ITG

Investment
Technology Group, Inc.
380 Madison Avenue
New York, NY 10017

T 212.588.4000
F 212.444.6353
www.itg.com

October 22, 2012

VIA ELECTRONIC MAIL

Ms. Elizabeth M. Murphy
Secretary
U.S. Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549-1090

Re: SEC Market Technology Roundtable (File No. 4-652)

Dear Ms. Murphy:

ITG Inc. ("ITG" or the "Firm") appreciates the opportunity to comment on the issues raised during the Securities and Exchange Commission's ("SEC" or the "Commission") Market Technology Roundtable (the "Roundtable") of October 2, 2012. The Roundtable panelists discussed a variety of issues concerning the prevention of transaction errors through the design, testing, deployment, and operation of trading systems and technology. In addition, the panelists shared their thoughts on responding to errors and system malfunctions and managing technology crises on a real-time basis.

I.   **Background Information on ITG**

ITG is an independent execution and research broker that partners with global portfolio managers and traders to provide unique data-driven insights throughout the investment process. From investment decision through settlement, ITG helps clients understand market trends, improve performance, mitigate risk, and navigate increasingly complex markets.

ITG operates an alternative trading system ("ATS") called POSIT® that conducts matches of orders from institutional investors and broker-dealers on a confidential (*i.e.,* non-displayed) basis. We also offer portfolio construction and optimization services, pre-trade analytics, execution management and connectivity, post-trade processing services, and investment research to clients. As an agency broker, technology provider, and operator of an ATS, ITG has a diverse background from which to provide input on the issues raised during the Roundtable.

As an initial matter, ITG commends the Commission for its continued focus on ensuring the integrity of the securities markets. Although the U.S. equity markets are robust and efficient, recent events make this an opportune time to review the complex network of interconnected trading systems among market participants and the way technology development methods and testing protocols impact the integrity and stability of the securities markets.

ITG seeks to continuously innovate and develop new products and services for the benefit of our customers while striving for zero errors in the performance of our brokerage operations. When errors do occur, however, efficient recovery is critical to protect the markets from artificial price movements and liquidity failures, as well as prevent the financial collapse of broker-dealers, institutional investors, and exchanges – and any associated damage to retail investors and public confidence in our markets. Furthermore, improved coordination among industry participants based on agreed upon metrics and established communication plans and protocols are also crucial to prevent market wide calamities and large scale trading debacles.

As you know, Sudhanshu Arya – ITG's Head of Technology for Liquidity Management – participated on Panel One of the Roundtable. Mr. Arya's Opening Statement is enclosed herein as Exhibit A. Our comments focus primarily on the topics discussed during Panel One, which addressed the prevention of errors through the design, deployment, and development of robust trading systems. Accordingly, we provide below written responses to the seven questions that were directed to Panel One participants.

II.   Responses to Panel One Questions

1.   What are current best practices for ensuring adequate testing, robustness, deployment, and use of software systems? Are these practices sufficient to support market continuity and integrity? If not, what else should be done?

ITG employs several "best practices" for ensuring the adequate testing of software systems prior to deployment. Such best practices pertain to design consideration, software code review, automated testing, parallel production testing, and controlled deployment processes.

> **Design Considerations.** As a general rule, all modifications to ITG's critical systems are design-reviewed before the first line of software code is written. During this review, special attention is paid to the ability to: (1) maintain compatibility with internal and external systems; (2) roll out changes in a controlled fashion to a small subset of users; (3) test the modification in a controlled and incremental fashion; and (4) deactivate or modify the new functionality intra-day, in the event of behavioral issues. If the modification is expected to introduce new data flow or augment existing flow, throughput and

latency considerations are reviewed thoroughly, along with size estimates and simulations of the effects of the anticipated new flow.

Code Review. ITG's critical software code is reviewed by senior developers and peers before proceeding to the testing phase. Developer testing of new code is also mandated before any modification is provided to the quality assurance ("QA") staff.

Automated Testing. When feasible, ITG carefully scripts and executes automated testing of its software code. The suite of automated testing is continuously enhanced as additional functionality and test cases are added.

