Power Market Credit Management System: International Experience and Framework Design for China

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Abstract. China is currently building its own power market consisting of a long-term market and spot market. With more market participants and more trading varieties, a power market credit management system is urgently needed to maintain the order of power market competition. Considering the fact that China’s social credit system is also in its infancy, it is worthwhile to study the experience of mature power market such as PJM market and Nord Pool market. This paper focuses on reviewing the best practices in global power market credit management system, and proposes a framework for power market credit management system in China.

Introduction

Credit management system plays a key role in maintaining the orderly competition of the power market. In mature power markets such as the U.S. markets and the Nordic power market, the credit management system is deployed mainly to counteract the credit risks of market participants, so as to mitigate default risks for independent system operators (ISO) and power exchanges as a counterparty in financial settlement. This is partly because these western power markets are usually built upon a rather mature social credit system with active rating agencies and vast coverage.

In China, however, the notion of “social credit system” was not put forward until recent years. In 2014, the China’s State Council issued an outline for the national social credit system titled State Council Notice concerning Issuance of the Planning Outline for the Construction of a Social Credit System (2014–2020). This outline marks the beginning of social credit system construction. The plan shows the government’ intention to put the basic structures of the Social Credit System to be in place by 2020. The plan includes credit assessment of business operating in China, and mainly focuses on four areas: honesty in government affairs, commercial integrity, societal integrity, and judicial credibility.

Meanwhile, the construction of China’s power market accelerated in 2015, when the Guiding Opinion on Deepening the Power Sector Reform (also known as the No. 9 Document) was released. As the reform gradually deepens, more market participants have entered the market. According to latest statistics, over 69 thousand market participants have registered on the trading platform of State Grid Corporation of China, including nearly 3 thousand retail companies, which are the newborns of these new round of reform. As market trading activities expand, various incompetent trading behaviors have gradually surfaced, posing great problem to the orderly operation of China’s power market. Moreover, problems such as incorrect information release, market power abuse have also arisen. Therefore, China is looking for solutions to create the credit management system for power market, hoping to regulate the behaviors of market participants so as to keep a fair and just competition environment for power market participants.

This paper specially looks at the international experience of power market credit management system and draws valuable inspirations for creating China’s power market credit management system. Please note here that “power market credit management system” refers to a broader range of concepts. As mentioned earlier, credit management system in western power markets merely solves the issue of settlement risks, whereas the market monitoring system deals with misconducts of market...
participants. Hence, in this paper, credit management system will cover both aspects, making up a complete system for guaranteeing the operation of power markets.

The rest of this paper is organized as follows: Section II and Section III focuses on summarizing the characteristics of the power system credit management system in PJM and Nord Pool power markets. Section IV proposes suggested framework for China’s power market credit management system.

Credit Management System of PJM Market

The PJM market is a typical centralized power market model, which is adopted by most power markets in the United States [1]. PJM ISO is an independent system operator established on March 31, 1997. It currently operates power wholesale markets in 13 states and territories including Maryland, New Jersey, and Pennsylvania and manages its high-voltage power grid.

The credit management system of the PJM market mainly includes two aspects, the Credit Allowance System to cover the default risks caused by financial conditions of market participants and the Market Monitoring System to supervise the trading behavior of market participants and maintain market trading order.

Market Monitoring System

The structure of the U.S. power market monitoring system is shown in Figure 1. The Federal Energy Regulatory Commission (FERC) is responsible for supervision of U.S. power market and authorizes RTO/ISO to monitor trading activities of market participants. At the same time, RTO/ISOs are also supervised by the Market Monitoring Unit (MMU) and the North American Electric Reliability Council (NERC). At the federal level, FERC oversees the interstate electricity wholesale markets and RTOs. NERC is responsible for proposing security and stability requirements for RTO/ISOs, managing network information security, etc. State-level regulators are primarily state public utility commissions that are responsible for overseeing the state’s retail market. Since the PJM power market covers multiple states, it is directly regulated by FERC. The market monitoring unit of PJM market is Monitoring Analytics, a third-party organization outside PJM with the right to report directly to the PJM Board of Directors and FERC.

