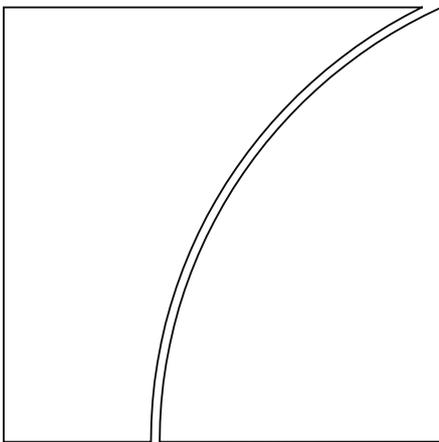


Committee on
Payments and Market
Infrastructures

Board of the International
Organization of Securities
Commissions



Implementation
monitoring of PFMI:
Level 3 assessment –
Report on the financial
risk management and
recovery practices of
10 derivatives CCPs

August 2016



BANK FOR INTERNATIONAL SETTLEMENTS



OICU-IOSCO

This publication is available on the BIS website (www.bis.org) and the IOSCO website (www.iosco.org).

© *Bank for International Settlements and International Organization of Securities Commissions 2016. All rights reserved. Brief excerpts may be reproduced or translated provided the source is stated.*

ISBN 978-92-9197-625-6 (online)

ISBN 978-92-9197-626-3 (print)

Abbreviations.....	viii
1. Executive summary.....	1
1.1 Scope of the assessment.....	2
1.2 Key changes to CCPs' risk frameworks since implementation of the PFMI	2
1.3 Key findings of the assessment.....	3
1.3.1 Governance of risk management.....	4
1.3.2 Credit risk management	4
1.3.3 Liquidity risk management	5
1.3.4 Margin.....	5
1.3.5 Collateral policy and investments.....	6
1.3.6 Default management and recovery planning	6
2. Introduction	8
2.1 Broader context of the Level 3 assessments.....	8
2.2 Objective of L3 assessments	8
2.3 Scope of this review	9
3. Process and methodology	11
3.1 Jurisdictional/CCP coverage.....	11
3.2 Data collection and analysis.....	13
3.3 Review of assessment findings by CCPs, relevant authorities and the parent committees	13
4. CCP risk frameworks.....	14
4.1 Role of a CCP.....	14
4.2 Sources of CCP risk and mitigation.....	14
4.3 Key changes to CCPs' risk frameworks	18
5. Key findings.....	20
5.1. Governance of risk management.....	20
5.1.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs.....	21
5.1.2 Key findings	22
5.1.2.1 Identification and consideration of stakeholder interests (Principle 2, KC 7).....	22
5.1.3 Other findings relevant to consistency of outcomes	23
5.1.4 Other observations	24
5.1.4.1 Governance arrangements and board structures (Principle 2, KC 2).....	24
5.1.4.2 Risk management framework (Principle 2, KC 6).....	24

5.1.4.3	Authority and independence of risk management and audit functions (Principle 2, KC 6).....	25
5.1.4.4	Disclosure (Principle 2, KC 7).....	25
5.1.4.5	Risks that arise in or are borne by the CCP (Principle 3, KC 1).....	26
5.1.4.6	Review of risk management policies, procedures and systems (Principle 3, KC 1).....	26
5.1.4.7	Incentives to manage risks (Principle 3, KC 2).....	27
5.1.4.8	Material interdependencies and risk management tools (Principle 3, KC 3).....	27
5.2	Credit risk management.....	28
5.2.1	Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs.....	29
5.2.2	Key findings.....	31
5.2.2.1	Sizing of prefunded resources (Principle 4, KC 4 and KC 5).....	31
5.2.2.2	Responses to breaches of target coverage (Principle 4, KC 4 and KC 5).....	37
5.2.2.3	Stress test assumptions and processes (Principle 4, KC 5).....	38
5.2.2.4	Stress testing of financial resources (Principle 4, KC 5).....	39
5.2.2.5	Stress testing scenarios (Principle 4, KC 6).....	40
5.2.2.6	Stress testing model review and validation (Principle 4, KC 5).....	43
5.2.3	Other findings relevant to consistency of outcomes	44
5.2.3.1	Coverage targets (Principle 4, KC 4).....	44
5.2.3.2	CCP contributions to prefunded financial resources (Principle 4, KC 4).....	45
5.2.4	Other observations.....	46
5.2.4.1	Credit risk frameworks and risk management tools (Principle 4, KC 1 and KC 2).....	46
5.2.4.2	Identification, monitoring and measurement of credit risk (Principle 4, KC 2).....	47
5.2.4.3	Reporting of stress-test results (Principle 4, KC 5).....	48
5.3	Liquidity risk management.....	49
5.3.1	Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs.....	50
5.3.2	Key findings.....	52
5.3.2.1	Approaches and key model parameters used to determine the amount and to test the sufficiency of liquid resources (Principle 7, KC 9).....	52
5.3.2.2	Scope of liquidity risk management framework and relevant currencies (Principle 7, KC 4).....	56
5.3.3	Other findings relevant to consistency of outcomes	56
5.3.3.1	Coverage of liquid resources (Principle 7, KC 4).....	56
5.3.3.2	Mitigating risks associated with access to qualifying liquid resources when needed (Principle 7, KC 5 and KC 7).....	57
5.3.3.3	Responses to breaches of coverage (Principle 7, KC 9).....	59

5.3.4	Other observations	60
5.3.4.1	Qualifying liquid resources (Principle 7, KC 5)	60
5.3.4.2	Supplemental liquid resources (Principle 7, KC 6)	62
5.3.4.3	Access to and use of central bank accounts and services (Principle 7, KC 8)	63
5.4	Margin practices	63
5.4.1	Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs	64
5.4.2	Key findings	68
5.4.2.1	Choice of margin model (Principle 6, KC 1)	68
5.4.2.2	Key model parameters (Principle 6, KC 3)	69
5.4.2.3	Procyclicality (Principle 6, KC 3)	71
5.4.2.4	Review, backtesting, sensitivity analysis and model validation (Principle 6, KC 6 and KC 7)	71
5.4.3	Other findings relevant to consistency of outcomes	73
5.4.3.1	Margin add-ons (Principle 6, KC 3)	73
5.4.3.2	Portfolio margining (Principle 6, KC 5)	74
5.4.3.3	Timing and frequency of margin calls (Principle 6, KC 4)	75
5.4.4	Other observations	76
5.4.4.1	Price information (Principle 6, KC 2)	76
5.4.4.2	Target coverage (Principle 6, KC 3)	77
5.4.4.3	Account structures (Principle 6, KC 3)	77
5.4.4.4	Discretion (Principle 6, KC 3)	78
5.4.4.5	Wrong-way risk (Principle 6, KC 3)	78
5.5	Collateral policy and investments	79
5.5.1	Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs	79
5.5.2	Key findings	81
5.5.2.1	Investment strategy (Principle 16, KC 4)	81
5.5.2.2	Setting haircuts and reducing the need for procyclical adjustments (Principle 5, KC 2 and KC 3)	83
5.5.3	Other findings relevant to consistency of outcomes	84
5.5.3.1	Valuation methods (Principle 5, KC 2)	84
5.5.4	Other observations	85
5.5.4.1	Assets accepted (Principle 5, KC 1)	85
5.5.4.2	Concentration limits (Principle 5, KC 4)	86
5.5.4.3	Cross-border collateral (Principle 5, KC 5)	87

5.6	Default management and recovery planning.....	87
5.6.1	Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs.....	89
5.6.2	Key findings	94
5.6.2.1	Appropriate plans for recovery or orderly wind-down (Principle 3, KC 4).....	94
5.6.2.2	Addressing unforeseen potentially uncovered liquidity shortfalls; Replenishment of liquidity resources (Principle 7, KC 10).....	95
5.6.2.3	Allocation of potentially uncovered credit losses (Principle 4, KC 7).....	96
5.6.2.4	Tools to re-establish a matched book following clearing participant default (Principle 4, KC 7).....	101
5.6.2.5	Replenishment of financial resources (Principle 4, KC 7).....	102
5.6.2.6	Tools to address losses not caused by clearing participant default (Principle 15, KC 3).....	105
5.6.3	Other findings relevant to consistency of outcomes	105
5.6.3.1	Testing and review of clearing participant default rules and procedures (Principle 13, KC 4)	105
5.6.3.2	Composition of liquid net assets funded by equity (Principle 15, KC 4)	106
5.6.3.3	Raising additional equity (Principle 15, KC 5).....	106
5.6.4	Other observations.....	107
5.6.4.1	Clearing participant default rules and procedures and use of financial resources (Principle 13, KC 1)	107
5.6.4.2	Holding sufficient liquid net assets funded by equity to implement the recovery or orderly wind-down plan (Principle 15, KC 3)	109
5.6.4.3	Consideration of insurance policies in the context of holding sufficient liquid net assets funded by equity to implement the recovery or orderly wind-down plan (Principle 15, KC 3)	109
6.	Summary and conclusions.....	110
6.1	Governance of risk management	111
6.2	Credit risk management.....	111
6.3	Liquidity risk management.....	112
6.4	Margin	113
6.5	Collateral policy and investments	113
6.6	Default management and recovery planning.....	114
	Annex A: Summary information for ASX Clear (Futures)	116
	Annex B: Summary information for BM&FBOVESPA Clearinghouse	120
	Annex C: Summary information for Clearing Corporation of India limited (CCIL)	125
	Annex D: Summary information for CME Clearing.....	128

Annex E: Summary information for Eurex Clearing AG	132
Annex F: Summary information for ICE Clear Credit	137
Annex G: Summary information for JSCC (ETD, CDS, and IRS)	141
Annex H: Summary information for LCH.Clearnet Ltd (SwapClear)	144
Annex I: Summary information for LCH.Clearnet SA.....	148
Annex J: Summary information for Singapore Exchange Derivatives Clearing (SGX-DC).....	151
Annex K: Members of the CPMI-IOSCO Implementation Monitoring Standing Group (IMSG) and assessment teams.....	155

Abbreviations

BCBS	Basel Committee on Banking Supervision
CCP	Central counterparty
CDS	Credit default swap
CPMI	Committee on Payments and Market Infrastructures
CPSS	Committee on Payment and Settlement Systems
CRO	Chief risk officer
CSD	Central securities depository
DF	Default fund
ES	Expected shortfall
ETD	Exchange traded derivatives
FMI	Financial market infrastructure
FSB	Financial Stability Board
HVaR	Historical simulation VaR
IM	Initial margin
IMSG	Implementation Monitoring Standing Group
IOSCO	International Organization of Securities Commissions
IRD	Interest rate derivatives
KC	Key Consideration
L1	Level 1
L2	Level 2
L3	Level 3
OTC	Over-the-counter
PFMI	Principles for financial market infrastructures
PSG	Policy Standing Group
PSR	Price scanning range
SPAN	Standardised Portfolio Analysis of Risk
SSS	Securities settlement system
TR	Trade repository
VaR	Value-at-risk
VSR	Volatility scanning range

1. Executive summary

In April 2012, the Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) published the *Principles for financial market infrastructures* (PFMI). The PFMI set expectations for the design and operation of key financial markets infrastructures (FMIs) to enhance their safety and efficiency and, more broadly, to limit systemic risk and foster transparency and financial stability. The Principles in the PFMI apply to all systemically important payment systems, central securities depositories (CSDs), securities settlement systems (SSSs), central counterparties (CCPs) and trade repositories (TRs) (collectively FMIs). These FMIs collectively clear, settle and record transactions in financial markets. Among other things, the PFMI provide important support for the G20 strategy to enhance financial system resilience by ensuring that standardised over-the-counter (OTC) derivatives are centrally cleared. CPMI and IOSCO members have undertaken to incorporate the PFMI in their jurisdictions' legal and regulatory frameworks.

Following the publication of the PFMI, the CPMI and IOSCO agreed to monitor their implementation in 28 CPMI and IOSCO member jurisdictions.¹ The implementation monitoring is being carried out in three levels. Level 1 self-assessments report on whether a jurisdiction has completed the process of adopting the legislation and other policies that will enable it to implement the Principles and Responsibilities. Level 2 assessments are peer reviews of the extent to which the content of the jurisdiction's implementation measures is complete and consistent with the PFMI. Level 3 (L3) peer reviews examine consistency in the outcomes of implementation of the Principles by FMIs and implementation of the Responsibilities by authorities. This implementation monitoring programme is conducted by a dedicated standing group of the CPMI-IOSCO Steering Group, the Implementation Monitoring Standing Group (IMSG).

This report represents a L3 assessment of consistency in the outcomes of CCPs' implementation of the PFMI with respect to their financial risk management and recovery practices. This first L3 assessment complements a broad work program on CCP resilience, recovery and resolution – the CCP Workplan – agreed in April 2015 by the Basel Committee on Banking Supervision (BCBS), the CPMI, the Financial Stability Board (FSB), and IOSCO². In future L3 assessment rounds, different assessment themes are anticipated, with the goal of covering over time a broad range of Principles, FMI types and jurisdictions.

L3 assessments are expected to inform the CPMI and IOSCO about the nature and potential causes of variations in approaches or outcomes because such variations may be due to challenges and interpretative issues that have emerged in implementing the PFMI. This information may feed into other CPMI and IOSCO work, including the work of the CPMI-IOSCO Policy Standing Group (PSG) on the ongoing development of standards and guidance. Given that this first L3 assessment deals with matters relevant to ongoing work by the PSG on CCP resilience and recovery under the CCP Workplan, the IMSG and PSG have coordinated their work. The findings of this L3 assessment have fed directly into the PSG's deliberations on additional guidance to the PFMI in this area.

This L3 assessment was carried out during 2015-16 by the IMSG with the help of experts from CPMI and IOSCO member jurisdictions.

¹ The 28 jurisdictions that are participating in the PFMI implementation monitoring exercise are: Argentina, Australia, Belgium, Brazil, Canada, Chile, China, the European Union, France, Germany, Hong Kong SAR, India, Indonesia, Italy, Japan, Korea, Mexico, the Netherlands, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

² See www.bis.org/cpmi/publ/d134.htm or www.iosco.org/library/pubdocs/pdf/IOSCOPD508.pdf.

1.1 Scope of the assessment

In this assessment, the IMSG has reviewed the financial risk management and recovery practices at a sample of 10 CCPs – including a mix of globally active and more regionally focused CCPs – that provide clearing services for derivatives. The 10 CCPs span nine jurisdictions.

The analysis was grouped into six topics: governance of risk management, credit risk management, margin practices, liquidity risk management, collateral policy and investments, and default management and recovery planning. These topics span a number of Principles and Key Considerations (KCs) in the PFMI.

The 10 CCPs participated voluntarily in the exercise, providing responses to a detailed survey covering all six risk management topics, responding to follow-up questions from the IMSG, and reviewing the final report for factual accuracy. The IMSG would like to thank the participating CCPs – and their supervisors and overseers – for their cooperation during this exercise.

In addition to qualitative information on risk management policies, processes and models, CCPs were requested to provide quantitative data on matters such as available prefunded financial resources, stress testing outcomes, and results of margin back testing and sensitivity analysis. The effective date for the information found in this report is 30 June 2015 unless otherwise stated.

Importantly, L3 assessments are peer-benchmarking exercises and not supervisory exercises. Accordingly, the focus of the report is on the consistency of outcomes of implementation of the relevant Principles and KCs across the group of CCPs as a whole rather than on each individual CCP's specific outcomes of implementation. As noted in Responsibility D of the PFMI, it falls within the responsibility of the relevant supervisory authorities to ensure that the Principles are applied by individual CCPs. Furthermore, the findings in this report are based on the IMSG's review of the 10 CCPs only and may not necessarily be representative of all CCPs.

1.2 Key changes to CCPs' risk frameworks since implementation of the PFMI

When published in April 2012, the PFMI strengthened and harmonised the three pre-existing sets of international standards for FMIs by raising minimum standards, providing more detailed guidance and broadening the scope of the standards to cover new risk management areas and a new type of FMI. For example, under the PFMI certain FMIs are expected to maintain a higher level of financial resources to address credit, liquidity and general business risks and set more detailed expectations for the governance of an FMI's operations than previously expected. The CPMI and IOSCO therefore anticipated that the implementation of the PFMI would lead to wide-ranging enhancements to FMIs' frameworks for managing risks. To verify this in the case of CCPs' risk management practices and thereby gauge the impact and effectiveness of the reform, the CPMI and IOSCO also requested that each CCP participating in this first L3 assessment identify the most significant enhancements to its risk framework since the implementation of the PFMI.

Many of the most significant enhancements cited by the CCPs were in the area of governance of risk management, including enhanced processes for approving changes to risk management practices, more formalised and comprehensive documentation of risk management frameworks, and the establishment of new risk committees with stakeholder representation. In addition to changes in their governance frameworks, the CCPs identified a number of other significant changes to their risk management practices. Many of these practices are described more fully as part of the detailed findings presented in this report, but include, by way of example: implementation of new "Cover 2" liquidity and credit coverage targets; implementation of new risk monitoring and risk management systems; enhanced model validation, testing and review processes; introduction of new margin methodologies or

enhancement of existing margin methodologies to address matters such as procyclicality; and implementation of comprehensive recovery planning arrangements.

1.3 Key findings of the assessment

The IMSG has made a number of important findings on consistency in the outcomes of implementation of the PFMI by the CCPs, both with the standards in the PFMI and across CCPs.