Parallel Production Testing. When feasible, ITG performs parallel production testing with real time parallel order flow and market data prior to releasing a system modification into production. Generally, no amount of automated off-line and/or manual testing is a sufficient substitute for observation under real-time trading conditions. The ability to test system modifications in a parallel, real-time environment is of tremendous value in detecting performance issues and evaluating the impact of an upcoming software release. ITG's automation and parallel testing is complemented by careful analyses of system designs, and an exhaustive line-by-line code review conducted by experienced software development staff. Such manual reviews by senior staff are an indispensable part of quality control. Specifically, manual reviews often detect potential issues early in the software life cycle, thereby preventing future trading errors and saving the Firm a considerable amount of time and resources in resolving technology issues.

Deployment. The deployment plan for new software or hardware is reviewed by both senior technology and product management staff, with special attention paid to ensuring that such deployment is effected incrementally. The ability to divert order flow intraday and, if necessary, to other internal redundant systems or external venues is also taken into consideration.

ITG maintains that the above best practices are effective measures for testing systems software prior to deployment. However, potential areas for improvement include: (1) additional tools for replaying market data and simulating trading algorithm performance; (2) real-time drop copies of routing and execution activities from exchanges; and (3) tight controls, reviews, and testing of configuration modifications to systems in addition to software and hardware modifications.

The ability to accurately reconstruct the market and simulate the actual behavior of trading algorithms, as well as other order routing and/or execution systems is invaluable in testing the impact of a planned software change. By replaying market data and analyzing how trading systems performed when processing such information, technology and business personnel could uncover software programming issues and other unintended system behaviors. In addition, real-time drop copies of executions and

cancellations from exchanges would enable member firms to ascertain the status of such orders more rapidly. Finally, many trading mishaps are not caused solely by flaws in the processing of real-time trading and/or market data. On occasion, technology issues arise from incorrect configuration changes to systems that are unrelated to software and/or hardware modifications. Additional testing and reviews of configuration changes is therefore, valuable in detecting potential issues with trading systems.

2.   *How do market participants balance speed-to-market against the need for extensive testing, or the costs of additional redundancy and safeguards compared with the potential benefits of innovation and rapid development?*

Many of the design considerations discussed in response to Question 1 determine which projects require more intensive review and/or testing. Specifically, if prospective new functionality is more complex and intra-day intervention during production could be inhibited, then the project will generally require more intensive testing and review prior to deployment. When feasible, for mandatory projects with short implementation timelines, we leverage a parallel testing environment coupled with an incremental deployment process for managing risk.

Continuous integration and testing are part of our internal development process that allows for cautious and rapid development. Since all systems have unique methodologies, our development process is tailored to the needs and characteristics of the individual systems. Accordingly, the Firm employs different testing, release, and deployment processes tailored for each of its three primary trading platforms: (1) core order routing infrastructure; (2) desktop software (*i.e.*, execution management system); and (3) internal execution engines.

The redundancy of connections and system components is considered paramount to failure recovery. In this regard, the cost of operations is considered secondary to the stability of the Firm's systems. We continue to explore innovative ways to increase efficiency and reduce latencies without sacrificing system stability and sufficient redundancy. It should be noted that the provision of best execution for client orders, the prevention of errors, and ITG's contribution to maintaining fair and orderly markets are paramount considerations that are never compromised for any reason, including efforts to innovate and develop technology.

3.   *How do firms test their system for capacity, contingencies, and other unexpected circumstances?*

ITG subjects its systems to a battery of tests to evaluate capacity and contingencies and detect unexpected circumstances, including but not limited to the following: (1) scripted tests to simulate high throughput; (2) latency checks for system functionalities; (3) simulations that create feeds and other behavior to emulate new functionality; (4) creation of parallel testing environments for analyzing order crossing activities using real-time market data; (5) automated comparisons of execution rates and

other criteria between test and production systems; (6) testing of internal "kill switches" at the client level, session level, and exchange/venue level; (7) testing of alerting and trading intervention tools; and (8) regularly conducted audits by Firm personnel of risk management procedures and risk alerting mechanisms.

Issues and/or concerns that are uncovered during the testing phase are studied by appropriate development staff and escalated to senior management when appropriate. Current systems are not activated and new systems are not moved into production until all tests are cleared and the Firm's QA Department issues its approval. Independent approval authority for the QA team is critical in ascertaining the quality of the releases. However, the QA team is deeply embedded in the process of development and design from the beginning. We strongly believe that an external or a separate, disjointed team would not have the necessary system insight to effectively test complex trading systems.