Market power abuse is the most common form of incompliant market behavior. It refers to the ability of market participants to influence market prices with their predominant market share and to make price deviate from that in full competition. Major forms of market power abuse primarily include physical or quantity withholding and financial or economic withholding [2]~[3].

![Diagram of market monitoring system structure of U.S. power market](image)

Figure 1. Diagram of market monitoring system structure of U.S. power market [4].

Physical or quantity withholding involves deliberately reducing the output of a generator on the market, although such output can still be sold at prices above the marginal cost. Detainment can be achieved by not bidding, lowering the output limit, or declaring the unit to be out of service. Financial or economic withholding involves bidding for certain units at a higher price than competitive prices.
Figure 2 shows an example of physical withholding and economic withholding. The blue and green curve refer to the reference and actual offering curve of a unit respectively. The LMP is $45/MWh. At this level, the unit should be producing 90 MW according to the reference curve. However, according to the actual offering curve, the unit is only producing 40 MW. The gap between 90 MW and 55 MW, which is the upper limit of the actual offering curve, is viewed as physical withholding. The gap between 55 MW and 40 MW is regarded as economic withholding, as the unit offer a price higher than its cost for this amount of output.

Figure 2. Diagram of economic and physical withholding.

To mitigate market power, PJM adopts the “Three Pivotal Supplier Test" method. It is one of the most effective methods for RTO/ISOs to monitor power market operation, to mitigate market power, and to prevent market risks. The basic principle is: to bind the two power producers with the largest market share with other power generators in turn, and test whether the power producers other than the three can meet the system load demand. If not, these three power producers have largest market power, and should be asked to bid based on their costs. The results of the “Three Pivotal Supplier Test” can be measured by the following index:

$$RSI_{3j} = \frac{\sum_{i=1}^{n} (S_i) - S_1 - S_2 - S_j}{D}$$

Where $j$ represents the tested producer, $S_j$ denotes the effective quantity provided by producer $j$, $\sum_{i=1}^{n} (S_i)$ is the sum of offered quantity in the system. $S_1$ and $S_2$ represent offered quantity of the two largest producers in the market. $D$ denotes the total demand in the system. If the index $RSI_{3j}$ is larger than 1, the tested producer passed the test. Otherwise, the producer failed the test, which means these three suppliers are the three pivotal suppliers in the system and their offers need to be replaced by their costs.

Credit Allowance System

The Credit Allowance System in PJM market consists of three parts: minimum participation requirement, calculation of credit allowance and credit monitoring.

Minimum Participation Requirement. The PJM market requires that all market participants must satisfy certain credit requirement to be eligible for market trading. PJM does not review the credit allowance of market participants for energy market. For capacity market and financial transmission rights trading, however, minimum credit allowance requirements are set, which need to be distinguished from the accounts of the market members’ total credit allowance to cover the risks arising from such specific transactions.

Calculation of Credit Allowance. In order to effectively control the settlement risk, PJM continuously monitors the credit allowance of market participants. The credit allowance of market
participants determines their trading volume in the market to a certain extent. It can be divided into two parts: one is *Unsecured Credit Allowance* and the other is *Secured Credit Allowance*.

*Unsecured credit allowance* is mainly generated through credit evaluation. PJM assign unsecured a tangible net worth factor to market participants according to their submitted credit rating reports (for example S&P, Moody’s, Fitch) or perform individual credit rating based on audit reports. The unsecured credit allowance is obtained with the following process as shown in Figure 3.

![Figure 3. Process of determining unsecured credit allowance in PJM market.](image)

For market members with credit ratings, PJM will give credit scores to market members based on the credit ratings of S&P, Moody’s or Fitch. For market members who do not have a credit rating, PJM will conduct credit scoring based on audit reports provided by market members. The main indicators include: interest coverage, debt repayment rate, total liabilities and tangible net assets ratio, total liabilities and tax depreciation and Earnings before sales (EBITDA), the ratio of short-term debt to assets, the ratio of free cash flow to total liabilities, and whether it is state-owned.

The credit scores of market members are mainly reflected in the Tangible Net Worth Factor. In addition, according to the credit scores of market members, the unsecured credit cap obtained is also different, as shown in Table 1. For market members with a credit score of 50 or less, PJM will not give them any unsecured credit allowance.