Overall, the CCPs have made important and meaningful progress in implementing arrangements consistent with the financial risk management and recovery standards of the PFMI. Some gaps and shortcomings have nevertheless been identified relative to these standards. In the area of recovery planning, in particular, a number of CCPs have not yet put in place the full set of recovery rules and procedures envisaged in the PFMI. These CCPs, and their supervisors, regulators and overseers, should consider this to be a serious issue of concern that should be addressed with the highest priority.

Some gaps and shortcomings have also been identified in the areas of credit and liquidity risk management. Most notably: some CCPs have not yet put in place sufficient policies and procedures to ensure that they maintain the required level of financial resources on an ongoing basis, including adequate arrangements to ensure a prompt return to the target level of coverage in the event of a breach; and some do not include sufficient liquidity-specific scenarios in their liquidity stress tests. Again, for such CCPs, these are serious issues of concern that should be addressed with the highest priority.

Relevant supervisors, regulators and overseers are encouraged to work with the CCPs for which they have responsibility to encourage prompt action in respect of these and any other issues of concern identified in this review that apply.

From the information obtained in respect of related work carried out by the PSG, it is understood that the key findings are generally consistent with observations across a broader sample of CCPs and clearing services. Accordingly, while the report focuses on the sample of 10 CCPs that were assessed, other CCPs, as well as their supervisors, regulators and overseers, should also consider whether any issues of concern identified would be relevant to their circumstances. If so, prompt action should be taken to address them. In some cases, greater clarity and granularity to be provided by the CPMI and IOSCO in the additional guidance to the PFMI under development by the PSG will further assist the relevant CCPs in making the appropriate enhancements to their practices.

The IMSG has also identified a number of other material differences in the outcomes of implementation across the CCPs. Even where these are not regarded as issues of concern relative to standards under the PFMI, they may nevertheless reveal differences in interpretation or approach that could lead to material differences in resilience which may need to be addressed. Again, where this is the case, progress towards achieving greater consistency in outcomes will be further assisted by additional guidance to the PFMI. Of course, in some cases, variations exist because individual CCPs have chosen to exceed relevant minimum standards in the PFMI, or have done so in accordance with the specific implementation of the PFMI in their home jurisdiction.

The report considers these findings in more detail and also discusses a number of other findings.

The CPMI and IOSCO are committed to the ongoing monitoring of CCPs' progress towards full implementation of the PFMI and the achievement of outcomes of implementation that are consistent with the PFMI. In light of the findings of this review, the IMSG commits to a follow-up review, as set out below:

- In the first half of 2017, the IMSG commits to conducting a follow-up targeted review of CCPs' progress in addressing the most serious issues of concern identified in this review – ie in the areas of recovery planning, coverage of financial resources on an ongoing basis (including

responses to breaches of target coverage), and the development of liquidity-specific scenarios in their stress testing frameworks. Where these issues of concern apply, CCPs are expected to make rapid progress in addressing them and are expected to have achieved outcomes of implementation that are consistent with the PFMI by the effective date of this exercise. This will be 31 December 2016. In the case of recovery, the follow-up exercise will be informed by the CPMI-IOSCO report, *Recovery of financial market infrastructures*, issued in October 2014 (Recovery Report).

This follow-up review is expected to cover a wider range of CCPs and product classes than have been considered in this exercise.

The key findings of the exercise are summarised, by topic, below.

1.3.1 Governance of risk management

All of the CCPs have documented and disclosed governance frameworks for financial risk management, approved by their respective boards. The IMSG has just one key finding on variation in the outcomes of implementation across CCPs in the area of CCPs' governance of risk management.

- *Identification and consideration of stakeholder interests.* All CCPs have mechanisms in place for stakeholder engagement and disclosure of key risk management decisions. However, the scope of stakeholders captured by these arrangements, the role of stakeholders under these arrangements, and the degree to which the board is bound by stakeholder views differ across CCPs. These differences may affect the effectiveness of these mechanisms.

1.3.2 Credit risk management

All of the CCPs collect margin and maintain other prefunded financial resources to cover participant exposures. All but one target a level of coverage consistent with relevant "Cover 1" and "Cover 2" standards and use stress testing to size resources in accordance with their coverage targets. However, the IMSG has identified a number of issues of concern in some CCPs' implementation of the PFMI. In particular:

- *Maintaining coverage on an ongoing basis.* The quantitative data suggest that in practice a small number of CCPs' prefunded financial resources may not be sized to meet the relevant target coverage on an ongoing basis. Furthermore, some CCPs do not have clear processes in place to promptly address any breach of target coverage.
- *Stress testing assumptions and processes.* In some cases, stress testing assumptions could be better calibrated to reflect more fully the challenges a CCP may face in managing a participant default in extreme but plausible market conditions. Most CCPs conduct a review of stress testing scenarios and parameters on at least a monthly basis, but some conduct such a review on a less frequent basis or on an ad hoc basis only.
- *Stress testing financial resources.* In most cases the CCPs' stress testing focuses exclusively on exposures and does not additionally consider stresses to CCPs' financial resources.
- *Stress testing scenarios.* While all CCPs consider historical scenarios, some do not consider all potentially relevant historical peak volatilities. And some CCPs do not meet the expectation that they supplement historical scenarios with a spectrum of forward-looking stress scenarios.

The most serious of these issues of concern relates to the failure of some CCPs to establish sufficient policies and procedures to ensure that they maintain the target level of coverage on an ongoing basis, including adequate arrangements to promptly address any breach of target coverage. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

1.3.3 Liquidity risk management

All of the CCPs set coverage targets to maintain liquid resources consistent with relevant "Cover 1" or "Cover 2" standards in the PFMI and use stress testing to assess the adequacy of their liquid resources.³ However, the IMSG has identified a number of issues of concern in some CCPs' implementation of the PFMI. The IMSG's key findings in relation to liquidity risk management are:

- *Relevant currencies.* The CCPs have taken different approaches to determining which currencies should be included in liquidity stress testing. Some CCPs include only those currencies that they consider to be 'material'. However, failure to include all relevant currencies in stress testing could have resilience implications for the CCP.⁴ In particular, the CCP may not be able to identify important exposures in some currencies; and the CCP may face a higher probability that it is unable to meet all of its payment obligations on time with a high degree of confidence.
- *Liquidity stress testing assumptions.* The scenarios and assumptions used by CCPs to stress test the size and adequacy of liquid resources are often similar to those used in credit stress testing. Many of the issues identified in relation to credit stress testing – as summarised above – therefore apply equally to liquidity stress testing.
- *Liquidity-specific stress testing scenarios.* Some CCPs do not identify liquidity exposures that could arise independently of a credit exposure in their liquidity stress testing scenarios; and, as in the case of credit stress testing, some CCPs do not appear adequately to supplement the stress testing of their liquidity exposures with stress testing of their liquid resources.

The most serious of these issues of concern relates to some CCPs' failure to include sufficient liquidity-specific scenarios in their stress testing frameworks. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

1.3.4 Margin

All of the CCPs apply initial and variation margin to derivatives exposures, using margin systems that in their judgment reflect the particular attributes of the cleared products. All of the CCPs have arrangements in place for backtesting their margin models and most also undertake monthly sensitivity analysis and more comprehensive annual model validation exercises. The IMSG's key findings relate to variation in the outcomes of implementation across CCPs with respect to the margin-related standards in the PFMI.

- *Model choice.* The CCPs' survey responses suggest that some CCPs may not systematically take into account all relevant factors⁵ in selecting from among alternative modelling approaches, or examine potential trade-offs between these factors.
- *Key model parameters and procyclicality.* A wide range of closeout periods and lookback periods are applied across the CCPs. Some assumptions are more conservative than others, and some CCPs could do more to demonstrate they have an appropriate method for measuring

³ Since the effective date of the assessment preceded the issuance on 5 February 2016 of the statement on clearing of deliverable FX instruments, which clarified the requirement for CCPs to maintain qualifying liquid resources even when using a 'paired delivery' settlement process, this assessment did not take that statement into consideration; future assessments will do so.

⁴ The CPMI and IOSCO note that the failure to maintain qualifying liquid resources in all relevant currencies could similarly have resilience implications. However, given the desktop nature of this review, the IMSG did not collect sufficiently detailed information to determine whether or not all CCPs maintain sufficient qualifying liquid resources in all relevant currencies.

⁵ For example: the number and interdependence of risk factors; data availability/reliability; the characteristics of the data (eg non-linearities, seasonality); model performance; model stability; flexibility and scalability; independence of errors/breaches; and transparency, predictability and replicability.

credit exposure that accounts for relevant product risk factors. The CCPs have also taken different approaches to dealing with procyclicality.

- *Review, backtesting, sensitivity analysis and model validation.* The depth and sophistication of the model testing and review processes vary across the CCPs.

1.3.5 Collateral policy and investments

All of the CCPs report that they have adopted collateral policies that are designed to address relevant credit, liquidity, market and legal risks. All state that their haircuts are set in a prudent manner. Cash collateral posted by participants is invested or held in custody. All of the CCPs state that they prioritize the minimisation of credit and liquidity risks over investment returns. The IMSG has made two key findings, which relate primarily to the consistency of outcomes of implementation across CCPs.

- *Cash collateral investment policy.* The CCPs deposit or invest cash collateral in different combinations of central bank deposits, commercial bank deposits, government bonds, reverse repurchase agreements, and other short-term instruments. These different approaches could involve different degrees of credit, market and liquidity risks.
- *Setting haircuts; procyclical adjustments.* There is a degree of variation across the sample of CCPs in the approaches taken to setting haircuts and also to mitigating potential procyclical adjustments under stressed market conditions.

1.3.6 Default management and recovery planning

All of the CCPs have established policies and procedures to manage clearing participant defaults, nearly all of which are regularly tested. Arrangements differ somewhat across the CCPs, reflecting the characteristics of the products cleared, participant profiles, and particular features of each CCP's operating environment.

In respect of recovery planning, however, some CCPs' progress in implementation has been significantly slower and a number of serious issues of concern have been identified. While a small number of CCPs had completed their recovery plans by the effective date of the IMSG's review, for most CCPs recovery planning is a fairly new and challenging exercise and experiences continue to evolve. Even among those CCPs that had detailed plans, relatively few considered their plans to be fully consistent with the PFMI. Nearly all are planning enhancements to their recovery plans to reflect the guidance in the Recovery Report.

While the additional guidance in the Recovery Report was published only eight months before the effective date of the L3 review, the specific standards related to recovery planning were already established in the PFMI. The CPMI and IOSCO reiterate the importance of developing comprehensive and effective recovery plans, consistent with standards in the PFMI and informed by associated guidance in the Recovery Report.

The report highlights a number of serious issues of concern in specific elements of CCPs' recovery plans. These include the following:

- *Loss allocation and restoring a matched book.* Most CCPs have at least some tools to allocate potentially uncovered credit losses to participants, most commonly assessments on surviving participants, in some cases supplemented with some form of variation margin gains (or other payments) haircutting. Most CCPs also employ either a form of service tear-up or forced allocation as their final tool for restoring a matched book for at least one of their clearing services. For the CCPs that do not have an uncapped loss allocation tool in place (whether through assessments, or through gains-based haircutting or service tear-up) however, it is unclear whether their plans would comprehensively address uncovered credit losses. Similarly, for CCPs that do not have a mandatory tool for liquidating the positions of the defaulter, such

as tear-up or forced allocation measures, it is unclear whether their plans would restore a matched book.

- *Replenishment.* Most CCPs have arrangements in place to replenish prefunded financial resources in the event of a drawdown following a participant default. There is a wide variation in the details of such arrangements, however, including in the timing of replenishment and the setting of caps on replenishment obligations. In some cases, there is also no clear distinction between assessments on participants for the purposes of loss allocation and assessments to replenish resources. Some CCPs have established delayed, phased or discretionary replenishment deadlines. While some of these CCPs have put in place interim measures to ensure that they can nevertheless continue to meet coverage standards, others have not; for these latter CCPs, it is unclear how they would ensure a timely return to full coverage following a depletion of resources. Such interim measures include calls for additional initial margin until replenishment of mutualised prefunded resources is complete.
- *Liquidity shortfalls.* Relatively few CCPs have arrangements in place to cover liquidity shortfalls with specific liquid resources, liquidity arrangements or liquidity generated by credit loss allocation tools. Some CCPs refer in their responses to the tools in place to avoid unforeseen and potentially uncovered liquidity shortfalls, but do not appear to have arrangements to deal with liquidity shortfalls should they actually arise. Even where arrangements are in place, some of these do not appear to meet the criteria for tools set out in the Recovery Report.
- *Tools to address losses not caused by clearing participant default (ie non-default losses).* Most CCPs would rely on capital injections from holding companies, shareholders or insurance policies to address uncovered non-default losses. Some have also developed arrangements to allocate certain general business risk losses – principally, investment losses – to participants beyond some threshold. A number of CCPs plan to develop their recovery plans further to more comprehensively address non-default losses.

The CPMI and IOSCO expect CCPs with shortcomings in their recovery plans to accord the highest priority to developing and completing their plans. It is expected that these CCPs will have done so by 31 December 2016.

2. Introduction

2.1 Broader context of the Level 3 assessments

In line with the G20's expectations, CPMI and IOSCO members have undertaken to incorporate the Principles and the Responsibilities included in the PFMI in their legal and regulatory frameworks. The CPMI and IOSCO regard full, timely and consistent implementation of the PFMI as fundamental to ensuring the safety and soundness of FMIs and to supporting the resilience of the global financial system.

To that end, the CPMI and IOSCO established a dedicated standing group, the Implementation Monitoring Standing Group (IMSG), to actively monitor the implementation of the PFMI. This work is proceeding according to a monitoring framework that involves three overlapping phases:

- (1) Level 1 (L1) to assess whether jurisdictions have completed the process of adopting the legislation, regulations and other policies that will enable them to implement the PFMI;
- (2) Level 2 (L2) to assess whether the content of legislation, regulations and policies is complete and consistent with the PFMI; and
- (3) Level 3 (L3) to assess whether there is consistency in the outcomes of implementation of the PFMI.

Since the publication of the PFMI, the CPMI and IOSCO have conducted: four rounds of L1 assessments; two rounds of L2 assessments, first for the implementation of the Principles by CCPs and TRs in the European Union, Japan, and the United States, and second for all FMI types in Australia; and a combined L2 and L3 assessment of the authorities' implementation of the Responsibilities for authorities in the PFMI.⁶ The CPMI and IOSCO will continue to monitor jurisdictions' progress in implementing the PFMI in future L1 and L2 assessments.

In parallel to these ongoing L1 and L2 assessments, the CPMI and IOSCO is carrying out thematic L3 assessments on the consistency of outcomes arising from the implementation of the Principles applying to FMIs.

2.2 Objective of L3 assessments

This assessment is the first L3 assessment carried out by the CPMI and IOSCO.

Assessing the consistency of outcomes involves detailed consideration of the consistency of each participating FMI's outcomes of implementation with the Principles and analysis of the range of outcomes of implementation observed across FMIs. There are three key inputs to the assessment:

- Identification of implementation measures and approaches across FMIs;
- Consideration of the consistency of implementation outcomes with the relevant Principles and the Key Considerations (KCs) that sit beneath them; and
- Comparison of implementation outcomes across FMIs, with attention, where possible, to the drivers, degree and implications of observed variations.

⁶ See www.bis.org/cpmi/publ/d129.htm; www.bis.org/cpmi/publ/d128.htm; www.bis.org/cpmi/publ/d127.htm; www.bis.org/cpmi/publ/d126.htm; www.bis.org/cpmi/publ/d139.htm.

Importantly, L3 reviews are peer-benchmarking exercises and not supervisory exercises. Accordingly, the focus of the reviews is on the consistency of outcomes of implementation of the relevant Principles and KCs across the group of participating FMIs as a whole rather than on each individual FMI's specific outcomes of implementation. As a result, in contrast to other implementation monitoring assessments carried out by CPMI and IOSCO, this L3 review does not, and future L3 reviews are not expected to, include formal ratings of observance. Rather, the output of each L3 review will typically be a single narrative-based report that compares the range of outcomes achieved across FMIs. The reports will make observations about the broad consistency of outcomes achieved by FMIs, both with the standards under the PFMI and with each other.

In addition to monitoring the progress in implementing standards under the PFMI, L3 assessments are expected to inform the CPMI and IOSCO about variations in outcomes that may be due to challenges and interpretative issues. This information will feed into other CPMI and IOSCO work. For example, the PSG, which has responsibility for the ongoing development of standards and guidance, is drawing on findings from L3 assessments in conducting its policy work.

2.3 Scope of this review

This report represents a L3 assessment of CCPs' financial risk management and recovery practices. This first L3 assessment complements a broad work programme on CCP resilience, recovery and resolution – the CCP Workplan – agreed in April 2015 by the BCBS, the CPMI, the FSB and IOSCO.⁷ In future rounds of L3 assessments, different assessment themes are anticipated, with the goal of covering a broad range of Principles, FMI types and jurisdictions over time.

In this assessment, the IMSG has reviewed the financial risk management and recovery practices of a sample of 10 derivatives CCPs – a mix of globally active and more domestically focused CCPs. Participation by the CCPs was voluntary.

The review has considered a range of financial risk management and recovery practices topics, which have been mapped to specific Principles and KCs in Table 1. Some topics span multiple KCs in multiple Principles. This approach also recognises that the Principles and associated KCs are designed to build on or complement one another. Indeed, in this exercise, due regard was given to the intended application of the Principles, as set out in paragraph 1.19 of the PFMI. That is, in recognition of the significant interaction between them, the Principles should be applied as a set and not on a standalone basis.

