recognizes limitations exist with the current bilateral market structure. The current PJM bilateral bulletin board facilitates ownership changes of previously awarded FTRs. It is not currently intended to facilitate additional trading opportunities, which may occur outside of the purview of PJM. Any benefits of adding bilateral or “off-market” trading opportunities (and therefore additional risk management) should be carefully weighed against the original intent of the FTR product of enhancing the efficiency of congestion-hedging mechanisms.

Since 2014, there have been roughly 45,000 bilateral transactions. Those transactions account for less than 0.5 percent of the total 10 million-plus transactions in FTR auctions since 2014.

Appendix D: Additional Market Observations

Figure 8 highlights the participant make-up of the long-term auction. Load-serving entities account for roughly 32 percent of the market participants in year 1, 35 percent in year 2, and 35 percent in year 3. The three-year FTR period (YRALL) was removed in 2018.

Figure 8. Long-Term Auction Participants



For reference, Figure 9 highlights the annual auction participant make-up. Load-serving entities account for roughly 50 percent of the market participants on average over the last six years.

Figure 9. Annual Auction Participants

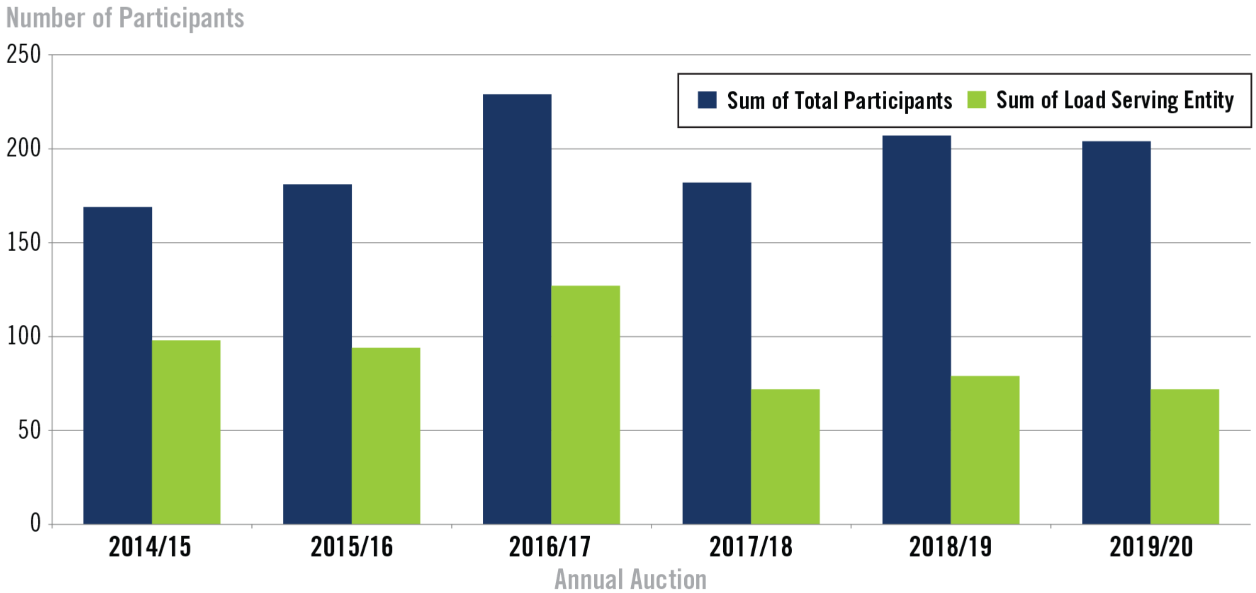


Figure 10 highlights the annual, long-term and balance-of-planning-period (monthly) auction revenue streams to ARR holders during the 2018/2019 Planning Period.

Figure 10. 2018/2019 Planning Period FTR Auction Revenues