



BANK OF ENGLAND
PRUDENTIAL REGULATION
AUTHORITY

Consultation Paper | CP5/18
Algorithmic trading

February 2018

Prudential Regulation Authority
20 Moorgate
London EC2R 6DA



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Responses are requested by Monday 7 May 2018.

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1 Overview

1.1 This consultation paper (CP) sets out the Prudential Regulation Authority's (PRA's) proposed expectations regarding firms' governance and risk management of algorithmic trading. The PRA proposes to publish a new supervisory statement (SS) on algorithmic trading, which is set out in the Appendix.

1.2 The CP is relevant to firms that engage in algorithmic trading and are subject to the rules in the Algorithmic Trading Part of the PRA Rulebook and Commission Delegated Regulation (EU) 2017/589.¹ The draft SS would apply to all algorithmic trading activities of a firm including in respect of unregulated financial instruments such as spot foreign exchange (FX).

1.3 For non-EEA ('third country') firms operating in the United Kingdom through a branch, the PRA will continue to follow the supervisory approach set out in SS10/14 'Supervising international banks: the Prudential Regulation Authority's approach to branch supervision'² and will continue to consider the home regulator's approach to internal governance and controls. Proposed amendments to SS10/14 in CP29/17 'International banks: the Prudential Regulation Authority's approach to branch authorisation and supervision'³ currently under consultation, create a specific expectation that third country branches will have appropriate risk management in place to support the critical functions they undertake, including managing risks stemming from algorithmic trading.

1.4 The proposals in this CP are based on a cross-firm review carried out by the PRA between November 2014 and March 2017. The review highlighted areas where the PRA considered that further clarification was needed on its expectations as to how firms can demonstrate compliance with the relevant regulatory requirements.

Implementation

1.5 The PRA proposes that the algorithmic trading SS applies from Saturday 30 June 2018.⁴

Responses and next steps

1.6 This consultation closes on Monday 7 May 2018. The PRA invites feedback on the proposals set out in this consultation. Please address any comments or enquiries to CP5_18@bankofengland.co.uk.

1.7 The proposals in this CP have been designed in the context of the current UK and EU regulatory framework. The PRA will keep its policy under review, to assess whether any changes would be required due to changes in the UK regulatory framework, including those arising once any new arrangements with the European Union take effect.

1 Commission Delegated Regulation (EU) 2017/589 of 19 July 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council with regard to regulatory technical standards specifying the organisational requirements of investment firms engaged in algorithmic trading.

2 September 2014: www.bankofengland.co.uk/prudential-regulation/publication/2014/supervising-international-banks-the-pra-approach-to-branch-supervision-ss.

3 December 2017: www.bankofengland.co.uk/prudential-regulation/publication/2017/international-banks-pras-approach-to-branch-authorisation-and-supervision.

4 This date aligns with the implementation of EBA revised guidelines on internal governance under Directive 2013/36/EU and joint ESMA and EBA guidelines on the assessment of the suitability of members of the management body and key function holders under Directive 2013/36/EU and Directive 2014/65/EU: www.eba.europa.eu/documents/10180/1972987/Final+Guidelines+on+Internal+Governance+%28EBA+GL-2017-11%29.pdf and www.esma.europa.eu/sites/default/files/library/esma71-99-598_joint_esma_and_eba_guidelines_eba-gl-2017-12_0.pdf.

2 Proposals

2.1 The PRA proposes to introduce an SS on algorithmic trading that would set out the PRA's expectations of firms' governance and risk management in respect of algorithmic trading activity. The PRA expects to complement this SS with future work, and where necessary policy proposals, in areas such as operational resilience. The PRA intends to publish a Discussion Paper on operational resilience in 2018.

2.2 Algorithmic trading is automated and trades can be executed rapidly. Appropriate governance and risk management arrangements including, in particular, risk controls¹ linked to a firm's risk appetite, are crucial for managing the risks stemming from algorithmic trading.