Mapping of Principles and KCs reviewed by this L3 assessment* Table 1

Topics	Principle (KC)
(1) Governance of risk management	2(2), 2(6) – 2(7), 3(1) – 3(3)
(2) Credit risk management	4(1) – 4(2), 4(4) – 4(6)
(3) Margin practices	6(1) – 6(7)
(4) Liquidity risk management	7(4) – 7(9)
(5) Collateral policy and investments	5(1) – 5(5), 16(4)
(6) Default management and recovery planning	3(4), 4(7), 7(10), 13(1), 13(4), 15(3) – 15(5)

* The IMSG also considered the explanatory notes in the PFMI to assist in interpreting relevant standards in the Principles and KCs. Consideration of outcomes of implementation in the area of recovery planning referred to the guidance in the Recovery Report.

⁷ See www.bis.org/cpmi/publ/d134.htm or www.iosco.org/library/pubdocs/pdf/IOSCOPD508.pdf.

CCPs were requested to provide responses to a survey comprising both qualitative and quantitative elements. The effective date for the information found in this report, including the quantitative data, is 30 June 2015 unless otherwise stated.⁸ Some CCPs provided information on relevant developments subsequent to the effective date. Where important to the broader findings of the review, the report references such developments. However, it should be noted that in some cases relevant developments may have occurred since the effective date that were not reported by the CCPs.

This report presents the IMSG's findings from the review of CCPs' responses. While some high-level CCP-specific summary information is provided in the annexes to the report, the discussion of variation in CCPs' outcomes of implementation and consistency of outcomes with the PFMI is anonymised to respect the confidentiality of certain information provided by the CCPs.

Given the breadth and comparative nature of the exercise, and to ensure effective use of resources, the assessment has been carried out as a desktop exercise and did not involve detailed review of source documents beyond the CCPs' responses to the survey and follow-up questions. Also, it has not involved on-site visits to the participating CCPs. As noted in Responsibility D of the PFMI, it falls within the responsibility of the relevant supervisory authorities to ensure that the PFMI are applied by individual CCPs.

For similar reasons – ie this review has been carried out as a desktop exercise – the IMSG was not always able to translate its observations on particular outcomes of implementation to definitive conclusions on the materiality of outcomes for CCP resilience. The report nevertheless seeks, where possible, to identify the drivers of observed variations (for instance, differences in interpretation, regulatory requirements and features of the relevant operating environment) and to assess the degree of observed variations, as well as their implications.

⁸ The exception are questions related to stress testing, which had an as-of date of 31 March 2015, to align with an earlier CPMI-IOSCO questionnaire on stress testing.

3. Process and methodology

This L3 assessment proceeded in three main stages over the course of 12 months: (i) setting the jurisdictional and CCP coverage of the exercise; (ii) data collection and analysis; and (iii) review of assessment findings by CCPs, relevant authorities and the CPMI-IOSCO Steering Group (SG).

3.1 Jurisdictional/CCP coverage

This first L3 assessment covers only CCPs (or relevant clearing services within a CCP) that clear derivative products (exchange-traded and/or OTC). Restricting the scope to CCPs' services for clearing derivatives products allowed for a more straightforward and meaningful comparison of responses across CCPs.

Participating CCPs were selected according to a range of criteria, including that each should be domiciled in a jurisdiction in which relevant measures to implement the PFMI for CCPs were assessed to be "fully in force" (ie given a rating of "4") in the June 2015 CPMI-IOSCO L1 assessment for at least one of the authorities with relevant responsibility.⁹ Other relevant factors were the desire to achieve a regional balance in the sample of CCPs, as well as a balance between globally active and more regionally focused CCPs.

Based on these criteria, 10 CCPs were selected to be part of this assessment (Table 2). CCPs' participation in this exercise was voluntary and was requested after confirming support from the relevant authorities.

⁹ See www.bis.org/cpmi/publ/d129.pdf and www.iosco.org/library/pubdocs/pdf/IOSCOPD489.pdf.

List of selected derivatives CCPs

Table 2

CCP*	Acronym	Jurisdiction	Derivative products reviewed
ASX Clear (Futures)	ASX	Australia	Exchange-traded: interest rates, equity indices and commodities OTC: interest rates
BM&FBovespa	BM&F	Brazil	Exchange-traded: interest rates, FX, commodities OTC: interest rates, equities, FX, commodities
The Clearing Corporation of India Ltd.	CCIL	India	OTC: FX derivatives
CME Inc	CME	United States	Exchange-traded: interest rates, equity indexes, foreign exchange, energy, metals, agricultural commodities, alternative investment products OTC: interest rates, credit FX
Eurex Clearing AG	Eurex	Germany	Exchange-traded: interest rates, equities, equity indices, FX, dividends, volatility indices, ETFs, commodities, property OTC: interest rates
ICE Clear Credit	ICC	United States	OTC: credit
Japan Securities Clearing Corporation	JSCC	Japan	Exchange-traded: equities, indices, debt OTC: interest rates, credit
LCH.Clearnet SA	LCH SA	France	Exchange-traded: equities, indices, FX, commodities OTC: credit
LCH.Clearnet Ltd (SwapClear)	LCH Ltd SC	United Kingdom	OTC: interest rates*
SGX Derivatives Clearing Limited	SGX	Singapore	Exchange-traded: interest rates, equities, debt, commodities OTC: interest rates, FX, commodities

* The review considered only LCH.Clearnet Ltd's SwapClear clearing service. LCH.Clearnet Ltd also clears other derivative products.

3.2 Data collection and analysis

A detailed survey covering the topics set out in Table 1 was circulated to the selected CCPs. The survey included both qualitative and quantitative questions. The survey built on the questions in the PFMI Assessment Methodology,¹⁰ but with more detailed and more granular questions where necessary.¹¹ Policy, procedural or methodological documents were not requested, although some limited supporting documents were provided where necessary. Quantitative questions were based on data required under the CPMI-IOSCO *Public quantitative disclosure standards for CCPs*.¹² In some cases, data provided in conjunction with CCPs' survey responses were supplemented with data from CCPs' published quantitative disclosures, as well as data submitted by the CCPs to the PSG to support its policy deliberations. It should be emphasised that since the evidence base for this exercise was necessarily not exhaustive, some more detailed or subjective matters were not considered.

The assessment was conducted by IMSG members with support from experts nominated by CPMI and IOSCO member authorities (see Annex K). Analysis of the CCPs' survey responses was combined with follow-up questions and conference calls with CCPs (and/or their supervisors) as necessary.

The work proceeded in two stages:

- In the first stage, the IMSG focused on compiling the information based on each CCP's survey responses and reviewing the consistency of each CCP's outcomes of implementation with the PFMI.
- In the second stage, the IMSG reviewed the consistency of implementation outcomes across all selected CCPs with the aim of identifying, by topic, areas in which the differences in implementation could lead to material differences in resilience.

3.3 Review of assessment findings by CCPs, relevant authorities and the parent committees

The CCPs and relevant authorities were given an opportunity to provide input on the findings of the review. In particular, CCPs and relevant authorities were invited to review, primarily for factual accuracy, a draft of the assessment report as well as the summary information in the CCP-specific annex. Relevant authorities were also invited to review for factual accuracy the evidence base and reference material that the IMSG used to develop the findings in the final report.

The final report was approved by the CPMI and IOSCO.

¹⁰ CPMI-IOSCO, *PFMI – Disclosure framework and Assessment methodology*, December 2012, www.bis.org/cpmi/publ/d106.pdf.

¹¹ Since there was some overlap between CCPs' inputs to this L3 exercise and those to parallel work by the PSG (as part of the *CCP Workplan*), the two groups coordinated the development and administration of their surveys.

¹² CPMI-IOSCO, *Public quantitative disclosure standards for central counterparties*, February 2015, www.bis.org/cpmi/publ/d125.pdf.

4. CCP risk frameworks

This section introduces the elements of CCP risk frameworks that have been considered in this assessment. This introduction is based on a summary of the text contained in the PFMI.¹³

4.1 Role of a CCP

As PFMI paragraph 1.13 describes, a CCP is an entity that interposes itself between counterparties to contracts traded in one or more financial markets, becoming the buyer to every seller and the seller to every buyer and thereby ensuring the performance of open contracts. A CCP becomes counterparty to trades with market participants through novation, an open-offer system, or an analogous legally binding arrangement.

CCPs have the potential to reduce risks to participants significantly through the multilateral netting of trades and by imposing more effective risk controls on all participants. For example, CCPs typically require participants to provide collateral (in the form of margin and other financial resources) to cover current and potential future exposures. CCPs may also mutualise certain financial risks through arrangements such as default funds. As a result of their potential to reduce risks to participants, CCPs can also reduce systemic risk in the markets they serve. The effectiveness of a CCP's risk controls and the adequacy of its financial resources are critical to achieving these risk reduction benefits.

In 2009, the G20 Leaders made a commitment to ensure that all standardised OTC derivatives contracts were cleared through CCPs.¹⁴ Reflecting key lessons from the financial crisis, the G20 Leaders' commitment aimed to reduce counterparty risk in the financial system. While progress towards meeting this commitment has been slower than expected, mandatory clearing of some OTC derivatives products is now in place in a number of jurisdictions.¹⁵

For the stability and resilience of the financial system, including the safety and soundness of other systemically important institutions, it is crucial that CCPs are held to high risk management and transparency standards that are implemented consistently. The relevant global standards in this regard are the PFMI. As part of this, it is important that CCPs not only meet high risk management standards in normal circumstances and in times of extreme but plausible market stress, but also that they have comprehensive and effective recovery plans to address more extreme circumstances that could threaten the CCP's viability and financial strength. The Recovery Report provides guidance for CCPs, other FMIs and relevant authorities on the development of FMI recovery plans.

4.2 Sources of CCP risk and mitigation

As PFMI paragraph 2.1 describes, CCPs are generally sophisticated multilateral systems that handle significant transaction volumes and sizable monetary values. Through the centralisation of certain activities, CCPs allow participants to manage their risks more effectively and efficiently, and, in some instances, reduce or eliminate certain risks. By performing centralised activities, however, CCPs can concentrate risks and create interdependencies between and among CCPs and participating institutions.

¹³ For more comprehensive coverage of these matters, please see www.bis.org/cpmi/publ/d101a.pdf.

¹⁴ See <https://www.oecd.org/g20/summits/pittsburgh/G20-Pittsburgh-Leaders-Declaration.pdf>.

¹⁵ See FSB, *OTC Derivatives Market Reforms Tenth Progress Report on Implementation*, 4 November 2015, www.fsb.org/wp-content/uploads/OTC-Derivatives-10th-Progress-Report.pdf.

Most prominently, CCPs are exposed to both credit and liquidity risks, primarily in the event of the default of one or more clearing participants. CCPs also face a range of other financial risks, including investment and custody risks and other general business risks. The L3 assessment has examined CCPs' risk management arrangements in each of the key areas of their financial risk management and recovery practices, as well as the governance frameworks applied to CCPs' risk management activities. With reference to guidance contained in the PFMI, each topic area considered in this assessment is introduced below.

- *Governance.* As PFMI explanatory note 3.2.1 describes, governance is the set of relationships between a CCP's owners, board of directors (or equivalent), management and other relevant parties, including participants, authorities and other stakeholders (such as participants' customers, other interdependent FMIs and the broader market). Governance provides the processes through which an organisation sets its objectives, determines the means for achieving those objectives, and monitors performance against those objectives. Good governance provides the proper incentives for a CCP's board and management to pursue objectives that are in the interest of its stakeholders and that support relevant public interest considerations.

According to PFMI explanatory note 3.3.1, a CCP would be expected to take an integrated and comprehensive view of its risks, including the risks it bears from and poses to its participants and their customers, as well as the risks it bears from and poses to other entities, such as other FMIs, settlement banks, liquidity providers and service providers. Its risk management framework (including policies, procedures and systems) would enable it to identify, measure, monitor, and manage effectively the range of risks that arise in or are borne by the CCP, and provide appropriate incentives and the relevant information for its participants and other entities to manage and contain their risks vis-à-vis the CCP. The board of directors plays a critical role in establishing and maintaining a sound risk management framework.

- *Credit risk.* As PFMI explanatory note 3.4.1 describes, credit risk is broadly defined as the risk that a counterparty will be unable to meet fully its financial obligations when due or at any time in the future. The default of a participant (and its affiliates) has the potential to cause severe disruption to a CCP, its other participants and the financial markets more broadly. Therefore, a CCP should establish a robust framework to manage its credit exposures to its participants and the credit risks arising from its activities. Credit exposure may arise in the form of current exposures, potential future exposures, or both. Current exposure, in this context, is defined as the loss that a CCP would face immediately if a participant were to default. Potential future exposure is broadly defined as any potential credit exposure that a CCP could face at a future point in time. The type and level of credit exposure faced by a CCP varies based on its design and the profile of its products and its participants.

As PFMI explanatory note 3.4.14 describes, a CCP typically faces both current and potential future exposures because it typically holds open positions with its participants. Current exposure arises from fluctuations in the market value of open positions between the CCP and its participants. Potential future exposure arises from potential fluctuations in the market value of a defaulting participant's open positions until the positions are closed out, fully hedged, or transferred by the CCP following an event of default. For example, during the period in which a CCP neutralises or closes out a position following a participant default, the market value of the position or asset being cleared may change, which could increase the CCP's credit exposure, potentially significantly. A CCP can also face potential future exposure due to the risk that the collateral (initial margin) held declines significantly in value over the closeout period.

- *Liquidity risk.* As PFMI explanatory note 3.7.1 describes, liquidity risk arises in a CCP when it, its participants, or other entities cannot settle their payment obligations when due as part of the clearing or settlement process. Depending on the design of a CCP, liquidity risk can arise

between the CCP and its participants, between the CCP and other entities, or between participants in a CCP. It is particularly important for a CCP to manage carefully its liquidity risk if, as is typical in many FMIs, the CCP relies on incoming payments from participants – eg variation margin payments – in order to make payments to other participants. If a participant or another entity fails to pay the CCP, the CCP may not have sufficient funds to meet its payment obligations to other participants. In such an event, the CCP would need to rely on its own liquidity resources (that is, liquid assets and prearranged funding arrangements) to cover the funds shortfall and complete settlement. A CCP should have a robust framework to manage its liquidity risks from the full range of participants and other entities. In some cases, a participant may play other roles within the CCP, such as a settlement or custodian bank or liquidity provider. These other roles should be considered in determining a CCP's liquidity needs.

Further, as PFMI explanatory note 3.7.9 describes, to manage its liquidity risk effectively, a CCP needs to maintain sufficient liquid resources in all relevant currencies to settle securities-related payment obligations, make required variation margin payments, and meet other payment obligations on time with a high degree of confidence under a wide range of potential stress scenarios.

- *Margin.* As PFMI explanatory note 3.6.1 describes, an effective margining system is a key risk management tool for a CCP to manage the credit exposures posed by its participants' open positions. A CCP should collect margin, which is a deposit of collateral in the form of money, securities or other financial instruments to assure performance and to mitigate its credit exposures for all products that it clears if a participant defaults. Margin systems typically differentiate between initial margin and variation margin. Initial margin is typically collected to cover potential changes in the value of each participant's position (ie potential future exposure) over the appropriate closeout period in the event the participant defaults. Calculating potential future exposure requires modelling potential price movements and other relevant factors, as well as specifying the target degree of confidence and length of the closeout period. Variation margin is collected and paid out to reflect current exposures resulting from actual changes in market prices. To calculate variation margin, open positions are marked to current market prices and funds are typically collected from (or paid to) a counterparty to settle any losses (or gains) on those positions.
- *Collateral and investments.* As PFMI explanatory note 3.5.1 describes, collateralising credit exposures protects a CCP and, where relevant, its participants against potential losses in the event of a participant default. Besides mitigating a CCP's own credit risk, the use of collateral can provide participants with incentives to manage the risks they pose to the CCP or other participants. A CCP should apply prudent haircuts to the value of the collateral to achieve a high degree of confidence that the liquidation value of the collateral will be greater than or equal to the obligation that the collateral secures in extreme but plausible market conditions. Additionally, a CCP should have the capacity to use the collateral promptly when needed.

As PFMI explanatory note 3.16.1 describes, an FMI has responsibility to safeguard its own assets and those provided to the FMI by its participants. In particular, the FMI should manage its exposure to custody risk – the risk of losses on assets held in custody, arising for instance from the insolvency, negligence or fraud of the custodian – and investment risk – the risk of losses arising when the FMI invests its own or its participants' assets.

- *Default management and recovery planning.* As PFMI explanatory note 3.13.1 describes, participant-default rules and procedures facilitate the continued functioning of a CCP in the event that a participant fails to meet its obligations. These rules and procedures help limit the potential for the effects of a participant's failure to spread to other participants and undermine the viability of the CCP. Key objectives of default rules and procedures would be expected to

include: (a) ensuring timely completion of settlement, even in extreme but plausible market conditions; (b) minimising losses for the CCP and for non-defaulting participants; (c) limiting disruptions to the market; (d) providing a clear framework for accessing CCP liquidity facilities as needed; and (e) managing and closing out the defaulting participant's positions and liquidating any applicable collateral in a prudent and orderly manner. In some instances, managing a participant default may involve hedging open positions, funding collateral so that the positions can be closed out over time, or both. A CCP may also decide to auction or allocate open positions to its participants.