<table>
<thead>
<tr>
<th>Credit Score</th>
<th>Tangible Net Worth Factor</th>
<th>Unsecured Credit Cap (in Million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-100</td>
<td>2.125-2.50%</td>
<td>50</td>
</tr>
<tr>
<td>81-90</td>
<td>1.708-2.083%</td>
<td>42</td>
</tr>
<tr>
<td>71-80</td>
<td>1.292-1.667%</td>
<td>33</td>
</tr>
<tr>
<td>61-70</td>
<td>0.875-1.25%</td>
<td>7</td>
</tr>
<tr>
<td>51-60</td>
<td>0.458-0.833%</td>
<td>0-2</td>
</tr>
<tr>
<td>Below 50</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Secured Credit Allowance* is an addition to unsecured credit allowance. Market members can obtain secured credit allowance by offering cash collateral or a Letter of Credit to PJM.

**Cash Deposit:** PJM deposits a separate deposit for the market members to deposit the mortgage deposit. The interest earned is owned by the market members. Market members can negotiate with PJM to collect interest income periodically (such as monthly).

**Letter of Credit:** A written document issued by a bank for conditional commitments issued by market members, similar to a domestic “guarantee letter”.

**Credit Monitoring.** In order to ensure the orderly operation of the power market and prevent settlement risks, PJM will monitor the available credit lines of market members in real time to ensure that the long-term credit risk of market members does not exceed the credit limit, and the short-term credit limit does not exceed 75% of the credit limit.
Long-term credit risk refers to the total amount of bills of market members after the previous period’s bill payment until the period of default, generally calculated based on the highest three-week trading volume of the market members within a certain period of time (usually half a year).

Short-term credit risk refers to the amount of outlying bills. In order to ensure the handling of unexpected situations such as defaults and market activities, PJM will reserve 25% of the credit limit for the buffering of unexpected situations.

Once market members have insufficient credit allowance or are unable to meet PJM’s settlement requirements, PJM will first issue a warning to market members, and market members will have 2 business days to handle the situation. If the market member does not deal with it in a timely manner, PJM marks the market member as “defaulting party” and terminates its trading qualification in the market. PJM will release market default records to all members every month. If the defaulting entity is an LSE, PJM will transfer all the loads served by the entity to the default service provider. When the market member’s debt is close to the credit line, PJM may liquidate the market member’s collateral to repay its debt.

Credit Management System of Nord Pool Spot Market

The earliest predecessor of Nord Pool Spot AS was the Norwegian Electricity Trading Agency in 1993. In 1996, its coverage extended to Sweden. In 2000, Finland and Denmark joined, followed by Lithuania, Latvia, Estonia, etc. Currently, Nord Pool Spot covers power spot market trading in 12 countries and is one of the largest power exchange centres in the Nordic region [6].

The Nord Pool power market credit management system is mainly composed of two parts: one is the margin system, which is mainly used to prevent market members’ compliance risk; the other is the market surveillance system, which is mainly used to prevent market operation risks brought by market violations.

Market Surveillance System

In 2011, the European Commission issued Regulations on Wholesale Energy Market Integrity and Transparency (REMIT) issued requirements on the prohibition of internal transactions, information release, market manipulation, market surveillance, data collection, market registration, information sharing with regulatory agencies, data protection, and operational reliability of the market. The regulations are supervised by the regulatory bodies of the member states. ACER issues guidance documents to guide the development of energy market supervision in various countries.

At the national level, national regulatory agencies regulate electricity trading institutions in accordance with their own energy bills or trading laws. Each member country usually formulates its own transaction-related bills or rules in accordance with the requirements of the EU Directive and the national circumstances. The main regulatory basis for the Nord Pool Spot is the Energy Act introduced in Norway in 1990.

Margin System

Nord Pool requires all market participants to pay a deposit in the form of a cash collateral, letter of credit or bank performance bond as a guarantee of their repayment of the contract. In terms of credit rating, Nord Pool does not separately conduct credit ratings on market entities, mainly based on credit ratings of guarantee entities (banks, etc.) by S&P and Moody’s.