2.3 The PRA expects that a firm that follows the proposed expectations would promote its own safety and soundness through having appropriate governance and risk management around algorithmic trading.

2.4 The proposed SS is structured in the following sections:

- Governance;
- Algorithmic approval process (by the firm);
- Testing and deployment;
- Inventories and documentation; and
- Risk Management and Other System and Controls functions.

2.5 The following sections summarise the PRA's proposed expectations under each of these headings.

Governance

2.6 The PRA proposes that a firm's governing body explicitly approve the governance framework for algorithmic trading, and a firm's management body identify the relevant Senior Management Function(s) with responsibility for algorithmic trading. A governance framework is critical to ensuring a firm's sound operation, and an effective governance framework includes the implementation of a sound risk management strategy and framework. The PRA's review highlighted that not all firms' algorithmic trading activities were adequately captured in their governance frameworks.

Algorithmic approval process

2.7 The PRA proposes that firms have a robust algorithm approval process with clear scope and conditions that would need to be met prior to approving an algorithm's use. Prior to granting approval, each algorithm should have assigned owners and have completed testing successfully. The testing should include all relevant parties (eg Front Office, Risk Management, Other Systems and Controls Functions). It is important that, prior to use, an algorithm is assessed and that potential risks that could arise are assessed by relevant functions and that, if required, risk controls implemented.

¹ Article 17 of Directive 2014/65/EU of the European Parliament and of the Council.

Testing and deployment

2.8 The PRA proposes that all algorithms and risk controls be tested prior to deployment and subject to periodic re-validation. The testing should involve all relevant functions and be carried out at a frequency and to a standard commensurate with the risks that the firm could be exposed to were algorithms or risk controls not to operate as intended. An algorithm that does not operate as intended in the market can have unintended consequences for the firm that deployed it and also for other market participants.

Inventories and documentation

2.9 The PRA proposes that firms create and maintain: comprehensive inventories of algorithms and risk controls; and documentation that sets out each algorithm's strategy and risk mitigants, kill-switch control procedures and the algorithmic trading system architecture. Firms would need to adequately document their algorithmic trading activity to ensure that those within the firm understand the activity being undertaken and are thereby able to challenge and mitigate any potential risk.

Risk Management and Other Systems and Controls functions

2.10 The PRA proposes that each firm's Risk Management function (that is independent of the Front Office) and Other Systems and Controls functions understand and have oversight of the risks of algorithmic trading. The PRA would expect these functions to have the authority and expertise to challenge front office and to impose on algorithmic trading whatever additional risk controls are necessary to its effective risk management.

3 The PRA's statutory obligations

3.1 The PRA is required by the Financial Services and Markets Act 2000 (FSMA) to consult when setting its general policies and practices.¹ In doing so, it is required to comply with several statutory and public law obligations. The PRA meets these obligations by providing the following in its consultations:

- a cost benefit analysis;
- an explanation of the PRA's reasons for believing that making the proposed policy is compatible with the PRA's duty to act in a way that advances its general objective,² and secondary competition objective;³
- an explanation of the PRA's reasons for believing that making the proposed policy is compatible with its duty to have regard to the regulatory principles;⁴ and
- a statement as to whether the impact of the proposed policy on mutuals will be significantly different its effects on other persons.

3.2 The Prudential Regulation Committee (PRC) should have regard to aspects of the Government's economic policy as recommended by HM Treasury.⁵

1 Section 2L of FSMA.

2 Section 2B of FSMA.

3 Section 2H(1) of FSMA

4 Section 2H(2) and 3B of FSMA.

5 Section 30B of the Bank of England Act 1998.

3.3 The PRA is also required by the Equality Act 2010¹ to have due regard to the need to eliminate discrimination and to promote equality of opportunity in carrying out its policies, services and functions.

Cost benefit analysis

3.4 The PRA has assessed that the proposals in this CP require minimal incremental investment by firms above that already made in order to comply with existing regulation and guidance for this activity. The PRA considers those costs are outweighed by the benefit of reducing uncertainty over its expectations in this area, and therefore reducing the risk of firms investing in approaches that would not meet its expectations.