According to paragraph 2.1.1 of the Recovery Report, CCPs are subject to a number of risks that could threaten their viability and financial strength, including credit, liquidity and general business risks. For example, for CCPs that take on credit or liquidity risks in providing their services, significant credit losses or liquidity shortfalls may arise from the default of one or more participants. For CCPs that hold or invest cash or collateral posted by participants, the failure of a custodian bank or poorly performing investments could create losses or liquidity shortfalls for the CCP. General business risk, including the financial consequences of operational and legal risks, could lead to unanticipated extraordinary one-off or ongoing losses or liquidity shortfalls. The realisation of these risks has the potential to result in a CCP's financial failure. A CCP therefore needs to consider the range of stress scenarios that may prevent it from being able to provide its critical services as a going concern (Recovery Report, paragraph 2.4.5). As set out in paragraph 2.4.9 of the Recovery Report, a CCP's recovery plan should then include tools to cover shortfalls from the stress scenarios identified – whether or not caused by participant default – that would not be covered by prefunded financial resources, or where the CCP does not have sufficient liquidity arrangements to meet its obligations on time. Also included should be tools to deal with other losses or liquidity shortfalls, in particular those from general business risks that may materialise more slowly. A CCP may also need tools to increase its capital.

The PFMI set out a variety of potential mitigants to financial risks that a CCP should employ. For instance, to manage credit and liquidity risks, a CCP is expected to develop a detailed modelling and stress testing framework to ensure that it maintains adequate prefunded financial resources and qualifying liquid resources. The overall risk management framework should be subject to rigorous governance, within parameters set by the board, that give due consideration to the stability of the broader financial system, other relevant public interest considerations and the objectives of relevant stakeholders.

With a few exceptions, the PFMI do not prescribe specific tools or arrangements to achieve their standards and allow for different means to satisfy the relevant standards. Even where specific examples of tools or arrangements are provided, these examples are not typically expected to be exhaustive. The PFMI are also quite clear that the full set of Principles are designed to be applied holistically rather than considered on a standalone basis, given the significant interaction between Principles (paragraph 1.19).

Notably, some Principles build upon others, while other Principles complement each other. For example, in managing financial risk, the Principles on credit risk, collateral, margin and liquidity risk are closely intertwined. In other instances, a set of Principles reference an important, common topic, such as governance. The role of governance in managing financial risks and achieving the public policy objectives of safety and efficiency is primarily addressed in Principle 2; however, given the general importance and relevance of governance, it is also referred to in other Principles.

An implication of this is that failure to apply all of the Principles as a set may result in less-than-robust overall risk management (see PFMI, footnote 17). Furthermore, more conservative practices in one area do not compensate for gaps and shortcomings in other areas. For instance, a highly conservative approach to sizing prefunded financial resources does not compensate for the absence of a

comprehensive and effective recovery plan. Similarly, a highly sophisticated approach to stress testing for the purpose of sizing prefunded financial resources in a CCP's default fund does not substitute for gaps and shortcomings in the liquidity stress testing framework.

4.3 Key changes to CCPs' risk frameworks

The PFMI were published in April 2012 and replaced the three pre-existing sets of international standards for FMIs: the CPSS *Core principles for systemically important payment systems*,¹⁶ the CPSS-IOSCO *Recommendations for securities settlement systems*¹⁷ and the CPSS-IOSCO *Recommendations for central counterparties*.¹⁸ The PFMI strengthened and harmonised these three sets of standards by raising minimum standards, providing more detailed guidance and broadening the scope of the standards to cover new risk management areas and trade repositories. For example, the Principles state that FMIs should maintain a higher minimum level of financial resources to address credit, liquidity and general business risks than previously expected. In addition, the PFMI provide additional guidance on governance of an FMI's operations. Further, the PFMI provide more detailed guidance on the risks associated with tiered participation in FMIs and place new emphasis on transparency.¹⁹

The CPMI and IOSCO therefore anticipated that the implementation of the PFMI would lead to wide-ranging enhancements to FMIs' frameworks for managing risks. To examine this in the case of CCPs' risk management practices, and thereby gauge the impact and effectiveness of the reforms, the survey circulated to CCPs as part of this L3 assessment also requested that each participating CCP identify the five most significant enhancements to its risk framework since the implementation of the PFMI. The CCPs' responses are summarised below and in Table 3.

Many of the five most significant enhancements identified by the CCPs were in the area of governance of risk management.

- All CCPs have formalised their risk management frameworks. Most CCPs note that they have also consolidated their risk management practices in a single document and have established risk oversight committees to oversee compliance with these policies. These comprehensive framework documents typically identify the risks faced by the CCP, the governing board's risk tolerance (both quantitative and qualitative), and outline the responsibility for managing the identified risks.
- Some CCPs note that they have revised their procedures for approving changes to their risk management practices. Some of these CCPs now require that their governing boards approve all significant changes affecting risk management or risk policy, where previously such decisions were made by designated risk committees.
- Some CCPs note that they have also taken steps to increase the involvement of direct and indirect clearing participants in risk management framework decisions. For instance, one CCP that did not previously have a participant risk committee established such a committee to advise the CCP's board on risk management matters. Other CCPs have sought to include indirect CCP participants in their risk management process by including customers of clearing participants on their existing participant risk committees. More generally, CCPs have also taken

¹⁶ Committee on Payment and Settlement Systems (CPSS), *Core principles for systemically important payment systems*, January 2001, www.bis.org/cpmi/publ/d43.pdf.

¹⁷ CPSS-IOSCO, *Recommendations for securities settlement systems*, November 2001, www.bis.org/cpmi/publ/d46.pdf.

¹⁸ CPSS-IOSCO, *Recommendations for central counterparties*, November 2004, www.bis.org/cpmi/publ/d64.pdf.

¹⁹ See www.bis.org/cpmi/publ/d101e.pdf.

steps to enhance the transparency of their risk management practices, principally by providing more detailed website disclosures to CCP members and the public.

In addition to changes in their governance frameworks, CCPs identified a number of other significant changes to their risk management practices. Many of these practices are described more fully in other sections of this report, but include, by way of example: implementation of a new risk monitoring and risk management systems; enhanced model validation, testing and external annual independent model validations; introduction of new margin methodologies or enhancement of existing margin methodologies to address matters such as procyclicality; refinement of settlement procedures; implementation of comprehensive recovery planning arrangements; and expansion of financial resource pools available to the CCPs by, for example, resizing guaranty funds, including to meet new "Cover 2" credit and liquidity coverage targets, or increasing clearing participants' prefunded commitments to loss allocation. In some cases, the CCPs' changes reflected specific detailed requirements in the relevant jurisdiction's implementation of the PFMI.

Illustrative examples of CCPs' key risk management enhancements⁺

Table 3

Topics/Themes	Practice/Enhancement
Governance	<ul style="list-style-type: none"> • Approval of all significant changes impacting risk management or risk policy by the board • Formalisation of risk management framework with clear responsibilities • Designation of a chief risk officer (CRO) • Establishment of participant risk consultative committee • Inclusion of indirect CCP participants in the risk management process by including customers of clearing participants on the risk committee • Enhancement to the transparency of the risk management practices, principally by providing more detailed website disclosures to CCP members and the public • Implementation of a new risk management system for monitoring trade positions • Enhancement to model validation, testing and external annual independent model evaluations
Credit/liquidity risk management	<ul style="list-style-type: none"> • Expansion of financial resource pools available to the CCPs by resizing guaranty funds or increasing clearing participants' prefunded commitments to loss allocation • Implementation of the Cover 2 standard based on regulatory requirements of home jurisdictions • Refinement of settlement procedures • Enhancements to backtesting and stress testing arrangements to assess adequacy of resources on a daily basis (relevant also to "margin") • Introduction of online exposure monitoring on settlement banks
Margin	<ul style="list-style-type: none"> • Implementation of more conservative confidence intervals to determine the margin requirement based on specific regulatory requirements • Introduction of new margin methodologies • Enhancements to existing margin methodologies to include margin floors and limits to address procyclicality • Introduction of online margining process for all products
Collateral and investments	<ul style="list-style-type: none"> • Implementation of segregation models for customer protection
Default management and recovery planning	<ul style="list-style-type: none"> • Implementation of minimum liquidation periods • Implementation of comprehensive recovery planning arrangements

⁺ Draws from the five most significant enhancements to CCPs' risks frameworks since implementation of the PFMI (April 2012), as

5. Key findings

This section presents the findings of the IMSG's review. For each of the six areas of financial risk management and recovery practices analysed as part of this assessment exercise, the CCPs' key implementation measures are summarised, before making observations on consistency in the outcomes of implementation of the PFMI by the CCPs, both with the standards in the PFMI and across CCPs.

Identified gaps or shortcomings in CCPs' outcomes of implementation relative to standards under the relevant Principle or KC are generally regarded as issues of concern. In some cases, these are considered to be serious issues of concern that should be addressed with the highest priority. In other cases, observations relate to differences in the outcomes of implementation across CCPs rather than consistency with the PFMI; these could nevertheless have resilience implications, which may need to be addressed.

The most noteworthy findings for each topic are detailed under "Key findings". A number of other differences in the outcomes of implementation that could give rise to material differences in resilience across CCPs are summarised under "Other findings relevant to consistency of outcomes".

Finally, a number of other differences in the CCPs' outcomes of implementation have been identified by the IMSG. For each topic, these are considered under "Other observations", noting that in most cases these identified differences would not be expected to give rise to material differences in resilience. Indeed, the principles-based approach in the PFMI explicitly acknowledges that a variety of implementation approaches can lead to equivalent resilience. In some cases, variations exist because individual CCPs have chosen to exceed relevant minimum standards in the PFMI, or have done so in accordance with the specific implementation of the PFMI in their home jurisdiction.

As noted earlier, the findings in this report are based on a review of 10 derivatives CCPs. While the findings are not necessarily representative of all CCPs, they may nevertheless in some cases be relevant to other CCPs. Further, it should be reiterated that in considering implementation of the PFMI by these CCPs, the IMSG has not conducted a supervisory review or examination. Accordingly, the focus of the report is on the consistency of outcomes of implementation of the relevant Principles and KCs across the group of CCPs as a whole rather than on each individual CCP's specific outcomes of implementation.

5.1. Governance of risk management

This section considers the CCPs' outcomes of implementation in respect of the following governance standards in Principle 2 and Principle 3 of the PFMI.

Principle 2 states that "An FMI should have governance arrangements that are clear and transparent, promote the safety and efficiency of the FMI, and support the stability of the broader financial system, other relevant public interest considerations, and the objectives of relevant stakeholders". The relevant Principle 2 standards are set out in the following KCs:

2. *An FMI should have documented governance arrangements that provide clear and direct lines of responsibility and accountability. These arrangements should be disclosed to owners, relevant authorities, participants, and, at a more general level, the public.*
6. *The board should establish a clear, documented risk-management framework that includes the FMI's risk-tolerance policy, assigns responsibilities and accountability for risk decisions, and*

addresses decision making in crises and emergencies. Governance arrangements should ensure that the risk-management and internal control functions have sufficient authority, independence, resources, and access to the board.

- 7. The board should ensure that the FMI's design, rules, overall strategy, and major decisions reflect appropriately the legitimate interests of its direct and indirect participants and other relevant stakeholders. Major decisions should be clearly disclosed to relevant stakeholders and, where there is a broad market impact, the public.*

Principle 3 states "An FMI should have a sound risk-management framework for comprehensively managing legal, credit, liquidity, operational, and other risks". The relevant Principle 3 standards considered in this review are set out in the following KCs:

- 1. An FMI should have risk-management policies, procedures, and systems that enable it to identify, measure, monitor, and manage the range of risks that arise in or are borne by the FMI. Risk-management frameworks should be subject to periodic review.*
- 2. An FMI should provide incentives to participants and, where relevant, their customers to manage and contain the risks they pose to the FMI.*
- 3. An FMI should regularly review the material risks it bears from and poses to other entities (such as other FMIs, settlement banks, liquidity providers, and service providers) as a result of interdependencies and develop appropriate risk-management tools to address these risks.*

5.1.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, CCPs have made important and meaningful progress in implementing arrangements consistent with standards in the PFMI relevant to governance of financial risk management and recovery practices. All CCPs have established governance arrangements for risk management. Each CCP's arrangements have been approved by its board and are documented and disclosed. Since legal requirements in each of the jurisdictions in which the CCPs operate differ, documentation of governance frameworks takes a variety of forms. CCPs have a range of mechanisms for stakeholder engagement and disclosure of key risk management decisions.

All CCPs report having risk management policies, procedures and systems to identify the range of risks to which they are potentially exposed, although they categorise risks in different ways. In particular, some take a more granular approach than do others. Each CCP also has frameworks and controls in place that aim to ensure risks are appropriately measured, monitored and managed, and also provide incentives to stakeholders to manage and contain the risks they pose to the CCP.

In considering the consistency of implementation outcomes with standards in the PFMI and across CCPs, the following high-level observations are made:

- Principle 2, KC 2.* All CCPs have documented and disclosed governance arrangements that establish and outline the roles and responsibilities of the CCPs' governing boards and committees. All CCPs have a board responsible for the primary governance of the CCP. In most instances, the composition of the CCP's governing board overlaps at least in part with that of a parent company board or an affiliate board. In such cases, most CCPs have established policies and procedures to prevent and to manage conflicts of interest; in some jurisdictions, the relevant corporate legal structure aims to address such conflicts. Most CCPs have established a risk committee (or an audit/financial and risk committee) to further facilitate governance of risk management and to advise the board on major risk management issues.
- Principle 2, KC 6.* All CCPs have established documented risk management frameworks that have been approved by their respective boards. Many CCPs have adopted enterprise-wide risk management approaches when developing their risk management frameworks. In addition to

the PFMI, many CCPs have utilised international standards, such as the risk management standards set by the International Organization for Standardization (ISO), as a basis for elements of their risk management frameworks. The survey responses suggest that each CCP's risk management and internal control functions appear to have the requisite authority, independence, resources and access to the CCP's governing board.

- *Principle 2, KC 7.* All CCPs have mechanisms in place for stakeholder engagement (eg formal consultation processes, round tables, committee memberships and stakeholder board memberships) and disclosure of key risk management decisions (eg circulars and websites). However, the scope of stakeholders captured by these arrangements, the role of stakeholders under these arrangements and the degree to which the board is bound by stakeholder views differs across the CCPs. Different mechanisms may have different levels of effectiveness in reflecting stakeholders' legitimate interests in the CCP's design, rules, overall strategy and major decisions.
- *Principle 3, KC 1.* The survey responses suggest that all CCPs have risk management policies, procedures and systems that enable them to identify, measure, monitor and manage risks. In each case, the risk management framework identifies the range of risks to which the CCP is potentially exposed; these frameworks are subject to periodic review.
- *Principle 3, KC 2.* All CCPs provide a range of incentives to their participants to manage and contain the risks they pose to the CCP. These include position- and exposure-based financial obligations to the CCP, such as margin, default fund contributions and unfunded commitments in recovery.
- *Principle 3, KC 3.* All CCPs have identified risk interdependencies with other entities. These vary across the CCPs, and all the CCPs state that they have tools in place to manage the risks they bear from and pose to other entities as a result of interdependencies.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of observed differences across CCPs.

5.1.2 Key findings

The IMSG has one key finding of variation in the outcomes of implementation in the area of governance of risk management. This is described below.

5.1.2.1 Identification and consideration of stakeholder interests (Principle 2, KC 7)

All CCPs have mechanisms for stakeholder engagement and disclosure of key risk management decisions. It should be noted, however, that the formalisation of these mechanisms varies considerably across CCPs, as does the scope of stakeholders engaged through these mechanisms (ie clearing participants, customers and trading venues). Furthermore, there are differences across CCPs in the role of stakeholder-nominated or -selected participants in some arrangements (such as a risk committee or an advisory committee). For instance, practices differ in terms of whether a participant in such an arrangement represents its own organisation's views, whether that participant's duty is to the CCP, or both. This could have implications for the effectiveness of such arrangements in serving as a means to ensure that stakeholders' legitimate interests are taken into account in the CCP's design, rules, overall strategy and major decisions. As discussed below, there is also considerable variation in the extent to which in its decision making the board is bound by stakeholder views.

CCPs use various mechanisms for stakeholder engagement. All CCPs operate with a combination of regular product advisory groups, committees and other formal participant forums, as well as formal consultation processes, either public or with participants. At one end of the spectrum, a

small number of CCPs rely on mechanisms such as bilateral consultation with participants, ad hoc working level groups and round tables. At the other end of the spectrum, most CCPs have within their governance structures board risk committees that include participants, customers and in some cases representatives of relevant trading venues.

Even where mechanisms for stakeholder engagement are relatively formal, the effectiveness of these arrangements as a means to ensure that legitimate stakeholder interests are reflected in the CCP's design, rules, overall strategy and major decisions by the board is likely to vary. Two relevant determinants of effectiveness are: (a) the scope of stakeholders captured by the arrangement; and (b) the degree to which the board is bound by stakeholder views.