4.   *How is scenario testing performed? Who determines what types of operational risk scenarios a system must be able to withstand?*

ITG performs a combination of manual and automated tests for new functionalities that are introduced to our systems. Any areas identified as introducing a new risk are thoroughly reviewed and relevant scenarios are considered for testing. One of the most difficult challenges is to test scenarios involving the interaction between the Firm's systems and the systems of other market participants (including exchanges) during the occurrence of a trading error. In many cases, testing for a particular system's reaction to an initial error is attainable. However, unanticipated market conditions and issues caused by responses of external systems to the initial error could create a cascading effect of multiple system failures. These compounded system failures are capable of transforming an initial trading error caused by one market participant into a large scale trading debacle with market wide effects. If testing procedures do not account for the interaction between and among external and internal systems, multi-level failures will remain unforeseeable and market participants will continue to be woefully unprepared to address them in an expedient and effective manner. Accordingly, it is imperative to develop testing scenarios that involve the interaction between internal and external systems and contemplate secondary failures.

We have found that post-mortem analysis and exhaustive reviews of past issues and failures provide invaluable insight when addressing these issues. Furthermore, one of the keys to evaluating test scenarios and the ensuing results for risk management is the close interaction between technology and business staff. Our risk management team is comprised of representatives from product management, operations, technology, compliance, and senior management to ensure that all aspects of a risk exposure event are reviewed by appropriate personnel.

5. *What level of robustness is expected by the market? What is needed? Are there acceptable rates of errors? What levels are practical or achievable?*

As mentioned earlier, ITG strives for zero errors in production. Although this goal may seem unrealistic, it establishes a culture of prevention and planning. An error-free production environment is critical to ITG's license to innovate. In an extremely competitive environment, we are highly motivated to minimize trading risk and errors. Accordingly, ITG spends significant resources on error prevention and recovery mechanisms that exceed regulatory requirements.

When providing brokerage services to its clients, ITG interacts with a variety of other market participants and their respective systems, including exchange trading platforms, dark liquidity pools, order routing systems (*e.g.*, execution management systems and order managements systems), and customized client trading applications. Although we expect market participants to satisfy applicable regulatory requirements, including but not limited to Rule 15c3-5 of the Securities Exchange Act of 1934 ("Market Access Rule")[1] and applicable rules of self-regulatory organizations ("SROs") concerning erroneous orders and trades, our expectations for system robustness varies greatly across the spectrum of providers and their respective functions. However, our expectations concerning the efficient and timely communication of errors and the proper allocation of responsibility are similar for all providers.

6. *What is the role of independent parties in testing or certifying the many aspects of a robust software development life cycle?*

ITG does not use independent parties for systems and technology testing. In our experience, external parties are not familiar enough with the complex functionality of in-house trading systems, and are therefore, ineffective in identifying potential software issues. However, independent parties could play a useful role in developing tools for improved simulation, such as mechanisms for controlled replay of market data. Broker-dealers and exchanges should find innovative ways to test new software and components in a parallel real-time fashion using network mirroring and other means.

7. *What additional role, if any, might further or different regulations play in these processes?*

ITG maintains that existing rules and regulations such as the Market Access Rule,[2] Rule 201 of Regulation SHO,[3] and the Single Stock Circuit Breakers[4] have

---

[1] *See* 17 C.F.R. §240.15c3-5.

[2] *Id.*

[3] *See* 17 C.F.R. §242.201.

[4] *See* Exchange Act Rel. No. 62251 (June 10, 2010), 75 FR 34183 (June 16, 2010) ("Approval Order of Single Stock Circuit Breakers").

improved market conditions by requiring market participants to more closely monitor their respective trading activities for regulatory, financial, and operational risk. In addition, we believe that the Limit Up / Limit Down Plan[5] and Market Wide Circuit Breakers,[6] which will take effect on February 4, 2013, will result in the implementation of more robust policies, procedures, and automated controls concerning risk management and the prevention of trading errors. In light of the existing regulatory infrastructure compounded with the complex and dynamic nature of trading technology, humility is required when considering the role for new regulations. Instead of implementing additional regulatory obligations, existing rules and regulations should be improved and updated, and industry guidelines and best practices should be promoted.

As mentioned earlier, drop copies from exchanges reflecting details of order handling and/or execution activities would greatly benefit member firms. Specifically, market participants could use enhanced drop copies that are integrated with real-time execution monitoring and clearing systems as an effective tool for independent risk monitoring. Such drop copy feeds could be enhanced to include point-in-time or end-of-day aggregate positions, as well as electronic dissemination of alerts when exchange monitored thresholds (e.g., notional value or average daily traded volume) are crossed. In addition, SROs and member firms should work together to establish metrics and thresholds for issuing alerts and instituting related actions. The ability to track and disseminate comparable metrics across market participants is critical to the timely and effective detection of systemic issues.