Compatibility with the PRA's objectives

3.5 The PRA has considered whether the proposals are compatible with the PRA's statutory objectives under FSMA to promote the safety and soundness of PRA-authorized firms. Firms meeting the proposed expectations would have risk controls for algorithmic trading that align with their risk appetite, which should promote their safety and soundness and, if adhered to across the industry, should promote financial stability.

3.6 The PRA has assessed whether the proposals are compatible with the PRA's secondary objective to facilitate effective competition. The proposed SS would apply to CRR² firms. The PRA considers that these firms will not be disadvantaged through hampering their competitiveness, as the SS provides expectations on how rules and guidance should be met.

Regulatory principles

3.7 In developing the proposals in this CP, the PRA has had regard to the regulatory principles. Three principles are of particular relevance.

3.8 The principle that a burden should be proportionate to the benefits which are expected to result from the imposition of that burden. The PRA has followed this principle when developing the proposals outlined in this CP. In particular, the PRA has only been prescriptive where it is necessary, and has not articulated how a firm should meet the expectations outlined in the SS, as the PRA recognises that these could be met in a number of ways.

3.9 The principle that senior management take responsibility for the management of their firm. The draft SS would set expectations of the management body in relation to algorithmic trading which are in line with their responsibilities for other trading activities.

3.10 The desirability of the PRA exercising its functions in a way that recognises differences between firms as to the objectives and nature of their business. The proposals in this CP have been developed to take these factors into account. For example, the proposals recognise that smaller firms may not have a standalone independent risk management function.

Impact on mutuals

3.11 In the PRA's opinion, the impact of the proposals on mutuals is expected to be no different from the impact on other firms.

¹ Section 149.

² Capital Requirements Regulation (575/2013) (CRR).

HM Treasury recommendation letter

3.12 HM Treasury has made recommendations to the PRC about aspects of the Government's economic policy to which the PRC should have regard when considering how to advance the PRA's objectives and apply the regulatory principles.¹

3.13 The aspects of the Government's economic policy most relevant to the proposals in this CP are:

- (i) competition;
- (ii) innovation; and
- (iii) diversity of business models.

3.14 Aspects (i) and (iii) have been considered in the 'compatibility with the PRA's objectives' and 'regulatory principles' sections above.

Innovation

3.15 Innovation is and will continue to occur in relation to algorithmic trading, for example with technology developments. Developments to date have been rapid and therefore where appropriate the proposals in the CP have been set out at a high level to account for innovation while ensuring that firms align with the PRA's expectations.

Equality and diversity

3.16 The PRA does not consider that the proposals give rise to equality and diversity implications.

¹ Information about the PRC and the recommendations from HM Treasury are available on the Bank's website at www.bankofengland.co.uk/about/people/prudential-regulation-committee.

Appendix: Draft supervisory statement 'Algorithmic trading'

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Introduction

Governance

Algorithm approval process

Testing and deployment

Inventories and documentation

Risk Management and Other Systems and Controls functions

1 Introduction

1.1 This supervisory statement (SS) sets out the PRA's expectations of a firm's risk management and governance of algorithmic trading and should be read alongside: Commission Delegated Regulation (EU) 2017/565 on organisational requirements and operating conditions for investment firms¹ (if applicable); the General Organisational Requirements Part and Risk Control Part of the PRA Rulebook; European Securities and Markets Authority (ESMA) Guidelines on systems and controls in automated trading environment trading platforms;² Joint ESMA and European Banking Authority (EBA) Guidelines on the assessment of suitability of members of the management body and key function holders;³ and EBA Guidelines on internal governance.⁴

1.2 This SS applies to firms that engage in algorithmic trading⁵ and are subject to the rules in the Algorithmic Trading Part of the PRA Rulebook and Commission Delegated Regulation (EU) 2017/589.⁶ It also applies to all algorithmic trading activities of a firm including in respect of unregulated financial instruments such as spot foreign exchange (FX).

