United States General Accounting Office

U.S. Senate

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GAO

United States
General Accounting Office
Washington, D.C. 20548

Information Management and
Technology Division

B-234478

September 7, 1989

The Honorable Patrick J. Leahy, Chairman
The Honorable Richard G. Lugar, Ranking
Minority Member
Committee on Agriculture, Nutrition,
and Forestry
United States Senate

A recent Federal Bureau of Investigation announcement on an undercover operation at the Chicago Board of Trade and the Chicago Mercantile Exchange alleged that a variety of illegal trading schemes were being used by floor brokers and traders to defraud customers. The investigation also raised questions about the effectiveness of the exchanges' controls on their open-outcry trading process to detect or prevent identified trade practice abuses.[1]

This report responds to your March 27, 1989, request and further discussions with your office in which you asked for information on the (1) potential benefits in using the Chicago futures exchanges' planned automated systems to detect or prevent trade practice abuses, (2) potential vulnerabilities associated with using automated systems in conjunction with or in place of the current open-outcry trading process, and (3) Commodity Futures Trading Commission's activities in assessing automated exchange systems. Responses to your remaining questions regarding the sufficiency and intensity of the Commission's efforts to identify and punish trading abusers are contained in another report.[2]

In conducting our work, we reviewed documentation and interviewed officials at the Commission, the Chicago Board of Trade, and the Chicago Mercantile Exchange. Details of our objectives, scope, and methodology are included in appendix II.

Principal Findings

The Chicago Board of Trade and the Chicago Mercantile Exchange are studying and developing new automated systems. Automated order routing systems are being developed to increase the efficiency of the open-outcry trading process and better handle larger trading volumes.

[1]In the open-outcry trading process, traders verbally and through hand signals make bids and offers to each other at centralized trading floor locations, called trading pits. A description of the trading process and definitions of identified trade practice abuses are provided in appendix I.

[2]Futures Markets: Strengthening Trade Practice Oversight (GAO/GGD-89-120, Sept. 7, 1989).

To better detect trade practice abuses in the open-outcry process, the exchanges recently announced a joint effort to develop an electronic audit trail system to record each trading transaction using hand-held terminals. In addition, the exchanges are developing after-hours trading systems, which will be used instead of the open-outcry process to expand operations outside normal trading hours.

If properly implemented, these planned automation initiatives can be used to more readily detect trading abuses because they can provide improved trade timing data. In addition, the exchanges plan to incorporate features in their after-hours trading systems that can prevent certain abuses. However, because these systems are still in the planning stage, the extent to which the exchanges will take advantage of technology to control trading abuses is uncertain.

Although the exchanges' planned systems have the potential to better control trading abuses, they introduce risks that must be addressed to ensure the correct processing of transactions, responsive operations, and secure and continuous service. The exchanges are aware of these risks and are taking steps to mitigate them.

The Commission's responsibility to safeguard market integrity and protect market participants against manipulation, abusive trade practices, and fraud in the marketplace require that it be involved in the technical assessments of exchanges' automated systems. However, the Commission has not been actively involved in conducting or setting guidelines for technical assessments of these systems' capabilities to control trading abuses and automation risks, and it does not have the necessary technical resources for such assessments. During our review, the Commission questioned the need to conduct technical assessments because it believed that the exchanges have a vested interest in developing sound systems. Commission officials later said that our review had increased their receptiveness to taking a more active role in reviewing the technical capabilities of exchanges' automated systems, and have, for example, contacted other government agencies to better understand the automation issues that should be included in technology assessments.

Conclusion and Recommendation

As the futures exchanges become increasingly dependent upon automation, it is critical that the Commission take a greater leadership role to safeguard the integrity of the futures markets.

We recommend that the Chairman, Commodity Futures Trading Commission, acquire the necessary expertise to technically assess the systems planned by the futures exchanges. Such assessments should include analyses of proposed technical solutions and alternatives to ensure that the futures exchanges design, develop, and implement systems that maximize automation's potential to control trade practice abuses. The Commission should also assess the risks of using the exchanges' automated systems to ensure that they are adequately controlled.

To acquire the expertise needed for such assessments, the Commission needs to consider (1) obtaining its own technical resources, (2) requiring exchanges to have independent technical assessments performed on their systems under guidelines set by the Commission, and/or (3) creating a technical advisory committee consisting of government and private-sector representatives to advise the Commission on the relative merits and risks associated with using automated systems to better detect or prevent trade practice abuses.