- *Stakeholder scope.* The most inclusive arrangements capture direct participants, customers and other relevant parties, such as trading venues served by the CCP. However, even where a breadth of stakeholders is represented (for example on a risk committee), the effectiveness of each member's ability to represent its own organisation's views may vary. For instance, practices differ in terms of whether a participant in such an arrangement performs an advocacy role for its organisation or stakeholder group, or participates as a nominated "expert". In particular, as a member of the risk committee, an individual clearing participant or customer may be expected to function independently of its own institution's interest and may also be prohibited from sharing relevant information received as a committee member within its own institution. As a result, the intended scope of stakeholder input may fall short of that implied by the scope of membership, requiring that other channels be established to ensure that stakeholders' interests are reflected in the CCP's design, rules, overall strategy and major decisions. Furthermore, the admission criteria for one CCP's risk committee provides for customer representation where the customer maintains an individual segregated account (as opposed to being part of a pooled account), but no customer had yet met the requirements for participation as at the effective date of this review.²⁰
- *Board decision.* The mechanisms for stakeholders to influence board decisions vary across CCPs. Some mechanisms, even if formal, are advisory in nature as, in some cases, CCPs are not required to explain why the advice of stakeholders is not followed. There are, however, examples of arrangements that enhance the weight of stakeholder views. For instance, at least two CCPs use some form of "comply or explain" process, whereby if the board does not follow the advice of the stakeholders, the board must justify to its regulator and publicly state its decision not to do so. Other CCPs have similar requirements.²¹ Another CCP has a requirement that the board re-consult the relevant committee if the board does not plan to follow the committee's recommendations. If the board still does not follow the committee's recommendation after re-consultation, the board must follow a more stringent decision-making process than it would otherwise.

5.1.3 Other findings relevant to consistency of outcomes

The IMSG does not have any findings relevant to consistency of implementation outcomes in the area of governance of risk management beyond that identified in the above section.

²⁰ The customer representation model adopted by this CCP is relatively new. As at 30 June 2015, the CCP only operated one individually segregated customer account. Over time, the CCP may expect individually segregated customers to meet the required threshold to gain representation.

²¹ For instance, the European Market Infrastructure Regulation requires CCPs to establish an advisory risk committee comprised of representatives of clearing participants and representatives of customers. The regulation also requires CCPs to report deviations from the advice of the risk committee to local supervisors.

There are, however, findings in Section 5.2 on credit risk management relevant to the governance of risk models, including related to board-level involvement in key risk decisions, model reviews and documentation and reporting.

5.1.4 Other observations

Finally, the IMSG has made some additional observations on variation in CCPs' implementation outcomes. While these differences may not give rise to material differences in resilience, they are nevertheless noteworthy.

5.1.4.1 Governance arrangements and board structures (Principle 2, KC 2)

CCPs have documented governance arrangements that establish and outline the roles and responsibilities of their governing boards and committees. In each case, governance arrangements are disclosed to CCP owners, relevant authorities, clearing participants and the public (typically via the CCP's website). The CCPs' governance documents take a variety of forms, including board charters, operating rules, requirements under listing rules, code of conduct documents and others, all typically dependent upon the legal requirements of the jurisdictions in which they operate.

Each CCP has a board that assumes overall responsibility for the governance of the CCP. Most CCPs have a single governing board and one CCP utilises a two-tiered board structure in which a supervisory board (comprised entirely of non-executive directors) is separated from a management board (comprised of executive directors).

In each case, the composition of the board includes independent and non-independent directors. The inclusion of independent directors is typically mandated by the CCP's governance documents. A variety of definitions or standards of independence apply across the CCPs. For instance:

- Two CCPs have rule-based requirements under exchange-listing rules that set standards for determining when a board director is "independent".
- Some standards state generally that an "independent director" is a person that does not have a material relationship with the CCP.
- Other standards state more specifically that an "independent director" is a person other than an executive officer or employee of the company or any other individual that has a relationship which, in the opinion of the CCP's board, would interfere with the exercise of independent judgment in carrying out the responsibilities of a director.

In most instances, the composition of the CCP's governing board overlaps, at least in part, with that of a parent company board or an affiliate board. Due to the inherent potential conflict for board members that are also members of affiliated company boards within a CCP's corporate group (or with other non-affiliated boards), most CCPs have established policies and procedures that aim to prevent and manage potential conflicts of interest. In some cases, jurisdictions have legal provisions in place that aim to address such conflicts of interest.

Each CCP's governing board has established committees to further facilitate governance of the CCP. Common examples include risk, audit and remuneration committees. These committees report to the CCP's governing board(s) and are typically chaired by a board member. The functions of these board committees are typically disclosed on the participating CCPs' websites.

5.1.4.2 Risk management framework (Principle 2, KC 6)

All CCPs have established documented risk management frameworks that have been adopted and reviewed by their respective boards. In doing so, many CCPs have adopted enterprise-wide risk management approaches when developing the CCPs' risk management framework. In at least one

instance, a participating CCP has established two risk management frameworks; one for managing CCP risk and one for managing corporate risk.

Some CCPs have utilised international standards as benchmarks in developing their risk management frameworks. For instance, in addition to ensuring that their risk management frameworks are consistent with the PFMI, some CCPs have taken into consideration *ISO 31000:2009 Risk Management – Principles and Guidelines* when drafting their risk management frameworks. Other CCPs have used either the *ISO 27001 Information security management* or COBIT Framework, or utilised best practices from the COSO ERM Integrated Framework when formulating certain aspects of their risk management frameworks.

All CCPs have processes for determining, endorsing and reviewing their respective risk management frameworks. Most CCPs have their risk models validated on an annual basis by an independent external or internal party (see, for example, Section 5.4.2.4 on margin practices and Section 5.2.2.6 on stress testing practices). New risk models and changes to risk models are also typically subject to independent validation prior to implementation, as well as being subject to the annual independent validation.

5.1.4.3 Authority and independence of risk management and audit functions (Principle 2, KC 6)

The IMSG did not identify evidence to suggest that CCPs' risk management and internal control functions did not have the requisite authority, independence, resources and access to the CCP's governing board. Given the nature of this review, the IMSG has not examined a detailed evidence base to validate the assumptions used by the CCPs.

Most CCPs have a designated chief risk officer (CRO), who is responsible for designing, implementing and maintaining the CCP's risk management framework. The CRO typically reports directly to the chief executive officer or president of the CCP, who ultimately reports to the board. In some cases, the CRO has a direct reporting line to the CCP's board. In each case, the CCP's risk management framework is reviewed by its board at least annually. Additionally, each CCP has an internal audit group responsible for performing audits of the CCP, including its risk management processes. To ensure their independence, these internal audit groups typically report directly to the CCP's audit committee or the board. In some instances, the internal audit function is outsourced to a group or enterprise-wide audit unit.

All CCPs have risk management frameworks that assign responsibilities and accountability for risk decisions. Typically, the board (or its risk or audit committees) defines the tolerance levels for each category of risk and sets guidelines for internal reporting to make sure that the risk framework is observed.

As stated in Principle 2, KC 6, since the board is ultimately responsible for managing a CCP's risks, it should establish a clear, documented risk management framework that addresses decision-making in crises and emergencies. The survey responses suggest that all CCPs have established specific arrangements for such decision-making. For instance, most CCPs have set up dedicated committees or teams that include senior business and operational staff to address crises or emergency situations. More details on governance of crisis management are set out in the CCPs' default management frameworks and their recovery and wind-down plans (see Section 5.6 on default management and recovery planning).

5.1.4.4 Disclosure (Principle 2, KC 7)

The survey responses suggest that all CCPs disclose major decisions (eg changes to the rules, product offerings, procedures, the risk management framework, or to fees) to stakeholders through various media including circulars and in some cases also to the wider public via the CCP's public website and public consultations.

The degree to which other board-related information is disclosed to different types of stakeholders and the public varies across the CCPs. For instance, one CCP publishes minutes from board meetings on its website, and another provides its shareholders with information on the CCP's affairs as long as this information is pertinent to an item on the shareholders' meeting agenda.

All CCPs have specific frameworks in place to identify and manage potential conflicts of interest that may arise between the CCP and its various stakeholders. Some rely on consultations with clearing participants and other stakeholders to identify and address any such conflicts.

5.1.4.5 Risks that arise in or are borne by the CCP (Principle 3, KC 1)

Each CCP has risk management policies, procedures and systems that aim to enable it to identify, measure, monitor and manage the range of risks that arise in or are borne by the CCP. As further elaborated in PFMI explanatory note 3.3.2, in order to establish a sound risk management framework, a CCP should first identify the range of risks that arise within the CCP and the risks it directly bears from or poses to its participants, its participants' customers and other entities. It should identify those risks that could materially affect its ability to perform or to provide clearing services as expected.

Each CCP has a risk management framework that identifies the range of risks to which it is potentially exposed. While all CCPs identify and manage legal, credit, liquidity and operational risks, some CCPs take a more granular approach than others do in identifying risks to which they are exposed. Some CCPs divide risks into broad categories – examples include "financial risks", "risks specific to member positions", "strategic risks" and "operational risks" – and subsequently further subdivide types of risks within those groups. In addition to such classification, one CCP further classifies risks according to those to which it is exposed, those that arise internally, and those it may pose to others.

Despite these variations (and as mentioned above), all CCPs have specific frameworks in place for managing risks in crisis situations, and in particular risks that could materially affect their ongoing ability to provide clearing services.

Analysis of the survey responses indicates that CCPs appear to take an integrated and comprehensive view of their risks. As elaborated in PFMI explanatory note 3.3.1, a CCP should consider how various risks relate to, and interact with, each other. PFMI explanatory note 3.3.2 goes on to say that in identifying risks, a CCP should take a broad perspective and identify the risks that it bears from other entities, such as other FMI, settlement banks, liquidity providers, service providers and any entities that could be materially affected by the CCP's inability to provide clearing services. Most CCPs state that their risk management framework adopts a holistic approach and considers the risks they bear from relationships with clearing participants, customers or other entities. Most CCPs identify and manage the risks resulting from such interdependencies within their risk management frameworks (see also Section 5.1.4.8).

5.1.4.6 Review of risk management policies, procedures and systems (Principle 3, KC 1)

All CCPs have boards and internal committees that oversee the CCP's risk management policies. In addition, each CCP's governing board has established a risk committee (or an audit/financial and risk committee) to further support the governance of risk management and to advise the board on major risk management issues. Internal committees that oversee CCPs' risk management policies may vary according to the types of products cleared by the CCP.

In all cases, the CCP's risk management framework is reviewed by the CCP board at least annually or sooner if conditions require. Additionally, each CCP has arrangements in place for internal audits of its risk management framework. To ensure their independence, the internal audit groups generally report directly to the audit committee. Finally, all CCPs have risk management systems in place that aim to capture risk exposures and help the CCP to identify, monitor and manage risks such as

counterparty risk exposures, and to support margining and credit and liquidity stress testing (see Sections 5.4 on margin practices, 5.2 on credit risk management and 5.3 on liquidity risk management, respectively). Although no standard system is used by the CCPs, some CCPs have a centralised risk database or an integrated platform to record key risks and controls.

5.1.4.7 *Incentives to manage risks (Principle 3, KC 2)*

All CCPs provide a range of incentives to their clearing participants to manage and contain the risks they pose to the CCP. Although incentives vary across CCPs, all have risk-based (ie position and exposure-based) financial incentives for their clearing participants. CCPs generally also have sanctions for rule breaches, while some provide incentives for customers' accounts and incentives to minimise exposures to commitments to the default fund or to contingent obligations in recovery. Examples of risk-based financial incentives include:

- *Initial margin.* Most CCPs achieve coverage beyond the 99% initial margin confidence interval envisaged under Principle 6 (see Table 9 in Section 5.4 on margin practices), therefore reducing mutualisation of risk through the default fund. All else equal, higher initial margin coverage may create a stronger incentive for clearing participants to monitor and manage risks they bring to the CCP.
- *Risk-based default funds.* For all but one CCP, clearing participants' contributions to the default fund are calibrated based on the risk each clearing participant brings to the CCP. Furthermore, the defaulter's contribution to the default fund is part of the defaulter-pays portion of the default waterfall. Some CCPs also call for additional margin in response to breaches of specified stress-test limits (see Section 5.2.2.2). Risk-based contributions create incentives for participants to manage the risks they bring to the CCP.
- *Segregated gross margin customer accounts.* Some CCPs offer individually segregated margin accounts for customers rather than being netted against each other by their clearing participant or against their clearing participant's own margin requirements. This requirement not only increases margin resources available to the CCP, it may also incentivise customers to better manage the risks they bring to the CCP.

5.1.4.8 *Material interdependencies and risk management tools (Principle 3, KC 3)*

All CCPs have identified interdependencies, which vary across the CCPs, and have in place tools intended to manage the resulting risks they bear from and pose to other entities.

For instance, all CCPs have identified their clearing participants as key interdependencies. Most CCPs have also identified their various external service providers (eg third-party system vendors or utilities) as interdependencies. One CCP reports having no significant interdependencies with external operational service providers as its main systems are internal. Some CCPs have identified interdependencies as:

- Customers of clearing participants;
- Commercial banks that provide various services to the CCP, such as settlement or custodial services, facilitation of margin payments or liquidity provision;
- Other linked or interoperating CCPs;
- Other FMI types such as payment systems, securities settlement systems or central securities depositories.

All the CCPs appear to have frameworks, risk policies, procedures and controls in place to manage the material risks associated with interdependencies. Examples of the mechanisms for dealing with risks arising from interdependencies include:

- Applying regular monitoring and review processes such as margin backtesting, due diligence reviews, operational incident analysis, limit breaches, key control assessments and credit and liquidity stress testing of counterparty and/or clearing participant exposures;
- Conducting money settlements in central bank money and ensuring CSDs/custodians/intermediaries/settlement banks meet predefined credit standards and have suitable contingency/back-up plans in place;
- Requiring that clearing participants meet minimum membership standards and, in some cases, specific monitoring of clearing participant service outsourcing and business continuity arrangements;
- Charging linked or interoperating CCPs the same initial margins and margin add-ons for concentration and liquidity risks as those applied to clearing participants;
- Carrying out annual reviews of the risk management framework and ensuring back-up payment mechanisms and liquidity providers are in place, as well as redundant IT systems, including geographical diversity and back-up technical infrastructure.

These mechanisms include tools to assess, monitor, mitigate and report on the level of risks borne by or created by the CCP as a result of interdependencies. Typically, these tools involve oversight from risk departments, clearing house operations departments, treasury operations departments and clearing participant review/monitoring committees, and are governed by policies and committee structures which include:

- Risk governance frameworks, risk management frameworks and enterprise risk management frameworks;
- Operational risk policies, business continuity policies/plans and disaster recovery plans;
- Board-designated risk tolerance levels, new product approval processes, rule change committees and risk management governance committees;
- Credit exposure frameworks and policies governing the treatment of payments to settlement banks, the deposit of collateral with custodians and the monitoring of service level agreements with infrastructure outsourcers.

In the event that a problem is identified – for instance, when agreed risk tolerance thresholds are exceeded – the reporting line and escalation procedure for most CCPs includes a report from management or the relevant oversight committee to the CRO, the risk committee or an executive committee. Serious or egregious breaches are generally also reported to the CCP’s board. Some CCPs monitor counterparties to ensure multiple exposures are aggregated and report breaches to their board and executive/risk committees. Two CCPs have the discretion to suspend or terminate a counterparty relationship if risk tolerances are exceeded.

5.2 Credit risk management

This section considers the CCPs’ implementation outcomes in respect of the following standards in Principle 4 of the PFMI, which states that an FMI should effectively measure, monitor and manage its credit exposures to participants and those arising from its payment, clearing and settlement processes, and should maintain sufficient financial resources to cover its credit exposure to each participant fully with a high degree of confidence. The relevant Principle 4 standards are set out in the following KCs:²²

²² KC 3 is not relevant to CCPs. KC 7 is covered in Section 5.6 on default management and recovery planning.

1. *An FMI should establish a robust framework to manage its credit exposures to its participants and the credit risks arising from its payment, clearing, and settlement processes. Credit exposure may arise from current exposures, potential future exposures, or both.*
2. *An FMI should identify sources of credit risk, routinely measure and monitor credit exposures, and use appropriate risk-management tools to control these risks.*
4. *A CCP should cover its current and potential future exposures to each participant fully with a high degree of confidence using margin and other prefunded financial resources (see Principle 5 on collateral and Principle 6 on margin). In addition, a CCP that is involved in activities with a more-complex risk profile or that is systemically important in multiple jurisdictions should maintain additional financial resources to cover a wide range of potential stress scenarios that should include, but not be limited to, the default of the two participants and their affiliates that would potentially cause the largest aggregate credit exposure for the CCP in extreme but plausible market conditions. All other CCPs should maintain additional financial resources sufficient to cover a wide range of potential stress scenarios that should include, but not be limited to, the default of the participant and its affiliates that would potentially cause the largest aggregate credit exposure for the CCP in extreme but plausible market conditions. In all cases, a CCP should document its supporting rationale for, and should have appropriate governance arrangements relating to, the amount of total financial resources it maintains.*
5. *A CCP should determine the amount and regularly test the sufficiency of its total financial resources available in the event of a default or multiple defaults in extreme but plausible market conditions through rigorous stress testing. A CCP should have clear procedures to report the results of its stress tests to appropriate decision makers at the CCP and to use these results to evaluate the adequacy of and adjust its total financial resources. Stress tests should be performed daily using standard and predetermined parameters and assumptions. On at least a monthly basis, a CCP should perform a comprehensive and thorough analysis of stress testing scenarios, models, and underlying parameters and assumptions used to ensure they are appropriate for determining the CCP's required level of default protection in light of current and evolving market conditions. A CCP should perform this analysis of stress testing more frequently when the products cleared or markets served display high volatility, become less liquid, or when the size or concentration of positions held by a CCP's participants increases significantly. A full validation of a CCP's risk-management model should be performed at least annually.*
6. *In conducting stress testing, a CCP should consider the effect of a wide range of relevant stress scenarios in terms of both defaulters' positions and possible price changes in liquidation periods. Scenarios should include relevant peak historic price volatilities, shifts in other market factors such as price determinants and yield curves, multiple defaults over various time horizons, simultaneous pressures in funding and asset markets, and a spectrum of forward-looking stress scenarios in a variety of extreme but plausible market conditions.*

5.2.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, CCPs have made important and meaningful progress in the implementation arrangements for the measurement, monitoring and management of credit exposures, in accordance with Principle 4. All CCPs have established policies and procedures designed to ensure that they can effectively manage credit exposures to their participants and have adopted a range of tools to support these policies and procedures. All CCPs collect margin and maintain other prefunded financial resources to cover participant exposures. Further, all but one CCP carry out daily stress testing to test the sufficiency of total prefunded resources.