1.3 In setting these expectations, the PRA considers that a firm's risk controls are critical to ensuring appropriate governance arrangements are in place when engaging in algorithmic trading. Such controls express the risk appetite of a firm's governing body and include, for example, restrictions as to the types of security that can be traded and eligibility of counterparties.

1.4 The PRA sets expectations in respect of a firm's algorithmic trading activities in a number of areas:

- Governance;
- Algorithm approval process (by the firm);
- Testing and deployment;
- Inventories and documentation; and
- Risk Management and Other Systems and Controls functions.

2 Governance

2.1 A firm that engages in algorithmic trading should ensure that this activity adheres to its strategic objectives, risk strategy and governance as set by its governing body.

2.2 The PRA expects the firm's governing body or, where applicable, its risk committee to approve the governance framework for the oversight of the firm's algorithmic trading.

1 Commission Delegated Regulation (EU) 2017/565 of 25 April 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council as regards organisational requirements and operating conditions for investment firms and defined terms for the purposes of that Directive.

2 www.esma.europa.eu/sites/default/files/library/2015/11/esma_2012_122_en.pdf.

3 www.eba.europa.eu/documents/10180/1972984/Joint+ESMA+and+EBA+Guidelines+on+the+assessment+of+suitability+of+members+of+the+management+body+and+key+function+holders+%28EBA-GL-2017-12%29.pdf.

4 www.eba.europa.eu/documents/10180/1972987/Final+Guidelines+on+Internal+Governance+%28EBA-GL-2017-11%29.pdf/eb859955-614a-4afb-bdcd-aaa664994889.

5 As defined in the Algorithmic Trading Part of the PRA Rulebook.

6 Commission Delegated Regulation (EU) 2017/589 of 19 July 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council with regard to regulatory technical standards specifying the organisational requirements of investment firms engaged in algorithmic trading.

The governance framework

2.3 The PRA expects the governance framework to define lines of responsibility, including for:

- (a) overseeing the execution of the algorithmic trading policy and monitoring adherence to that policy;
- (b) reviewing and approving algorithms in line with the algorithm approval process;
- (c) assigning ownership for the inventory of algorithms and risk controls;
- (d) ensuring the inventories of algorithms and risk controls are accurate;
- (e) assigning ownership for the kill-switch controls; and
- (f) setting out and overseeing a process that reviews algorithmic trading incidents, where an incident occurs if an algorithm or a risk control does not operate as intended.

The management body

2.4 The PRA expects the firm's management body to have, and to maintain, an understanding of the firm's algorithmic trading and the risk controls viewed as most important to mitigate and contain the risks from algorithmic trading.

2.5 The management body should identify the relevant Senior Management Function(s) (SMF(s)) with responsibility for algorithmic trading and ensure that this is included in the SMF's Statement of Responsibility.

2.6 The firm's management body should ensure, at a minimum, that:

- (a) traders, prior to trading electronically, understand the characteristics of algorithms, trading venues and market liquidity;
- (b) traders' access to algorithms aligns to their remit and the firm's risk management framework and appetite; and
- (c) there is oversight of traders' use of algorithms.

Algorithmic trading policy

2.7 The PRA expects a firm to have an algorithmic trading policy which at a minimum should:

- (a) identify the firm's algorithmic trading activity, including where it is undertaken within the firm;
- (b) define the term 'algorithm' as used by the firm in the context of algorithmic trading;
- (c) prescribe the process for the approval and decommissioning of an algorithm;
- (d) outline the testing and validation process for algorithmic trading, including who has responsibility for these activities. The PRA expects the testing and validation process to have a clear scope and purpose and to express the prioritisation and frequency with which testing and validation should be undertaken;
- (e) set out minimum requirements for the monitoring and risk management of algorithmic trading, including escalation procedures relating to limit breaches;

- (f) set out minimum risk controls that should be in place;
- (g) set out the minimum standards for calibration of risk controls. The PRA expects a firm in the calibration of its risk controls to have accounted for a range of market conditions (both historical and hypothetical), including stressed market conditions;
- (h) set out the roles and responsibilities of the algorithm owners and the risk control owners;
- (i) set out minimum requirements for the structure and content of inventories of algorithms and risk controls;
- (j) set minimum requirements for documentation in relation to algorithmic trading; and
- (k) make reference to other policies and procedures, as necessary.