The Chairman, Commodity Futures Trading Commission, agreed with our recommendation and said that she would acquire additional expertise and resources needed to ensure that adequate technical assessments of the exchanges' automated systems are performed.

Background

In fiscal year 1988, the Chicago Board of Trade and the Chicago Mercantile Exchange traded 218.2 million futures contracts[3] and options on futures contracts. This represents 75 percent of the contract volume traded on the 14 domestic futures exchanges in 1988. Both exchanges trade these contracts through the open-outcry process. During active trading, this process can involve hundreds of floor participants simultaneously attempting to execute trades at highly volatile prices. In this process, floor participants can engage in several types of trade practice abuses to avoid competitive order executions. By avoiding competition, floor participants may secure a better transaction price at the expense of other market participants, including customers and other traders.

Identifying most trade practice abuses depends on accurate and complete documentation of the times and sequence of the trading activity. Currently, documentation is obtained from (1) manual records of timing

[3]A futures contract is an agreement to purchase or sell a commodity for delivery in the future at a price that is determined at initiation of the contract.

and other information on trading cards and order tickets prepared by floor participants, (2) mechanical time-stamping of customer orders, and (3) exchange records on the timing of price changes. Exchanges use this information in audit trail and surveillance systems. Audit trail systems attempt to reconstruct to within 1 minute the most likely execution time of each trade. Surveillance systems analyze these audit trail data and generate reports on various trading patterns, which exchange surveillance staff use to help identify and investigate abuses.

In our March 1989 report,[4] we pointed out that because of trading record imprecision, the exchanges' audit trail systems may not precisely reconstruct the actual times and sequences for all trades. We noted that participants may intentionally or accidentally record erroneous trading data. We also reported that where exchange members trade with each other for their own accounts (instead of on behalf of customers), the trading data are not precise because traders are only required to report a 30-minute time bracket for such trades.[5] With such a large time bracket, it is difficult to use the automated audit trail systems to accurately determine times for these types of trades.

However, even if the manual records provided 1-minute accuracy for all trades, this information would not be sufficient to accurately identify all trade relationships for surveillance purposes. In this regard, exchange officials stated that during active trading periods it is possible to have hundreds of trades executed in a minute, and one trader could make as many as 20 trades at several different execution prices within that minute. To the extent that the audit trail does not precisely identify when orders are received, executed, and moved off the trading floor, an opportunity exists for dishonest floor participants to violate trading rules without detection and to get a better price for themselves or others at the expense of customers and other traders.

[4]Chicago Futures Market: Initial Observations on Trade Practice Abuses (GAO/GGD-89-58, Mar. 13, 1989).

[5]For time recording purposes, the trading day is divided into 30-minute segments called brackets.

Exchanges' Planned Automation Initiatives Have Potential to Better Detect or Prevent Trade Abuses

The Chicago Board of Trade and the Chicago Mercantile Exchange are developing automated order routing systems and researching the use of hand-held trading terminals to improve the operational efficiency and integrity of their open-outcry trading process. The exchanges also are developing automated trading systems that will be used instead of the open-outcry trading process for after-hours trading. To varying degrees, we found that each planned initiative could provide more accurate trade records to better detect certain abuses, and automated trading systems could also prevent some abuses. These systems are still in the planning stage; the extent to which the exchanges will maximize the use of available technology to control trade practice abuses is, therefore, not certain.

Automated Order Routing Systems Can Provide Limited Information To Better Detect Abuses on the Open-outcry System

The exchanges are developing automated order routing systems to (1) enable member firms to send orders electronically to exchange floors for delivery to their designated brokers, and (2) report executed orders electronically back to member firms and to clearing organizations for further processing.

The planned Chicago Board of Trade system is currently being pilot tested by two member firms during the exchange's evening trading session. The planned Chicago Mercantile Exchange system is scheduled to be piloted in October 1989. At the close of our review, the exchanges were considering the development of a common interface to these systems to provide member firms with standard formats to route orders to either exchange from a single terminal.