Since Nord Pool power market covers multiple countries and regions, the margin requirements of different countries and regions may vary according to local laws and policies. In the UK, the form of margin allowed is primarily in the form of cash collateral, letters of credit and bank performance bonds. In the Nordic and Baltic regions, the permitted margin forms include the Pledged Cash Account, the Pledged Collateral Account and the On-Demand Guarantee.

All market members participating in the transaction should guarantee a collateral amount of 30,000 Euros before the first transaction. Since then, Nord Pool will calculate the collateral amount based on twice the maximum funding gap of the daily trading volume of the market participants.
Nord Pool uses a dynamic trading margin system. The margin is divided into initial margin and margin call, and the daily mark-to-market system is implemented. The settlement of the trading margin is after the end of each trading day.

Framework for China’s Power Market Credit Management System

The No. 9 Document proposed “to establish and improve the credit system of market entities, strengthen the integrity of market entities, and regulate market order”. At present, China’s power market construction is still in its infancy, with insufficient market experience and absence of power market credit management system. Therefore, it is urgent to establish and improve the credit system of the electricity market and promote the healthy and orderly development of China’s power market. The proposed framework for China’s power market credit management system consists of three parts.

Information Collection and Sharing System

**Establish A Credit Information Collection Mechanism for Market Members.** The credit information of market members is divided into three parts: external information, market registration information and market transaction information. External information is collected through the credit information exchange platform. Market registration and transaction information are collected by power exchange centre.

**Build A Market Credit Information Database.** Based on the unified social credit code, the database structure of the credit information of the main body of the electricity market is formulated, and the credit information of the market entity is converted into structured data to realize the digital management of the credit information of the market.

**Construct A Credit Information Interactive Sharing Platform.** Establish a nationwide unified credit information sharing and exchange platform for power market and realize the interconnection and exchange of credit information systems and credit information in various regions and fields. Establish and expand various functions of the platform, including basic functions such as credit information collection, sorting, exchange, sharing, and management functions such as statistical analysis, monitoring and early warning.

**Establish A Credit Record File for Market Entities.** Collect information on industrial and commercial registration, market registration, transaction records, etc. of market entities. Focus on credit indicators such as good records and bad records of market entities, establishing credit files for members of the electricity market, and gradually realizing full coverage of credit records.

Credit Evaluation System

**Establish A Credit Evaluation Model for Market Entities.** Build a credit evaluation model for China’s power market. Set up an evaluation index system for different types of entities. Define evaluation procedures to make sure credit evaluation work was carried out in an orderly manner.

**Conduct Credit Rating and Grading Work.** Combine the credit information database and the credit evaluation model to carry out the credit evaluation work for market participants. Classify different types of market entities separately, and publicize the evaluation grading standards, procedures and results to ensure fairness and objectiveness of credit evaluation.

**Actively Apply Credit Evaluation Results.** The credit evaluation results of market participants shall be recorded in their credit files and published on the power trading platform and credit website as appropriate. Promote relevant departments to actively apply credit evaluation results in bidding, government procurement, administrative examination and approval, market access, qualification management, etc.

Market Participant Credit Management System

**Establish A Credit “Red and Black List” System.** Establish a “red list” system for credit market integrity and the “blacklist” system for serious untrustworthy entities, including setting standards and
information release. Under the premise of ensuring independence, fairness and objectiveness, power exchange centres shall be encouraged to provide the power market “red list” and “blacklist” to the government for reference.

**Strengthen the Joint Incentives for Integrity.** Establish role models of integrity in the power market, implement a “green channel” for the integrity market, prioritize and simplify procedures, give priority support in government procurement, special fund subsidies, etc., and provide good credit information of credit market entities in the power trading platform, credit website, etc. for publicity.

**Strengthen the Joint Punishment of Dishonesty.** Dishonest market participants are listed as key surveillance objects. Relevant departments are encouraged to take disciplinary measures against serious dishonest market entities, implement administrative restrictions according to the law, and disclose the untrustworthy entities on the power trading platform and credit website in time. The public is encouraged to report serious untrustworthy behaviours in the power market. The information of the reporters will be kept strictly confidential.

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**References**


[4] PJM 2018 Credit Overview and Supplement to the PJM Credit Policy.