3 Algorithm approval process

3.1 The PRA expects a firm to embed an algorithm approval process as part of its systems and controls, which captures:

- (a) new algorithms; and
- (b) customisation of, or amendment to, existing algorithms.

3.2 A firm may choose to have different approval requirements depending on the algorithm's use, and where relevant the customisation or amendment being made. The PRA expects:

- (a) the approval process to be commensurate with the risks the firm could be exposed to via the algorithm;
- (b) the firm to set out its approval requirements, clearly indicating the conditions under which different approval requirements apply, if appropriate; and
- (c) the firm to ensure that the approval process does not incentivise approvals to be made in a manner that could result in a lower rigour of review. For example, the PRA would not expect a significant change to an algorithm to be broken into a number of smaller changes, each of which would be subject to testing less rigorous than would be applied to the significant change itself.

Conditions to be met prior to granting approval

3.3 Prior to approval, the PRA expects, at a minimum:

- (a) each algorithm to have assigned owners, who are accountable for the algorithm's use and performance. Such accountability includes ensuring that the algorithm is appropriately developed, implemented, used as intended and has undergone appropriate testing and deployment;
- (b) testing to be successfully completed; and
- (c) all relevant parties (eg Front Office, Risk Management,¹ Other Systems and Controls functions) to have considered and to have signed-off on the risks that the algorithm could

¹ Which are independent from the Front Office.

expose the firm to. This should be assessed under both normal, and severe but plausible conditions.

3.4 The PRA expects the firm's approval process to include the risk controls that must be in place prior to granting approval to use an algorithm. The PRA expects the risk controls to align with the firm's risk appetite. At a minimum, the PRA expects there to be risk controls that limit exposure to a counterparty, order attribution, message rate, frequency of orders, stale data, and order and position size (including in relation to market liquidity).

3.5 The PRA expects a firm to have manual and automated controls that stop trading or prevent user access and with manual intervention required to re-start trading (referred to as 'kill-switch' controls). A firm, at a minimum, is expected to:

- (a) have a governance process around the use of kill-switch controls;
- (b) detail the action to be taken in respect of outstanding and placed orders when kill-switch controls are activated; and
- (c) periodically assess kill-switch controls to ensure that they operate as intended. This includes an assessment of the speed at which the procedure can be affected.

4 Testing and deployment

4.1 The PRA expects all algorithms (including those provided by external vendors) and risk controls to be tested prior to deployment. Testing should assess their design and implementation.

4.2 The PRA expects a firm to periodically re-validate algorithms and risk controls. The reviews should be carried out at a frequency and with a level of rigour commensurate with the risks the firm could be exposed to if algorithms or risk controls are not operating as intended.

4.3 The PRA expects all relevant functions (including Front Office, Risk Management and Other Systems and Controls) to ensure that all automated risk controls operate as intended. This involves authorising the design of tests and signing-off the results of such tests to ensure the automated risk controls operate as intended.

4.4 Any variation of an algorithm (for example, regional variation) should be classified as a new algorithm and therefore subject to separate testing and approval. Minimum testing requirements should be clearly documented for all cases (new and variation of algorithms).

4.5 The PRA expects testing to be undertaken:

- (a) by a competent team that was not involved in the development (including implementation) of the code; and
- (b) with any differences between the test environment and the production environment being included in the testing documentation.