These systems are intended to get customer orders to and from the exchanges' trading floors more quickly, and would eliminate the need to manually time-stamp and route such orders into and from the exchanges. The systems are being designed to (1) automatically record to within a hundredth of a second the times orders enter exchanges and (2) accurately record the times that filled orders leave the exchanges. Officials from both exchanges believe that this improved timing data should increase the accuracy of the audit trail, facilitate the detection of abuses, and, therefore, act as a deterrent to trading violations.

The extent to which planned automated order routing systems will facilitate the detection of trading abuses is, however, unknown. Use of these systems by member firms is planned to be optional, and other alternatives will continue to exist for member firms to route customer orders to

the exchanges. As a result, the potential benefits provided by the systems may not be fully realized, and exchange officials were unable to estimate the percentage of orders that would flow through these systems. Also, current exchange audit trail systems will have to be modified to accept and analyze the improved electronic timing data. Although exchange officials said that audit trail system modifications will be made to accept the improved timing data, the extent of and schedule for such modification has not been determined. In addition, these systems will only provide improved timing data for customer orders and cannot be used to determine the timing and sequence of trades generated by floor traders for their own personal accounts.

Hand-held Trading Terminals Hold Promise to Detect Trading Abuses

The Chicago futures exchanges are researching systems that use hand-held trading terminals to improve the efficiency and integrity of trade timing data. In recent years, these devices have been explored for use on the trading floors to allow floor participants to enter information on executed trades for recordkeeping, audit trail, clearing, and price reporting purposes. However, on August 16, 1989, the two exchanges announced renewed efforts to expedite research and development of an electronic audit trail system. The system is intended to include stationary broker workstations that can be used to receive incoming orders from exchanges' planned order routing systems, and hand-held trading devices to more accurately track trade execution times in each trading pit. Overall, the Commission and exchange officials expect that such devices should automatically generate and document more precise trade timing data and make it more difficult for market participants to manipulate trade reporting to conceal abuses.

An August 1985 Commission report[6] concluded that "off-the-shelf" trade timing devices did not exist to meet the exchanges' requirements, but that a cost-effective, nondisruptive trade timing device could be engineered by using various components found in available retail products. Until recently, the exchanges believed that technological concerns such as problems with communications and ease of use prevented implementation of a device that would not require fundamental changes to their open-outcry process. Their renewed research is intended to focus on the (1) transmission technology that will automatically transfer trade data from the hand-held terminals to exchange-operated central computers and clearinghouses, and (2) input technology that will allow traders to quickly enter their trades on hand-held terminals. Transmission

[6]AUDIT TRAIL PROPOSAL: Research on Selected Technological Alternatives, August 14, 1985.

mediums being considered include radio and infrared signals. Input methods planned to be researched include various forms of programmable key, touch screen, and handwriting and voice recognition technologies.

Since the Chicago futures exchanges have not selected the specific capabilities and technologies for the stationary broker workstations and hand-held trading terminals, they had no specific information on how such devices would interface with the open-outcry trading process. Consequently, we could not assess the devices' capabilities to detect or deter trade practice abuses. However, various alternatives exist that could be used in implementing such systems. For example, one alternative could require all orders to be electronically delivered to trading floor participants, while another could permit both electronic and manual delivery of orders to floor participants. If the systems are not required to be consistently used by trading floor participants, the improved trade timing data provided by these technologies will not be fully realized.

Automated Trading Systems Could Better Control Some Trade Practice Abuses

Automated trading systems that would allow futures trading outside normal trading hours are now under development by both the Chicago Board of Trade and the Chicago Mercantile Exchange.[7] These systems are being designed to be used instead of the exchanges' trading floors for such after-hours trading and are planned to have features that can be used to prevent some abuses and provide an accurate audit trail of all systems' transactions, so as to better detect others. Although both exchanges are designing systems with different features, each believes that its system will be able to control how and when trades are executed, and will have the capability to record trading activity to within a hundredth of a second. Exchange officials believe that with this degree of accuracy in recordkeeping, investigators should be able to better identify various trade relationships and patterns that indicate trade practice abuses. Our review of the preliminary systems designs supports these views. In addition, this general opinion that automated systems can be designed to prevent and detect trade practice abuses is supported by officials of six foreign futures exchanges that use or plan to use automated futures trading systems.

[7]The planned Chicago Board of Trade system, called Aurora, is intended to electronically simulate pit trading by providing icons that identify traders on a screen. The planned Chicago Mercantile Exchange system, called Globex, is intended to electronically match buy and sell orders. During our review, the two exchanges were discussing possibly merging these systems into one.