Such metrics and thresholds could eventually form the criteria for kill switches and warning thresholds prior to the triggering of kill switches. Instead of relaying discrete threshold warnings ahead of kill switch execution, real time feeds of the underlying metrics should be disseminated over exchange drop copy feeds. This arrangement will ensure continuous, synchronized monitoring of trading activities by the SROs and their member firms, which should reduce the likelihood of receiving abrupt notice immediately before the arrival of a kill switch threshold. A testing period with dissemination of metrics would also allow member firms to test the impact and efficacy of such metrics as criteria for kill switches. Finally, all such enhanced risk management checks and controls should be discussed in the context of best practices concerning the handling and/or execution of client orders. These discussions could be facilitated through the efforts of industry trade groups such as the FIX Protocol Ltd.'s work on establishing uniform best practices and guidelines for trading risk management.[7]

<p style="text-align:center">*　　*　　*　　*　　*　　*</p>

---

[5] *See* Exchange Act Rel. No. 67091 (May 31, 2012), 77 FR 33498 (June 6, 2012) ("Order Approving Limit Up-Limit Down Plan on a Pilot Basis).
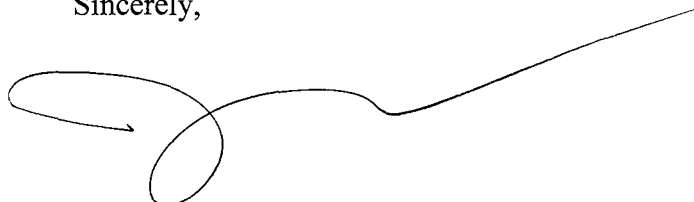
[6] *See* Exchange Act Rel. No. 67090 (May 31, 2012), 77 FR 33531 (June 6, 2012) ("Order Approving the Modification of the Market-wide Circuit Breakers").

[7] *See* Equity Risk Controls Issued by FIX Protocol Ltd. Risk Management Committee (January 10, 2011).

ITG appreciates the opportunity to comment on the issues raised during the Roundtable. If you have any questions related to our comments, please feel free to contact us.

Sincerely,

James P. Selway III
Managing Director
Head of Liquidity Management
ITG Inc.

Sudhanshu Arya
Managing Director
Head of Technology for Liquidity Management
ITG Inc.

cc: Honorable Mary L. Schapiro
       Honorable Elisse B. Walter
       Honorable Luis A. Aguilar
       Honorable Troy A. Paredes
       Honorable Daniel M. Gallagher
       Robert Cook, Director, Division of Trading and Markets

Exhibit A

<div align="center">

Statement of

Sudhanshu Arya, ITG, Inc.

for the

SEC Technology and Trading Roundtable

October 2, 2012

</div>

Opening Statement

Good morning Chairman Schapiro, Commissioners, and Division Staff, and thank you for the opportunity to participate in today's discussion of technology and trading. My name is Sudhanshu Arya and I am a Managing Director at ITG. ITG is a global broker that executes as agent on behalf of institutional investors and broker-dealers, both on- and off-exchange. We represent approximately 3% of daily volume in US equities.

At ITG, I am responsible for the full technology cycle for our Liquidity Management business. My responsibilities include algorithmic trading, routing to exchanges and other trading venues, middle-office functions, and POSIT—one of the largest, most established dark pools in the world. In our search for best execution, we are required to tackle a number of technical challenges, including: tracking client positions; intermediating order routes and parent-child relationships; managing open, filled, and cancelled orders in the marketplace; and tackling latency, throughput, and compliance demands associated with operating in today's environment.

Our aspiration for error prevention is simple: we strive for zero errors in production. Although this goal may seem unrealistic, it establishes a culture of prevention and planning. An error-free production environment is key to our license to innovate. In an extremely competitive environment, we are highly motivated to minimize trading risk and errors. ITG spends significant resources on prevention and recovery mechanisms that go above and beyond regulatory requirements.

Today's roundtable discussion represents a good opportunity to enhance industry-wide efforts to prevent errors. But errors happen – and always will. When they do occur, efficient recovery is critical. Industry co-ordination, based on agreed-upon metrics and established communication plans and protocols, is crucial. We look forward to contributing to the industry's efforts to establish trading technology "best practices," and we commend the Division for organizing today's event.