In considering consistency of outcomes with standards in the PFMI and across CCPs, the following high-level observations are made:

- *Principle 4, KC 1.* All CCPs have established frameworks to manage credit risk exposures to participants and other relevant counterparties. CCP credit risk frameworks typically share several key elements, including: minimum financial, legal and operational requirements for participants; ongoing monitoring of participants' creditworthiness and the CCP's exposures to clearing participants and other counterparties; collection of margin and other prefunded financial resources to collateralise credit exposures; position and exposure limits; as well as frameworks to manage credit exposures to settlement banks and custodians. While most CCPs' frameworks share common features, these may be implemented differently across CCPs. Core elements of these frameworks are covered in detail under other key considerations.
- *Principle 4, KC 2.* All CCPs have processes to measure and monitor credit exposures to participants, conducting both internal credit assessments of participants and daily (or more frequent) calculation of variation margin and initial margin to measure current and potential future credit exposure. CCPs have adopted a range of tools to manage these exposures, including collection of margin and maintenance of other prefunded resources, setting of position limits and ongoing participant monitoring. Where relevant, CCPs have separate frameworks to manage credit exposures to investment counterparties, settlement banks and custodians.
- *Principle 4, KC 4.* In respect of KC 4, the following high-level observations can be made.
 - *Target coverage and sizing of prefunded resources.* All CCPs collect margin and maintain other prefunded resources to cover participant exposures and all but one CCP report that they *target* a level of prefunded financial resources to cover, at a minimum, the default of any single participant and its affiliates that would cause the largest aggregate credit exposure in extreme but plausible market conditions (Cover 1). Some CCPs are engaged in activities with a more complex risk profile – such as clearing of CDS – or are considered by relevant regulators to be systemically important in more than one jurisdiction; these CCPs size total prefunded resources to cover the default of the two participants and their affiliates that would cause the largest aggregate credit exposure to the CCP in extreme but plausible market conditions (Cover 2). In aiming to ensure ongoing compliance with their respective coverage targets, some CCPs apply a “buffer” above the relevant coverage target or other similarly conservative measures when sizing total prefunded resources. However, analysis of quantitative data received from the CCPs suggests that a small number of CCPs' prefunded financial resources may not be sized to meet their target coverage on an ongoing basis. Failure to size prefunded financial resources so as to meet the relevant target coverage on an ongoing basis without adequate arrangements to promptly address any breach of target coverage may have implications for CCPs' resilience.
 - *Documentation and governance.* Typically, the level of a CCP's prefunded financial resources in business-as-usual circumstances is determined based on the results of stress tests and the CCP's sizing target and methodology. Some CCPs nevertheless require board-level approval for any change to the size of total mutualised prefunded resources. Material changes to risk management models generally require board-level approval, although for a small number of CCPs this responsibility is typically delegated to committees with no board-level representation. While a small number of CCPs have a consolidated group-wide policy on financial resource adequacy (covering both margin and default funds), most report that this rationale is set out either in a consolidated risk management framework document or across various policy documents that cover credit risk, stress testing and margin.

- *Principle 4, KC 5.* All CCPs use stress testing to determine the amount of prefunded resources held to cover participant default. However, in most cases CCPs' stress testing focuses exclusively on exposures and does not additionally consider stresses to CCPs' financial resources. This would not seem to meet the expectation in KC 5 to test the sufficiency of total financial resources under extreme but plausible market conditions. All CCPs have procedures to report the results of stress tests to relevant decision-makers, but the level of engagement at the board-level varies. In addition, some CCPs do not have clear processes in place to promptly address any breach of target coverage. In response to breaches (or near-breaches) of coverage, some CCPs call automatically for additional collateral, ensuring a timely return to the target level of coverage. Others, however, exercise discretion in their response to a breach of coverage, with potential implications for the timeliness of resizing decisions and, in turn, resilience. All but one CCP perform stress testing on a daily basis and all CCPs use standard and predetermined parameters and assumptions. However, in some cases, these assumptions could be better calibrated to reflect more fully the challenges a CCP may face in managing a participant default in extreme but plausible market conditions. Most CCPs conduct a review of stress testing scenarios and parameters on at least a monthly basis, but some conduct this review on a less frequent basis or on an ad hoc basis only. Most CCPs supplement their monthly model review with a full validation of their risk management model on at least an annual basis. This validation typically considers, at a minimum, a CCP's collateral haircuts, margin models, valuation models and a more comprehensive review of stress testing models and assumptions.
- *Principle 4, KC 6.* All CCPs consider historical scenarios in stress testing, typically applying a specified lookback period ranging from nine to 30 years. While some CCPs also include relevant peak volatilities outside of the lookback period, this is often not the case; some peaks are excluded simply because they no longer fall within the specified lookback period. This would not seem to be consistent with the expectation in the PFMI to consider all potentially relevant peak historical volatilities. Some CCPs also consider theoretical (statistical analysis-based) scenarios and some additionally consider event-based hypothetical scenarios in their stress tests. Those CCPs that do not supplement historical scenarios with "a spectrum of forward-looking stress scenarios" are not operating in accordance with KC 6, with potential implications for financial resource sizing decisions.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of any gaps and shortcomings relative to standards in the PFMI and observed differences across CCPs.

5.2.2 Key findings

The key findings relevant to CCPs' implementation outcomes in the area of credit risk management are described below. For some CCPs, gaps and shortcomings relative to the standards of the PFMI have been identified that are considered to be issues of concern. The most serious of these issues of concern relates to the failure of some CCPs to establish sufficient policies and procedures to ensure that they maintain the target level of coverage on an ongoing basis, including adequate arrangements to promptly address any breach of target coverage. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

5.2.2.1 Sizing of prefunded resources (Principle 4, KC 4 and KC 5)

Breaches of coverage

While all but one CCP report that they target a level of coverage consistent with the standards in KC 4 (see Section 5.2.3.1), in practice, analysis of quantitative data received from the CCPs suggests that a small number of CCPs' prefunded financial resources may not be sized to meet the relevant target

coverage on an ongoing basis. Failure to size prefunded financial resources so as to meet the relevant target coverage on an ongoing basis without adequate arrangements to promptly address any breach of target coverage may have implications for CCPs' resilience.

As part of the IMSG's survey and the parallel exercise conducted by the PSG, CCPs were asked to provide data on:

- the number of days in the 12-month period ending 30 June 2015 in which the stress test exposure arising from the default of the one or two participants and their affiliates that would potentially cause the largest aggregate credit exposure for the CCP in extreme but plausible market conditions exceeded the CCP's prefunded financial resources (ie the number of days on which there were breaches of coverage);
- the size of any breaches of coverage; and
- the level of prefunded resources relative to the CCP's Cover 1 or Cover 2 credit exposure (as applicable given the CCP's coverage target), reported as the minimum and average of this ratio over the 18 months to 30 June 2015. A ratio of less than one on a given day under this measure indicates a breach of coverage.

All but one CCP reported that they had met the minimum Cover 1 or Cover 2 standard on average over the 18 months to 30 June 2015 (Table 4). The majority of CCPs also reported that they had met their minimum target coverage level on a daily basis.

However, two CCPs reported a number of sizeable breaches of target coverage during the sample period.²³ For one of these CCPs, breaches were observed in one service line on 9 days and on 19 days in a second service line; the largest breach exceeded this CCP's default fund by 7.5%. The second CCP reported breaches of target coverage on 20 days, with the largest breach exceeding the CCP's default fund by 27%.

A third CCP reported breaches of target coverage on two days; these breaches were relatively small (exceeding the CCP's default fund by less than 0.5%) and were resolved with calls for additional collateral which, in each case, was received on the next day.^{24, 25}

Seven CCPs reported no breaches of coverage in any clearing service over the 12 months to 30 June 2015. For each of these CCPs, the level of prefunded resources exceeded the relevant coverage target by at least 5% on each day in the sample. However, one of these CCPs conducts stress testing of its total financial resources on only a monthly basis, rather than on a daily basis as expected under the PFMI. The difference in this CCP's approach reflects the fact that, relative to other CCPs in the sample, this CCP calibrates initial margin to achieve a higher proportion of defaulter-pays relative to mutualised resources in the default waterfall, and that its conservative margining approach is based on a stress testing methodology. Consequently, this CCP carries out stress testing for margin on a daily basis, but carries out stress testing for total financial resources, including mutualised funds, on a monthly, rather than daily, basis. All else equal, to the extent that the CCP's monthly stress tests consider scenarios that are more extreme than those used for the sizing of margins, large stressed exposures could arise between monthly stress tests. Should they arise, such exposures would not be identified on a timely basis and could remain uncovered until the next month's stress test.

²³ One of these CCP notes that, since the effective date of the review, it has introduced procedures that require it to resize prefunded financial resources for any of its clearing services upon a breach occurring. The other CCP also notes that it has changed its methodology for sizing the default fund.

²⁴ One CCP reported no breaches of target coverage but included in its calculation of prefunded financial resources additional initial margin that had been called but not yet received.

²⁵ See section 5.2.2.2 for a discussion of CCP's responses to breaches of target coverage.

Sizing of total prefunded financial resources

The approaches taken to sizing default resources vary across CCPs. More than half of the CCPs size their total prefunded resources at a level above their applicable Cover 1 or Cover 2 stress-test credit exposure to account for the uncertainty associated with future prices and trading activity, thereby reducing the likelihood of breaches of target coverage. All else being equal, adopting a more conservative sizing methodology increases the likelihood that a CCP will meet its coverage target on an ongoing basis, improving resilience.

For some CCPs, conservative sizing is achieved by applying a pre-specified "buffer" to the relevant coverage target when sizing total financial resources. In some cases this buffer is a fixed percentage (eg 10% of the coverage target), while for others it varies based on recent growth in the coverage target.

Given that sizing of total financial resources is inherently forward-looking, an appropriately sized minimum buffer – which may be adjusted in the light of expected market conditions or the size or concentration of participant positions – may be a reliable method for meeting coverage targets on an ongoing basis. However, notwithstanding the approach a CCP takes to sizing its financial resources, it should also have processes in place to identify and promptly address any breach of target coverage, with the aim of returning to the target level of coverage as soon as possible (see Section 5.2.2.2).

Most CCPs resize their default funds either monthly or quarterly in business-as-usual conditions. However, most also have the ability to resize the default fund on an ad-hoc basis or call for additional margin from participants in response to adverse market conditions or large stress-test losses. One CCP performs daily resizing of its default fund, with same-day top-ups required from any clearing participant with a total required default fund contribution that is at least 5% larger than its current default fund contribution. Another CCP performs weekly resizing of its default fund for its OTC products.

Two CCPs, both of which contribute a significant proportion of own resources to their respective default funds, set their default fund sizes in consultation with their boards and, in practice, resize their default funds infrequently. One CCP notes that the size of its default fund is based on a forward-looking view of the size of participant positions submitted for clearing and in practice operates with a sizeable buffer (as is shown in Table 4). This CCP also conducts an annual board-level review of the sufficiency of the CCP's total prefunded resources in order to determine the ongoing appropriateness of the default fund size. To ensure a prompt return to target coverage in the event of any breach (or near-breach) of the target between resizings, this CCP also calls automatically for additional margin should an individual participant's projected stress test loss exceed a specified participant stress test exposure limit (see Section 5.2.2.2). The other CCP tests the adequacy of its total financial resources on a monthly basis and can revise the levels of participant or CCP contributions to the default fund if necessary.

Some CCPs have default funds that are segregated by clearing service. This means that the default resources for a particular service (eg clearing of CDS) are available to be used only in the event of a default of a clearing participant that is a member of that service, and are sized independently of the resources held for other product classes cleared by the CCP. Only one CCP has different coverage targets for different clearing services, targeting Cover 2 for its CDS service and Cover 1 for its other derivatives clearing services.

Other CCPs have co-mingled default funds. In some cases, however, participants' contributions to default resources vary depending on the product class(es) in which they are active. The sequencing of the default waterfall for some CCPs also depends on the particular product class or other product grouping that the defaulting participant was active in. For example, at one CCP, if a defaulting participant was active in OTC-IRD, the default fund contributions of other participants that are active in that product class would be drawn down before the contributions of participants not active in that class.

All but one CCP scale participant contributions to the default fund in line with the CCP's exposure to the participant; at the remaining CCP, participants contribute a fixed amount depending on their membership category. Rules regarding participant contributions generally specify a fixed minimum contribution, with contributions then scaled proportional to either initial margin or, in at least two cases, a participant's stress-test losses²⁶.

Governance and documentation relating to total financial resources

Under KC 4, a CCP is expected to "document its rationale for, and have appropriate governance arrangements relating to, the amount of total financial resources it maintains". The amount of total financial resources held by CCPs is influenced by many aspects of the risk management framework, including most aspects of designing, implementing and interpreting the results of stress testing and margin models. While a small number of CCPs have a consolidated group-wide policy on financial resource adequacy (covering both margin and default funds), most report that this rationale is set out either in a consolidated risk management framework document or across various documents that cover credit risk, stress testing and margin.

In business-as-usual conditions, the level of a CCPs' prefunded financial resources is determined based on the results of stress tests and the CCP's sizing target and methodology. For most CCPs, business-as-usual changes to the size of total financial resources in response to stress-test results will therefore not require board approval. However, as discussed above, some CCPs require board-level approval for any change to the size of total mutualised prefunded resources. Moreover, some CCPs report that they have a regular (eg quarterly) review process for assessing the sufficiency of total financial resources, considering factors such as changes in the number or profile of clearing participants, longer-term trends in stress-test results and/or the results of for-information stress-test scenarios (see Section 5.2.2.6). All CCPs have processes for reporting stress-test results to relevant decision-makers and using these results to evaluate the adequacy of and adjust the CCP's total financial resources, but the level of engagement at the board level varies (see Section 5.2.4.3). For most CCPs, material changes to stress testing or margin models typically require board-level approval, although at a small number of CCPs this responsibility is delegated (eg to committees with executive-level representation).

²⁶ One of these CCPs has since the effective date of the review begun to scale contributions by initial margin.

Table 4: Default fund (DF) sizing, participant stress-test limits and breaches of target coverage

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
Sizing ²⁷	Cover 1 plus the 2 financially weakest participants	Additional buffer based on recent trends in ST losses and/or volatility in the market.	Infrequent resizing. No specified buffer.	A buffer that is equal to the stress loss of 5 weak entities	No specified buffer.	A 10% buffer	Infrequent resizing. Conservative buffer.	No specified buffer.	A 10% buffer	Buffer applied.
Segregated default funds	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes
Participant stress test exposure limit (STEL)	70% of aggregate DF for any one participant, 90% for any one plus two financially weakest	No, but discretionary DF resizing	No	No	No (but same-day call for DF top-up if required contribution > 5% larger than CM's posted amount)	45% of relevant DF for any one participant, 90% for top 2 together (Cover 2 target)	50% of aggregate DF for highest-rated participants (Cover 2 target)	50% of aggregate DF for any one participant, 90% for top 2 together (Cover 2 target)	45% of relevant DF for any one participant, 90% for top 2 together (Cover 2 target)	No
Response to STEL breach	Either additional margin or DF contribution will be called in response to breach of target coverage	N/A	N/A	N/A	N/A	Automatic call for additional margin	Automatic call for additional margin	CRO discretion. Supplementary margin may be called.	Automatic call for additional margin	N/A
Breaches of relevant coverage target – 12 months to 30 June 2015 ²⁸	Seven CCPs reported no breaches of coverage on any day in the 12 months to 30 June 2015; one CCP reported breaches on 2 days for one service line and no breaches in remaining service lines; one CCP reported 9 and 19 breaches in two service lines and none in remaining service lines; and one CCP reported 20 breaches across all service lines.									
Prefunded resources relative to target coverage ²⁹ – minimum, 18 months to 30 June 2015	Minimum across all CCPs and service lines: 0.79 Median across all CCPs and service lines: 1.04 Maximum across all CCPs and service lines: 2.55									
Prefunded resources relative to target coverage – average, 18 months to 30 June 2015	Minimum across all CCPs and service lines: 1.12 Median across all CCPs and service lines: 1.43 Maximum across all CCPs and service lines: 4.48									

²⁷ One CCP included within its calculation of prefunded financial resources additional margin that had been called but not yet received. The level of prefunded resources held (ie excluding this unfunded resource) cannot therefore be determined.

²⁸ Number of breaches' is the number of days in the 12 months to 30 June 2015 on which there was a breach of coverage. A breach of coverage occurs when the stress test exposure arising from the default of the one or two participants and their affiliates that would potentially cause the largest aggregate credit exposure for the CCP in extreme but plausible market conditions exceeds the CCP's prefunded financial resources.