4.6 Prior to deployment, the PRA expects, at a minimum, a firm to assess:

- (a) the latency¹ of the algorithmic trading system. The algorithmic trading system is the infrastructure used for algorithmic trading, including infrastructure used to oversee and manage algorithmic trading, for example the firm's risk management systems;
- (b) the latency between different parts of the algorithmic trading system where there are dependences. The firm should ensure that the latency does not adversely impact operations, including the intended operation of the risk controls; and
- (c) system capacity, including the number of orders that can be processed per second, both under normal and severe but plausible market conditions. The firm should detail the contingency plan to be followed if system capacity appears likely to be exhausted under normal and severe but plausible market conditions².

4.7 The PRA expects a firm, where it is connected to a trading venue, to assess the operational arrangements at the trading venue and determine whether actions should be taken to ensure that the algorithmic trading system operates as intended and, if necessary, what these actions should be.

4.8 The PRA expects a firm, where it is using infrastructure provided by an external vendor, to assess whether actions should be taken to ensure that the algorithmic trading system operates as intended and, if necessary, what these actions should be.

4.9 When deficiencies or errors are identified during the testing process, the firm should take remedial action. In particular, the use of the algorithm could be prohibited or limited via controls. The firm should have a process for managing identified issues that includes the tracking and documenting of outstanding issues to an auditable standard.

5 Inventories and documentation

5.1 The PRA expects a firm to have the following inventories and documentation:

- (a) a single and comprehensive inventory of algorithms;
- (b) a single and comprehensive inventory of risk controls;
- (c) documents that set out each algorithm's strategy and risk mitigants;
- (d) documents that set out the algorithmic trading system architecture; and
- (e) documentation of kill-switch controls procedures.

5.2 The inventories and documentation referred to above in paragraph 5.1 should be:

- (a) reviewed by staff independent of the development of the algorithms;
- (b) updated at least annually;
- (c) accessible immediately by all the firm's personnel who have responsibility for the oversight of algorithmic trading; and

1 Latency is the speed at which an action occurs following the issuing of an instruction. That is, the time it takes for an instruction to be sent from point A and received at point B and for B to then start to act on the instruction.

2 The head-room capacity, which is the capacity that is not utilised under normal market conditions, should be known to those involved in operating and overseeing algorithmic trading.

- (d) available to the PRA on request.

Inventory of algorithms

5.3 The inventory of algorithms should include, in respect of each algorithm:

- (a) provide a brief overview;
- (b) detail the status of the algorithm (eg implemented for use, under development, and/or recently retired);
- (c) state the date(s) the algorithm was approved and, if appropriate, retired;
- (d) detail the scope of approval of the algorithm, in terms of region, asset class, instrument, desk, portfolio;
- (e) detail any restrictions placed on the algorithm when approved;
- (f) identify the algorithm owner(s);
- (g) provide a link to the algorithm's documentation; and
- (h) provide a unique identifier.

Inventory of risk controls

5.4 The inventory of risk controls, at a minimum, should in respect of each control:

- (a) provide a brief overview, including the risk being mitigated by the control;
- (b) indicate whether the control is classed as a limit or trigger;
- (c) detail whether the control is for notification/alerting only, or if it results in changing the operation of the relevant algorithmic trading (for example, a control may prevent further orders being entered by a client);
- (d) detail if there are any automated alerts associated with the control and who they are sent to and when;
- (e) state the date the control was implemented and, if appropriate, retired;
- (f) identify its location in the algorithmic trading system architecture;
- (g) identify, if relevant, where its operation is dependent on other controls;
- (h) detail the current setting of the control and, if appropriate, the different values that the control can be set to without requiring authorisation;
- (i) detail who has authority to change the setting of the control;
- (j) identify the control owner;
- (k) provide a link to the controls documentation; and
- (l) provide a unique identifier.

5.5 The PRA expects the inventory to include any risk controls the firm sets externally (for example, risk controls set by the firm at a trading venue).