Officials of the Chicago and foreign futures exchanges cited the following examples of potential benefits of automated trading systems to prevent and detect trading abuses:

- These systems can prevent an abuse called "curb trading."[8] Specifically, officials representing the two Chicago and most foreign exchanges said that curb trading will not occur because automated trading systems will not allow trades outside the exchanges' set trading periods.
- These systems can be designed to require that all trades be presented to a competitive marketplace for execution, and that all executed trades have prices at or within the existing bid and offer spreads. Troublesome trading abuses within the open-outcry trading process involve instances where trades are noncompetitively executed and where customers receive worse prices than the existing best bids and offers. These abuses may include certain types of cross trading and bucketing.[9]
- These systems offer the potential to provide investigators with better audit trail information to detect trading abuses by providing more accurate and complete information on all bids, offers, and executions.

The benefits that can be derived from the more accurate and complete information that an automated system can provide depend on how the exchanges decide to use such information. Because these systems have yet to be fully designed and implemented, we could not assess whether the exchanges will fully utilize their systems to control trade practice abuses. Additionally, Chicago and foreign exchange officials agree that automated systems are not a panacea to eradicate all types of trading abuses. For example, an official of a foreign exchange said that although automated trading systems can be designed so that all bids and offers must be separately entered into the competitive marketplace, automated trading systems cannot prevent collusion by brokers who make trading arrangements before associated bids and offers enter the system.

[8]Curb trading is the trading that takes place after the official market has closed.

[9]Cross trading is an abuse where there is a noncompetitive match of the buy order of one customer against the sell order of another. Bucketing is defined as directly or indirectly taking the opposite side of a customer's order into the broker's own account or into an account in which the broker has an interest, without competitive execution of the order on an exchange.

Generic Risks Associated With Automation

Automated systems such as those planned by the Chicago Board of Trade and the Chicago Mercantile Exchange introduce risks that must be controlled to ensure that they do not reduce each exchange's ability to provide efficient, fair, and equitable treatment to all market participants. Although not meant to be all inclusive, the following list identifies some generic risks that need to be addressed:

- Correct processing: the need to ensure that the system hardware, software, and communications perform as intended. Risks include errors that cause orders to be processed incorrectly, or participants to receive privileged treatment.
- Responsive operations: the need to ensure that the system is properly sized and designed to support timely operations under normal and high-volume conditions. Risks include an inefficient system design and inadequate transmission, processing, and storage capacities.
- Secure operations: the need for established controls to prevent unauthorized access and the misuse of automated systems. Unauthorized access concerns include the failure to establish controls over who can enter the computer system processing area, who can use the system, and who can access the information contained in the system. Misuse of automated systems includes disabling system controls, erasing audit trails, and accessing system information in an unauthorized fashion.
- Continuous service: the need to ensure service to users in the event of equipment and software failures, natural disasters, and intentional malicious acts. Risks include a lack of contingency plans to ensure that systems could conduct normal operations under conditions such as floods, fires, etc.

Officials from both exchanges stated that they are aware of these risks and are actively taking steps to mitigate their adverse effects. As agreed with your office, given the time constraints of this review and the uncertainty associated with the exchanges' plans to merge their after-hours trading systems, we have not assessed their progress in these areas.

The Commission Should Ensure That Automated Systems Control Potential Trading Abuses and Risks

Congress created the Commodity Futures Trading Commission in 1974 and gave it the authority to regulate commodity futures and related trading in the United States. In this role, the Commission is responsible for ensuring the economic utility of futures markets by encouraging their competitiveness and efficiency, safeguarding their integrity, and protecting market participants against manipulation, abusive trade practices, and fraud in the marketplace. As the futures markets become increasingly dependent upon automation, it is important that technical reviews of exchanges' automated systems be conducted to (1) assess each system's ability to prevent or better detect trade practice abuses and (2) ensure that the risks associated with the introduction of an automated system do not diminish an exchange's competitiveness, efficiency, and integrity.

For example, the Commission approved the Chicago Mercantile Exchange's planned after-hours trading system on February 2, 1989. This approval included a review of the exchange's requested rule changes[10] for the system, and the exchange's responses to questions by the Commission on certain system functions. However, this approval did not include a detailed independent assessment of technological alternatives available to prevent or detect trade practice abuses, and the risks associated with the system.