²⁹ "Prefunded resources relative to target coverage" is the ratio of the level of prefunded mutualised resources held by the CCP (ie total default fund resources) relative to the CCP's relevant Cover 1 or Cover 2 credit stress test exposure (in excess of the initial margin held by the CCP on behalf of the (assumed) defaulting participant(s)).

CCPs are anonymised and randomised in tables 4 to 14 in order to preserve the confidentiality of the information. For instance, CCP1 does not necessarily represent the same CCP across the tables.

5.2.2.2 Responses to breaches of target coverage (Principle 4, KC 4 and KC 5)

Some CCPs set limits on the maximum stress-test losses that could arise from an individual participant's portfolio before certain actions (such as requiring additional collateral from the participant) would be taken by the CCP (Table 4).

The most common limit imposed is on the largest stress-test loss arising from any one participant, set as a proportion of the size of the relevant default fund; this type of limit is typically set such that any breach of target coverage would also trigger at least one participant stress-test limit. Two CCPs with Cover 2 targets set this proportion at 50%. One of these CCPs also imposes a 90% combined limit for the largest two participants by stress-test loss, and two other CCPs conservatively impose a 45% limit for any single participant. Limits also vary depending on the coverage target of the particular CCP or clearing service (one CCP that is not subject to a Cover 2 requirement has a stress-test limit of 70% for any single participant). In many cases, lower stress-test exposure limits apply for certain participants based on the CCP's internal assessment of the participant's creditworthiness. At least one CCP has adopted a "tiered" approach, whereby the CCP imposes on each participant one of five possible limits based on the CCP's internal credit rating for that participant.

For those CCPs that apply participant stress-test limits, all can call for additional financial resources from participants in response to a breach of the relevant limit. This is commonly in the form of additional initial margin. Some CCPs have in place processes to call for such additional margin from a participant on an automatic basis to cover the size of the breach. It should be noted that, to the extent that stress tests are run at the end of the day, additional margin will typically not be received until the following morning, rather than on the day on which the breach occurred. Nevertheless, automatic calls for additional initial margin provide a mechanism for a prompt non-discretionary response to a breach of target coverage. Furthermore, where additional initial margin is also called at lower stress-test exposure limits from participants of lower credit quality, the CCP can achieve a level of coverage that extends to an extreme but plausible level of stress, not only in respect of its largest one or two participants, but also (beyond the specified exposure limit) in respect of the least creditworthy. Such limits also provide incentives for participants to manage and contain the risk they pose to the CCP (see Section 5.1.4.7). Such a practice may therefore in some cases materially increase the CCP's resilience.

At least one CCP with participant stress-test limits applies a discretionary approach after reviewing the circumstances of a breach. Actions taken in such cases could include more intensive monitoring of the participant, reducing position limits, instructing the participant to reduce positions, and/or requiring additional collateral from the participant (either via additional initial margin or additional default fund contributions, depending on the particular circumstances and CCP). Such discretion by the CCP could be appropriate if exercised carefully. For example, a CCP may want the ability to choose to increase pooled (rather than segregated) resources in response to a participant stress-test breach if it considers the likelihood of future breaches by other participants to be elevated. However, to the extent that a CCP's discretion has the potential to delay the CCP returning to its target level of coverage, there could be less resilient outcomes in the transition.

Participant stress-test limits can be an effective tool for a CCP to meet its coverage target on an ongoing basis. For those CCPs without participant limits, the approach taken in response to a breach of target coverage varies:

- One CCP resizes the default fund on a daily basis, calling for additional default fund contributions if a clearing participant's total required default fund contribution is at least 5% larger than the participant's current default fund contribution. This CCP also has the ability to issue discretionary special calls for additional resources if deemed appropriate.
- Two CCPs first review the circumstances of the breach before taking action, including review and/or revision of total financial resources. One notes that an aggregate stress-test loss (ie Cover 2 credit exposure) greater than or equal to 95% of the size of the default fund will be

escalated to the CRO and other senior risk management staff. The CCP is able to resize the default fund whenever it is deemed appropriate.

- One CCP notes that it does not have a process for calling for additional margin in response to stress-test results, but may call for “volatility margin” during periods of high market volatility. Quantitative data for this CCP indicate that breaches of coverage often persist for multiple days.
- While the remaining CCP uses a stress test approach to calibrate margin, and therefore runs these stress tests on a daily basis, it tests the sufficiency of its total financial resources using stress tests only on a monthly basis. It can revise the levels of participant or CCP contributions to the default fund in response to results of these stress tests if necessary.

5.2.2.3 *Stress test assumptions and processes (Principle 4, KC 5)*

Consistent with KC 5, most CCPs test the sufficiency of total resources using stress tests at least daily. As noted above, the remaining CCP tests the sufficiency of its total resources using stress tests only on a monthly basis.

In general, the PFMI are not prescriptive regarding the assumptions a CCP should use in its stress testing framework. However, it is expected that such assumptions are consistent with the extreme but plausible market conditions under consideration in the CCP’s stress testing scenarios. Even if a CCP has established its arrangements in a manner consistent with the PFMI (including, for instance, in its default management plans, and its arrangements to support the segregation and portability of customer positions and collateral) it is possible that in extreme but plausible market conditions some default management processes, including hedging of portfolios and porting of customer positions, would not proceed as might be expected in less extreme market conditions. Such considerations are reflected differently in the CCPs’ stress testing assumptions, potentially leading to material differences in their resilience. In some cases, stress testing assumptions could be better calibrated to reflect more fully the challenges a CCP may face in managing a participant default in extreme but plausible market conditions.

- *Closeout periods.* The choice of closeout period used in most CCPs’ stress testing models appears to reflect each CCP’s conservative expectation of the length of time it may take to close out a defaulting participant’s positions in extreme but plausible market conditions. In recognition of the fact that closeout actions may take longer in extreme but plausible market conditions, three CCPs assume longer closeout periods in stress testing than in their margin models for some products (see Section 5.4.2.2). However, most CCPs use the same closeout periods for stress testing as for margin; this may reflect that margin closeout periods are already set conservatively with reference to “stressed market conditions”, consistent with KC 3 of Principle 6. One CCP uses a closeout assumption of one day in its stress testing of OTC derivatives; this is both shorter than the corresponding two-day closeout period this CCP assumes in its margin model and the closeout assumption of at least five days applied by other CCPs that clear OTC derivatives. While this CCP notes that it accounts for the possibility of closeout taking longer than one day by increasing the severity of price moves in its historical scenarios, it is unclear whether this results in outcomes that are more or less extreme than would be produced by embedding a longer closeout period directly into the stress testing framework.
- *Losses over multiday closeout horizons.* Where the closeout period is longer than one day, some CCPs use prices at the end of the last day of the relevant closeout period to determine the stress test loss. Others take the more conservative approach of using the worst return over the closeout period (eg determining the portfolio loss for each day’s prices and taking the worst loss as the stress-test result). At the effective date of the review, no CCP considered intraday price movements in determining the worst loss over the closeout period.

- *Customer positions.* Most CCPs' stress testing models assume that a house surplus could be used to cover a deficit on a customer account. In contrast, when testing for the adequacy of total financial resources, no CCP assumes hypothetical customer gains could be netted with house losses. CCPs' stress-test assumptions regarding customer accounts generally reflect existing customer segregation models and netting arrangements. For example, for customers that use an omnibus account structure, the CCP calculates the total loss for the omnibus account. Conversely, customers that use individually segregated accounts are stressed at the individual customer account level.
- *Porting of customer positions.* CCPs' stress-test assumptions regarding the porting of customer positions vary. Most CCPs conservatively assume either that no customer accounts could be ported (meaning that all such accounts would need to be liquidated, potentially at a different point in time than the defaulting clearing participant), or that porting will be possible only for in-the-money customers. The remaining CCPs assume porting of some or all loss-making customer accounts within the relevant closeout period. One CCP assumes all such customer accounts – including omnibus accounts – could be ported; two others assume that porting will fail for omnibus accounts and the two individually segregated customers with the largest net loss, but that other individually segregated customer accounts would be ported. These latter approaches assume that a clearing participant that had just defaulted to the CCP (and thus is already subject to termination of clearing membership) and was therefore likely to be in the initial phase of an insolvency proceeding would nonetheless reliably and promptly pass on payments from remaining customers. Such approaches may not accurately reflect difficulties that might plausibly emerge in porting loss-making customer accounts following a default in extreme but plausible market conditions.
- *Treatment of affiliates.* All but one CCP jointly stress test any affiliate exposures along with those of participants.
- *Changes in participant positions.* No CCP assumes any changes in participant positions during the closeout period in its stress testing. Participant positions are assumed to be liquidated during or at the end of the relevant closeout period (depending on the particular assumption regarding losses over multiday closeout horizons, discussed above) with no interim hedging.
- *Treatment of excess collateral.* Stress-test exposures are calculated in excess of margin collateral required, with most CCPs assuming no access to excess collateral posted by the participant. One CCP that assumes access to excess margin posted (but not excess default fund contributions) notes that the CCP's rulebook allows for complete discretion over whether excess margin deposits can be released. These resources are therefore considered to be available to settle payment obligations in the event of a default.

5.2.2.4 Stress testing of financial resources (Principle 4, KC 5)

KC 5 states that a CCP should "determine the amount and regularly test the sufficiency of its total financial resources available in the event of a default or multiple defaults in extreme but plausible market conditions through rigorous stress testing". In order to test the sufficiency of total financial resources, CCPs compare their credit exposures to their available prefunded financial resources in extreme but plausible stress scenarios. When applying these stress scenarios, all CCPs calculate stressed credit exposures and use post-haircut collateral values, but in most cases CCPs do not further stress the values of their prefunded financial resources in stress tests.

As noted in Section 5.5 on collateral policy and investments, CCPs report that they set prudent collateral haircuts that take into account stressed market conditions. In most cases, it appears that collateral haircuts are calibrated to a confidence level which is similar to or the same as that used in each CCP's margin model. For example, many CCPs use a value-at-risk (VaR) methodology for setting collateral haircuts, calibrated to cover 99% to 99.9% of price moves over a set lookback period. In

contrast, as noted in Section 5.2.2.5, CCPs typically cover all price moves over a longer lookback period (at least 10 years and more commonly 20 or more years) in their historical stress scenarios; and, where used, statistical stress scenarios generally reflect more extreme price moves than those used for setting collateral haircuts. While some CCPs apply haircuts for certain products that may result in price movements that are as extreme as, or more extreme than, those used for stress testing (for example, applying a 30% haircut to equities posted as collateral), only one CCP reports using the same methodology to stress participant credit exposures and collateral values. However, this CCP does not stress or haircut the value of other financial resources – including invested cash collateral – in stress testing.

CCPs that calibrate collateral haircuts to a lower level of stress than that used for stress testing of participant exposures and do not further stress the value of total financial resources, including own resources and invested cash collateral, may not meet the expectation in KC 5 that CCPs will test the sufficiency of financial resources in extreme but plausible market conditions. To the extent that this may result in CCPs holding insufficient prefunded resources to cover credit exposures arising from participant defaults in extreme but plausible market conditions, this shortcoming could have consequences for CCPs' resilience.

5.2.2.5 Stress testing scenarios (Principle 4, KC 6)

The PFMI state that a CCP should "consider the effect of a wide range of relevant stress scenarios." These include historical scenarios, statistical shifts and "a spectrum of forward-looking stress scenarios in a variety of extreme but plausible market conditions".

- *Responsibility for design.* The responsibility for designing stress tests generally rests with a specific expert team (eg stress testing committee, risk analytics unit) with reporting upstream to senior officials (eg CRO) and the board.
- *Historical scenarios.* All CCPs have developed historical scenarios that consider various lookback periods ranging from nine to 30 years, or at least in the case of CCPs that clear CDS as far back as a reliable history permits (see Table 5). The use of a specific lookback period, particularly the shorter periods, raises concerns that relevant historical scenarios will be removed simply due to lapse of time, although they remain plausible scenarios. This would not seem to be consistent with the expectation in the PFMI that CCPs will consider *all* potentially relevant peak historical volatilities; some peaks are excluded simply because they no longer fall within the specified lookback period. Some CCPs consider historical events falling outside their lookback periods for risk monitoring, but not directly for default fund sizing (see discussion of 'for-information stress-test scenarios' in Section 5.2.2.6). Stress scenarios for new products, where there is insufficient historical data, are often generated by considering actively traded proxy products with similar characteristics, benchmarks (if no proxy is available), or some other approach that is deemed to be sufficiently conservative (if no proxy or benchmark is available).
- *Theoretical scenarios.* All but one CCP³⁰ consider some form of theoretical (statistical analysis-based) scenarios, although the degree to which such scenarios deviate from historical experience varies significantly. In some cases, statistical techniques such as principal component analysis are employed to generate theoretically plausible extreme changes in portfolio values using historical data as an input. In other cases, antithetical scenarios are generated based on historical experience.

³⁰ The remaining CCP is also examining the possibility of incorporating theoretical (statistically derived) scenarios in its stress tests.

- *Hypothetical scenarios.* Some CCPs,³¹ use hypothetical event-based scenarios driven by factors such as potential macroeconomic trends, natural disasters, political-economic events (eg a sovereign default or an exit from a currency union by a member jurisdiction), or the results of surveys of market participants on their stress scenarios. In some cases, CCPs limit the impact of forward-looking scenarios by setting outer bound limitations (eg by calibrating to a “one in 30 year equivalent”). Those CCPs that do not supplement historical scenarios with “a spectrum of forward-looking stress scenarios” are not operating in accordance with KC 6, with potential implications for financial resource-sizing decisions.
- *Correlations.* Most CCPs also describe stress tests that incorporate changes in correlations among risk factors,³² based either on historical ranges of correlations or on hypothetical changes (eg considering a negative correlation between two risk factors that have historically been positively correlated). For example, some CCPs explicitly apply shocks to multiple risk factors simultaneously, based on a regression analysis of correlation between risk factors during stress periods, in scenarios across all products.

³¹ One of these CCPs implemented changes to its stress-testing framework in July 2015, including the addition of new hypothetical forward-looking scenarios. These scenarios were approved by the CCP’s board in March 2015, but were not in effect as of the survey cut-off date.

³² A risk factor influences the value of the asset or portfolio being stressed. For derivatives CCPs, relevant risk factors would commonly include the value of the rate or asset underlying a derivatives contract, or in some cases, the value of the contract itself.

Table 5: Summary of historical stress testing approaches

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
Type of window	Fixed start date	Rolling	Rolling	Rolling	Rolling	Fixed start date	Rolling	Rolling	Rolling window and event-based	Fixed start date
Lookback period	Since October 2002	7-30 years, depending on the service line	20 years	20 years	30 years	Since 1 April 2007	30 years	30 years	30 years or event-based (2008 crisis), depending on the service line	Since 2002
Events outside lookback?	N/A	N/A	For risk monitoring only	For risk monitoring only	N/A	For recovery rate analysis	N/A	N/A	N/A	N/A

5.2.2.6 Stress testing model review and validation (Principle 4, KC 5)

Under KC 5, a CCP should perform on a monthly basis a “comprehensive and thorough analysis of stress testing scenarios, models and underlying parameters and assumptions” to ensure that they remain fit for purpose in the light of current and evolving market conditions. Results of this review may be used to determine the appropriateness of or justify changes to the current set of stress test scenarios, parameters and assumptions. Explanatory note 3.4.23 provides additional interpretative guidance that a CCP should conduct, as appropriate, reverse stress tests aimed at identifying the extreme scenarios and market conditions in which its total financial resources would not provide sufficient coverage of tail risk. KC 5 also states that a full validation of a CCP’s risk management model should be performed annually, with explanatory note 3.2.16 (under Principle 2) elaborating that “the validation process should be independent of the development, implementation and operation of the models” and should include, amongst other things, an evaluation of the conceptual soundness of the models.