Documentation of strategies and risk controls

5.6 The PRA expects a firm to document the strategies associated with each algorithm and the associated risk controls. This documentation should be comprehensible to those who have oversight responsibilities for algorithmic trading.

Documentation of algorithmic trading system architecture

5.7 The PRA expects a firm to document the algorithmic trading system architecture. This document should clearly identify each system within the architecture and clearly indicate where the algorithmic trading architecture and risk management systems intersect.

Kill-switch procedure

5.8 The kill-switch procedure should describe clearly the process of cessation and re-starting of algorithmic trading, including clearly identifying those who have authority to re-start algorithmic trading.

5.9 The kill-switch procedure should set out points that have a bearing on the decision to stop and re-start trading.

5.10 The kill-switch procedure should include details on the testing procedure to periodically assess that the kill-switch controls operate as intended.

6 Risk Management and Other Systems and Controls functions

6.1 The functions responsible for Risk Management and Other Systems and Controls are expected to:

- (a) understand algorithmic trading being undertaken at the firm, the risks that such trading exposes the firm to, and how it affects their oversight responsibilities; and
- (b) have authority to challenge and ultimately restrict or impose additional controls or limits on algorithmic trading.

6.2 In addition to these general expectations, the PRA has the following specific expectations in relation to these units and/or functions.

Risk Management

6.3 The PRA expects the firm's Risk Management function to ensure that algorithmic trading is consistent with the firm's risk appetite and governance framework, as approved by the governing body.

6.4 The Risk Management function is responsible for ensuring that all risk controls that it owns, including those located in Front Office infrastructure, are updated in line with its expectations.

6.5 Where risk controls are located in the Front Office infrastructure but the Risk Management function does not have direct access to that infrastructure, the PRA expects there to be a policy in place that:

- (a) sets out how changes are made to the risk controls;

- (b) details on who has authority following instruction from the Risk Management function for altering the risk controls.

6.6 The PRA expects the Risk Management function to manage potential concentration of risk arising from counterparties using similar algorithmic trading strategies.

6.7 For direct electronic access counterparties, the PRA expects the Risk Management function to incorporate in its frameworks the oversight and management of these counterparties. Specifically, the Credit Risk Management function should assess the suitability of counterparties with direct electronic access and, if necessary, deny access.

6.8 The Risk Management function should identify, assess and report the risks that arise from algorithmic trading if the system architecture:

- (a) (including algorithms) operates as intended; and
- (b) does not operate as intended.

6.9 If the system architecture operates as intended, the Risk Management function is expected to assess intra-day exposure stemming from algorithmic trading and to design and implement, if necessary, measures to ensure that risk exposure at all times is within the firm's risk appetite.

6.10 In addition, the PRA expects a firm's Risk Management function to identify, assess and report the risks that would arise were parts of the system architecture do not to operate as intended (for example, if an algorithm or its associated controls were to malfunction, causing trading to stop or to continue but in an uncontrolled way). Such risks could include:

- (a) risk exposures rising beyond their limits and the firm's risk appetite; and/or
- (b) the firm failing to meet contractual or other obligations.

6.11 In respect of each of these risks, the Risk Management function should formulate and execute mitigation plans.

6.12 The PRA expects that algorithmic trading and its associated risks should be included in the design of a firm's stress tests, and in the design of market resilience testing. Where appropriate, a firm should undertake standalone algorithmic trading stress tests.

Other Systems and Controls functions

6.13 Algorithmic trading can result in a high volume of trades over a short period of time. The PRA expects those responsible for operations and settlements to be aware of the algorithmic trading system capacity and ensure that this aligns with post-trade processing capacity. Where post-trade controls are required, such as throttling controls to handle high capacity utilisation incidents, these should be clearly documented and relevant functions, including Front Office, should be aware of them.

6.14 A firm's Compliance Function should ensure that its algorithmic trading activities comply with the PRA Rulebook and meet the expectations set out in this SS.

6.15 A firm's Internal Audit function should ensure that reviews of algorithmic trading activities are included in its audit plans.