During the course of our review, Commission officials questioned the need to technically assess exchanges' automated systems because they believed that the exchanges have a vested interest in developing sound systems, and said the Commission lacked sufficient resources for detailed technical assessments of exchanges' automated systems. Although the exchanges are responsible for providing reasonable assurance that automated systems they introduce to their trading processes are reliable and properly safeguarded, the Commission has a similar role because of its responsibility to regulate commodity futures trading and to ensure the integrity, efficiency, and effectiveness of the futures markets. Commission officials later said that our review had increased their receptiveness to taking a more active role in reviewing the technical capabilities of exchanges' planned automated systems. For example, the Commission has contacted other government agencies in an attempt to better understand the automation issues that should be included in technology assessments.

[10]Rules are the principles for governing an exchange. Exchanges are required to submit all rule changes and new rules to the Commission for review.

Commission officials said that such technical assessments of exchanges' systems would be performed by personnel within their Office of Information Resources Management. The Office is responsible for the Commission's internal data processing operations. However, the extent to which the Office can perform such assessments is unclear because the Commission has not allocated resources to the Office for these activities, and has not established guidelines for conducting them.

We discussed the contents of this report with senior officials of the Commodity Futures Trading Commission, the Chicago Board of Trade, and the Chicago Mercantile Exchange, who generally agreed with the accuracy of the information presented. We have incorporated their comments in the report as appropriate.

We are providing copies of this report to other interested members of Congress, executive branch agencies, and the public. We will also make copies available to others upon request.

This work was performed under the direction of Howard G. Rhile, Director, General Government Information Systems, who can be reached at (202) 275-3455. Other major contributors are listed in appendix III.

Ralph V. Carlone
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Contents

Abbreviations

GAO	General Accounting Office
GGD	General Government Division
IMTEC	Information Management and Technology Division

Information on the Open-outcry Trading Process on Chicago Futures Exchanges

At the Chicago Board of Trade and the Chicago Mercantile Exchange, futures contracts and options on futures contracts are traded at centralized trading floor locations, called trading pits. Each futures or options product is assigned one trading pit, so that all market activity is concentrated in one centralized location. The exchanges use an open-outcry system wherein traders verbally or through hand signals make bids and offers to each other. Market participants in the pits are called floor brokers and floor traders. Floor brokers trade for others while floor traders trade strictly for themselves. Floor brokers can be referred to as "dual traders" if they trade for customers and themselves during the same day in the same contract.

To place an order, a customer typically contacts an account executive of a clearing member firm, referred to as a futures commission merchant.[1] If the futures commission merchant is not a clearing member of an exchange, then the order is transmitted to a clearing member at which the non-clearing firm has an account. The account executive prepares and time-stamps an office order ticket. The order is then transmitted to a trading booth on the exchange trading floor by telephone or automated computer transmission. Upon receipt of the order, a clearing member's order clerk prepares a floor ticket and time-stamps it. A clerk then hand-signals the order or sends a runner with the order ticket to the floor broker or his or her assistant at the rim of the pit. The hand signals or order ticket indicates to the floor broker the quantity, price, and type of futures contract to buy or sell. The floor broker executes the customer's order by offering or bidding it to other traders verbally and through hand signals. If accepted, the broker and opposite trader confirm the trade. The broker records it on a floor order ticket or trade card. Both participants in the trade (buyer and seller) are required to report the price to exchange price reporters and to verify that the price is reported accurately. The floor order ticket is returned to the trading booth, where it is time-stamped and the transaction reported to the futures commission merchant, who records the price on the office order ticket. The customer must receive written confirmation of the executed trade by the next day, but may also receive telephone confirmation that same day.

Personal trades of both brokers and traders executed by themselves do not require order tickets, but are required to be recorded on trading

[1]The futures commission merchants are generally equivalent to securities broker dealer firms.

cards. These cards include the trader's name or code, the clearing member, the date, the time period (i.e., half-hour bracket or minute, depending on the type of trade), the commodity, the month, the quantity bought or sold, the execution price, and the opposite floor broker or floor trader designation and opposite firm.

On the exchange floor, clearing firms collect order tickets and trading cards, record available trade data, and transmit the data to the exchange clearinghouse. The clearinghouse matches the buyer and seller reports of each trade and reports discrepancies, known as out-trades, to clearing firms, which are required to reconcile them.

The open-outcry trading process used at the Chicago Board of Trade and the Chicago Mercantile Exchange is dependent on a variety of handwritten records of orders and trades. Information from these manually prepared records, in conjunction with the exchange's trade price recording system, is used later by the exchanges in computerized trade-reconstruction systems to derive execution times for trades to within 1 minute. These execution times are later used by the exchanges and the Commission in automated surveillance systems to assist investigations of trade practice abuses.

Trade practice abuses include various techniques to avoid competitive order execution. By avoiding competition, floor participants may secure a better transaction price at the expense of other market participants, including customers and other traders. The following list, from our March 1989 report,[2] includes the major trade practice abuses that the Commission and exchanges try to detect. The abuses are not mutually exclusive, and some of the definitions partially overlap.

- Prearranged trading: agreeing to some aspect of a transaction before it is openly executed on the exchange floor.
- Accommodation trading: entering transactions to assist another floor participant in accomplishing improper trading objectives.
- Trading ahead of customer orders: trading for one's personal account or an account in which one has an interest, while having in hand any executable customer order in that contract.
- Bucketing: failing to introduce an order to the marketplace, traditionally occurring when a broker noncompetitively takes the order side of a customer order to the detriment of the customer or other members.

[2]GAO/GGD-89-58, March 13, 1989.

- Wash trading: entering or purporting to enter into transactions to provide the appearance of trading activity without resulting in a change in market position.
- Curb trading: trading after the official close of trading.
- Cross-trading: matching customer orders without offering them competitively.[3]

Exchange rules also preclude disclosing customer orders except to the exchange or Commission, and allocating the best trades to one's own account or to that of preferred customers.

In some cases, no direct harm may result to customers. However, unscrupulous traders also combine these and other abuses in complex schemes designed to cheat customers by circumventing the open-outcry system. Commission and exchange officials consider the most serious abuses to be those that give customers less advantageous prices than orders competitively executed.

[3]Crossing the orders of two customers is generally permitted, provided the broker first offers the orders competitively and meets certain other regulatory requirements.

Objectives, Scope, and Methodology

Our objectives were to provide information on the (1) potential benefits in using automated systems planned by the Chicago Board of Trade and Chicago Mercantile Exchange to detect or prevent trade practice abuses, (2) potential vulnerabilities associated with using automated systems in conjunction with or in place of the current open-outcry trading process, and (3) Commodity Futures Trading Commission's oversight role in reviewing automated exchange systems.

In conducting our work, we reviewed available systems' related documentation and interviewed officials at the Commodity Futures Trading Commission in Washington, D.C., and Chicago, Illinois, and the Chicago Board of Trade and the Chicago Mercantile Exchange on the operations and potential capabilities of automated order routing and handling systems, hand-held trading terminals, and automated trading systems to detect or prevent trade practice abuses. We also obtained information from officials of six foreign exchanges that use or plan to use automated futures trading systems, in Auckland, New Zealand; London, England; Sydney, Australia; Tokyo, Japan (2); and Zurich, Switzerland.

To identify vulnerabilities associated with automated systems, we met with officials of both Chicago futures exchanges and the Commission, and reviewed and analyzed relevant federal and private-sector information resources management publications to document generic concerns associated with using automated means to conduct futures trading.

We also interviewed officials of the Commodity Futures Trading Commission and obtained and reviewed supporting documentation of the Commission's role in assessing automated systems being developed and used by the futures exchanges. We examined the Commission's role in reviewing the Chicago Mercantile Exchange's planned after-hours trading system, including its report[1] that supported the Commission's approval of the system. We reviewed the Commission's AUDIT TRAIL PROPOSAL: Research on Selected Technological Alternatives, dated August 14, 1985, to assess the Commission's role in reviewing hand-held devices. We also reviewed the Commission's rule-enforcement reviews of the Chicago Mercantile Exchange and Chicago Board of Trade, dated September 27, 1988, and February 17, 1989, respectively, to assess its role in reviewing exchanges' audit trail and surveillance systems.

Our work was performed from March 1989 through August 1989, in accordance with generally accepted government auditing standards.

[1] Chicago Mercantile Exchange's Proposed Globex Trading System, February 2, 1989.

Major Contributors to This Report

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