- *Model review.* Stress testing model review is typically conducted by internal risk management staff. While most CCPs perform this level of review on a monthly basis, which is consistent with expectations in KC 5, some CCPs conduct reviews only on a quarterly or annual basis unless new products are introduced or market conditions warrant an ad hoc review. One CCP does not conduct a regular stress-test review, but notes a range of factors that would trigger a change in the hypotheses and parameters used, including changes in the macroeconomic outlook. The survey responses also suggest that there is variation in the breadth and depth of CCPs’ model reviews; in some cases, model review processes may be less “comprehensive and thorough” than envisaged by KC 5. To the extent that model review processes provide greater certainty that a CCPs’ stress testing models (and therefore sizing decisions) are robust, variation in the frequency and rigour of stress-test model reviews are likely to have consequences for CCPs’ resilience.
- *Reverse stress testing.* All CCPs also conduct reverse stress testing, typically on a monthly or quarterly basis. The approach taken varies across CCPs. All CCPs consider actual participant portfolios, and rely on their standard stress testing assumptions to determine scenarios that would exhaust available financial resources. This may occur due to additional participant defaults beyond the one or two participants used for Cover 1 or Cover 2 sizing, and/or due to extreme price moves that are not considered as part of the CCP’s standard stress testing framework (eg because the CCP considers the price move implausible). At least one CCP also considers the effect of hypothetical changes to actual participant portfolios (eg scaling of participants’ positions up or down), as well as tests of extreme hypothetical portfolios that would generate losses sufficient to exhaust default resources under plausible market scenarios. In some instances, results from reverse stress testing and/or sensitivity analysis form a key input into stress testing model review. For example, reverse stress testing may identify new scenarios for inclusion in a CCP’s stress testing framework.
- *For-information stress-test scenarios.* Some CCPs supplement their set of extreme but plausible stress-test scenarios with an additional set of scenarios that are considered by the CCP to be beyond extreme but plausible. Such scenarios are generally used for risk monitoring purposes but are excluded from the set of scenarios used directly for sizing of financial resources. Breaches of stress-test limits generated by such scenarios do not generate automatic calls for additional collateral, but may trigger a review (potentially leading to a discretionary call for additional collateral). One CCP notes that stress-test results generated under for-information scenarios are considered as part of the CCP’s periodic review of financial resource adequacy. At least one CCP considers in its periodic model review whether any for-information scenarios should be added to the set of scenarios used directly for sizing decisions.
- *Model validation.* Most CCPs supplement their monthly model review with a full independent validation of their risk management model on at least an annual basis. Regular, rigorous

independent model validations assist in facilitating ongoing improvement to a CCP's risk management models and providing necessary challenge to existing assumptions, scenarios and frameworks. Model validation is typically conducted by an external expert or an internal independent model validation team. Across all CCPs, model validation typically considers, at a minimum, a CCP's collateral haircuts, margin models³³ and valuation models; most CCPs also include as part of this validation a more comprehensive review of stress testing models and assumptions. Stress testing review and validation may result in the identification of additional stress testing scenarios and/or the recalibration of current scenarios using updated data. Some CCPs report that this annual review includes benchmarking of stress testing scenarios against industry standards or best practice. One CCP notes that recommendations arising from a recent independent validation resulted in changes to model assumptions and parameters (eg assumed holding periods, coverage targets and correlation assumptions) and the addition of new forward-looking stress scenarios. One CCP does not have a formal validation process in place other than via its annual external audit, and another³⁴ was at the time of the review conducting model validation once every two years.

5.2.3 Other findings relevant to consistency of outcomes

In addition to the potential issues of concern detailed above, the IMSG's findings also include a number of other observations relevant to an assessment of the consistency of outcomes. These include the following.

5.2.3.1 Coverage targets (Principle 4, KC 4)

The PFMI state that CCPs should hold financial resources sufficient to cover losses arising from a wide range of potential stress scenarios, including the default of the participant and its affiliates that would potentially cause the largest aggregate credit exposure to the CCP in extreme but plausible market conditions (Cover 1); or, for CCPs that are involved in activities with a more complex risk profile or are systemically important in multiple jurisdictions, losses arising from the default of the two participants and their affiliates that would potentially cause the largest aggregate credit exposure to the CCP in extreme but plausible market conditions (Cover 2).

The majority of CCPs target Cover 2 when sizing their financial resources, reflecting either (a) one or both of the two criteria outlined in KC 4, or (b) some other local requirement. All CCPs that report meeting one or both of the criteria outlined in KC 4 have a Cover 2 target, and all but one of the remaining CCPs have a target of Cover 1 or greater.³⁵ One CCP is required under local regulation to meet a standard equivalent to Cover 1 plus the two financially weakest direct participants.

All CCPs that clear CDSs report being involved in activities with a more complex risk profile and consequently had a Cover 2 target.³⁶ One CCP with segregated default funds for each clearing service sizes its financial resources to meet Cover 2 for its CDS service but Cover 1 for its other services. One

³³ See Section 5.4.3.4 for detail on CCPs' margin model validation approaches.

³⁴ Since the effective date of the exercise, this CCP has increased the frequency of its external reviews of risk processes to annual.

³⁵ One CCP calibrates initial margin to cover potential credit exposure to each participant in a wide range of potential stress scenarios, at a level of confidence of 99.96%, and additionally maintains a relatively small mutualized default fund to cover exposures beyond this level. In sizing this default fund, the CCP uses a methodology that is consistent with domestic regulatory requirements but does not align with the definition of Cover 1 or Cover 2 in the PFMI. Given this different approach, the IMSG cannot evaluate whether the CCP is operating consistent with either the Cover 1 or Cover 2 standards as defined in the PFMI.

³⁶ PFMI explanatory note 3.4.19 states that activities with a more complex risk profile may include clearing financial instruments that are characterised by discrete jump-to-default price changes or that are highly correlated with potential participant defaults.

CCP characterises the clearing of single stock exchange-traded derivatives as having a more complex risk profile due to the heightened possibility of wrong-way risk for certain participants involved in these activities.

PFMI explanatory note 3.4.19 outlines six criteria to consider in determining whether a CCP is systemically important in multiple jurisdictions. Some CCPs report that they have been determined by home and/or foreign regulators to be systemically important in multiple jurisdictions. Such a determination was made either by the home regulator, recognising that the CCP was systemically important in one or more foreign jurisdictions (with the home regulator then requiring the CCP to meet Cover 2), and/or by one or more foreign regulators.

5.2.3.2 CCP contributions to prefunded financial resources (Principle 4, KC 4)

Principles 4 and 15 of the PFMI state that a CCP should maintain financial resources to cover losses resulting from a participant default and general business risk, including custody and investment risk, respectively. The financial resources used to cover such losses may come from participants or the CCP itself, as specified by the CCP's rules.

For all CCPs, the CCP's own resources form the first layer of the default waterfall once the defaulting participant's margin and default fund contribution has been exhausted (Table 6). Some CCPs also have one or more additional layers of CCP contributions which would be drawn down alongside and/or after mutualised participant contributions.

CCP contributions to default resources*

Table 6

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
Ahead of participant contributions	16.8%	3.7%	18.4%	50%	1.7%	3.6%	1.7%	1.3%	1.5%	18.4%
Alongside participant contributions	9.8%	-	23.1%	-	-	0.4%	-	-	1.5%	-
After participant contributions	-	-	27.7%	-	-	-	-	-	-	-

* As a proportion of total prefunded mutualised default resources, as at 30 June 2015. For CCPs with segregated default funds, percentages are calculated using the sum of default resources across all service lines considered in this exercise (see Table 2).

Table 6 shows that the proportion of total mutualised prefunded financial resources comprised of CCP contributions varies significantly across CCPs. In some cases, this variation reflects differences in regulatory requirements across jurisdictions. For example, under EMIR a CCP must contribute a minimum of 25% of its (operational resource-based) regulatory capital requirement to the default waterfall, to be drawn down prior to any contributions from non-defaulting participants.³⁷ Across the EU-based CCPs, this requirement typically translates to around 1–2% of the default fund. In contrast, one CCP is required by its local regulator to maintain cash in an amount equal to at least 25% of the CCP's default fund, with

³⁷ Under EMIR, CCPs must hold capital against a number of risks: operational and legal risks; credit, counterparty and market risks; business risks; and wind-down or resolution.

a contribution of at least 15% of the default fund to be drawn down prior to any contributions from non-defaulting participants.

Some of the more regionally oriented CCPs considered in this exercise contribute significant proportions of own resources to their respective default funds, well in excess of local regulatory requirements. One CCP's contribution to prefunded resources makes up around 70% of the value of the default fund; this substantially exceeds the requirements of the CCP's home regulator which state only that a CCP's own resources would be expected to comprise a "material proportion" of pooled financial resources held to cover participant default. A second CCP contributes no less than 50% of the default fund (ie an amount equal to the total contributions of clearing participants) at any point in time, while another had contributed 18% to the default fund as at 30 June 2015. Neither of these CCPs is currently subject to a regulatory requirement regarding CCP contributions to prefunded default resources.

5.2.4 Other observations

Finally, the IMSG has made some additional observations on differences in CCPs' implementation outcomes. Particularly when considered alongside other elements of CCPs' risk frameworks, these differences may not give rise to material differences in resilience. They are nevertheless noteworthy.

5.2.4.1 Credit risk frameworks and risk management tools (Principle 4, KC 1 and KC 2)

KC 1 states that an FMI should establish a robust framework to manage its credit exposures to its participants and the credit risks arising from its payment, clearing and settlement processes. An FMI should also, under KC 2, use appropriate risk management tools to control the identified credit risks. A CCP has credit exposures to its participants, and may also have credit exposures to settlement banks, investment counterparties and/or custodians. CCPs' credit risk management frameworks include a number of elements.

- *Participation requirements.*³⁸ Participants are generally required to satisfy minimum financial, legal and operational requirements, which are validated by due diligence at the time of admission. At a minimum, participants are typically subject to minimum capital requirements and are required to make a contribution to the CCP's default fund. Some CCPs apply more stringent financial requirements for participants that clear OTC products relative to exchange-traded products. Participants are also typically required to report financial information to the CCP on a regular basis. At least three CCPs only admit entities that are under the supervision of the local prudential regulation authority, while other CCPs require that any foreign participant be subject to prudential or securities regulation in its home jurisdiction that is at least as stringent as that applicable to domestic participants, or have an entity within its group that is subject to prudential or securities regulation that is at least as stringent as that applicable to domestic participants. Operational requirements may include the participant having access to sufficient technology and human resources; participants may also need to demonstrate sufficient expertise and familiarity with the CCP's processes and procedures. Participation requirements may vary depending on the membership category of the participant.
- *Ongoing monitoring.* All CCPs report that they monitor exposures to clearing participants and other counterparties on an ongoing basis; see Section 5.2.4.2 below.
- *Collateral.* All CCPs report that they collect initial margin and other prefunded resources from participants, and make daily variation margin settlements, to manage their current and potential future exposures. Further information on the frameworks to size, collect and invest prefunded financial resources is covered in detail throughout this report.

³⁸ Principle 18 on access and participation requirements was not within the scope of this review.

- *Position and exposure limits.* Some CCPs impose position limits on certain products and/or participants. Participant-level limits are commonly set with reference to a clearing participant's internal credit rating at the CCP. As discussed above, most CCPs set limits on the maximum stress-test losses that could arise from an individual participant's portfolio before certain actions (such as requiring additional collateral from the participant) would be taken by the CCP.
- *Managing exposures to settlement banks.* Some CCPs have a standalone framework to manage exposures to settlement banks. Settlement banks may be required to meet the CCP's admission criteria and minimum external credit ratings or some other financial requirements. One CCP has established exposure and concentration limits for both settlement banks and commercial banks, which are monitored on a daily basis.
- *Managing exposures to investment counterparties.* All CCPs state that they place a higher priority on minimising liquidity risk over investment returns, and many CCPs set investment counterparty exposure limits. For participants that are also investment counterparties, at least one CCP applies a stress-test limit adjusted for the total credit risk exposure posed to the CCP from the participant's default (including both investment exposures and clearing exposures). See Section 5.5.3.1 for more detail.

All but one CCP review their credit risk frameworks at least annually; the remaining CCP reviews its framework on an as-needed basis (eg following a change in market structure or the launch of a new product).

5.2.4.2 Identification, monitoring and measurement of credit risk (Principle 4, KC 2)

KC 2 states that a CCP should identify sources of credit risk and routinely measure and monitor its credit exposures. Sources of credit risk identified by CCPs include the participants of the CCP, investment counterparties, settlement banks, custodian banks and other intermediaries. In some cases, the identification process is documented as part of the CCP's credit risk policy.

CCPs measure the size of current and potential future credit exposures to clearing participants through daily (or more frequent) variation and initial margin calculation, and through credit stress testing. As discussed in the margin chapter, all CCPs calculate and collect initial and variation margin on a daily basis and have the authority and operational capacity to make intraday margin calls and payments. All but one CCP also perform credit stress testing on a daily basis for the purposes of determining the adequacy of total financial resources to cover the CCP's potential credit exposure under a wide variety of extreme but plausible stress scenarios. The responsibility for the assessment of credit risk is generally taken up by a dedicated team of the CCP.

All CCPs report that they monitor the creditworthiness of their clearing participants and other relevant parties on an ongoing basis. To support this assessment, CCPs have developed internal credit ratings frameworks which are reflective of key financial metrics such as macroeconomic data of the domicile country, market variables (eg stock prices, spreads) and financial information (eg earning, liquidity, capital adequacy). In some cases³⁹, external credit rating agency or market-implied ratings will be used where available as an input into the internal score. At least two CCPs consider the counterparty's operational capabilities and risk management policies and procedures when determining their internal credit score. Some CCPs conduct regular onsite reviews of clearing participants and other counterparties as part of their monitoring processes.

³⁹ Since the effective date of the exercise, two CCPs no longer use external ratings or market-implied ratings as inputs to credit risk monitoring. Changes in external ratings are monitored as triggers to review the internal calculation but are not included in the scoring.

A lower internal credit rating may result in a range of actions by the CCP, including: the calling of additional margins/collateral from the participant, placement of restrictions on participant exposures (including, in more serious cases, the requirement that only risk-reducing transactions will be accepted), and subjecting the clearing participant to more intense monitoring. A clearing participant's position and/or stress-test exposure limits may also be linked to their internal credit score.

5.2.4.3 Reporting of stress-test results (Principle 4, KC 5)

KC 5 states that a CCP should have "clear procedures to report the results of its stress tests to appropriate decision-makers at the CCP and to use these results to evaluate the adequacy of and adjust its total financial resources". All CCPs have procedures to report the results of stress tests to appropriate decision-makers at the CCPs, but the level of engagement at board level varies. While the details of these procedures vary in line with each CCP's particular governance arrangements, several key themes can be noted:

- *Board-level communication.* Summary results from stress testing are commonly communicated to CCP boards and/or board-level risk committees, typically on a monthly or quarterly basis. The focus of this reporting is typically on the adequacy of total prefunded financial resources in the light of the results from stress testing; however, two CCPs also provide participant-level information to independent board members as part of a daily risk update. As noted above, decisions on changes to the size or composition of pooled prefunded resources may be made at the board level, using stress-test results as an input. In some cases, however, the timing of board-level reporting is more frequent than CCPs' periodic resizing of total financial resources. For one CCP, board-level communication of stress-test results occurs indirectly: results are presented to a committee with CRO (but not board-level) representation, with the CRO then acting as a liaison between this committee and a separate committee with board-level representation.
- *Senior and executive management.* More granular results are presented to members of senior and executive management at least monthly. In some cases this is as a daily report, generally circulated to the CRO and other management staff with risk management responsibilities. In addition to information on any breaches of coverage, these reports may include participant-level information such as breaches of individual stress-test limits, information on low-rated participant stressed exposures, or the largest participant stressed exposures. One CCP has a formalised stress testing committee, composed of the CRO and other members of the risk management team. This committee is responsible for designing and reviewing the stress testing framework, addressing breaches, and (with input from clearing risk committees) sizing financial resources. More commonly, such responsibilities are spread across different groups/teams and levels of seniority within the CCP, with responsibility for the design of the stress testing framework typically resting with expert teams within the risk management function (with reporting upstream to senior officials (eg CRO) and the board), and sizing decisions made at board- or executive-level.
- *Risk committees.* Most CCPs report that anonymised stress-test results are presented to risk committees or other advisory committees with participant representation. These results are typically aggregated in some form (eg across credit rating groupings or maximum Cover 1/Cover 2 exposures). The frequency of such reporting often reflects the frequency of the risk committee meetings – which are typically held monthly or quarterly – but ranges across CCPs from weekly to annually.
- *Participants.* Many CCPs allow participants to view their own stress-test results. In some cases a participant's results are disclosed upon request; in other cases, these results will only be disclosed if a participant breaches its stress-test limits or when the CCP determines that the

participant's stress test losses are significant. One CCP discloses this information to participants on a quarterly basis. As at June 2015, at least one CCP allowed participants to view anonymous CCP-level stress testing reports upon request. As of December 2015, however, all CCPs are expected to report information on aggregate stress-test exposures under the CPMI-IOSCO quantitative disclosures framework.

5.3 Liquidity risk management

This section considers the CCPs' implementation outcomes in respect of the following liquidity-related standards in Principle 7 of the PFMI, which states that "an FMI should effectively measure, monitor, and manage its liquidity risk".

The KCs that have been considered under Principle 7 are:

4. *A CCP should maintain sufficient liquid resources in all relevant currencies to settle securities-related payments, make required variation margin payments, and meet other payment obligations on time with a high degree of confidence under a wide range of potential stress scenarios that should include, but not be limited to, the default of the participant and its affiliates that would generate the largest aggregate payment obligation to the CCP in extreme but plausible market conditions. In addition, a CCP that is involved in activities with a more complex risk profile or that is systemically important in multiple jurisdictions should consider maintaining additional liquidity resources sufficient to cover a wider range of potential stress scenarios that should include, but not be limited to, the default of the two participants and their affiliates that would generate the largest aggregate payment obligation to the CCP in extreme but plausible market conditions.*
5. *For the purpose of meeting its minimum liquid resource requirement, an FMI's qualifying liquid resources in each currency include cash at the central bank of issue and at creditworthy commercial banks, committed lines of credit, committed foreign exchange swaps, and committed repos, as well as highly marketable collateral held in custody and investments that are readily available and convertible into cash with prearranged and highly reliable funding arrangements, even in extreme but plausible market conditions. If an FMI has access to routine credit at the central bank of issue, the FMI may count such access as part of the minimum requirement to the extent it has collateral that is eligible for pledging to (or for conducting other appropriate forms of transactions with) the relevant central bank. All such resources should be available when needed.*
6. *An FMI may supplement its qualifying liquid resources with other forms of liquid resources. If the FMI does so, then these liquid resources should be in the form of assets that are likely to be saleable or acceptable as collateral for lines of credit, swaps, or repos on an ad hoc basis following a default, even if this cannot be reliably prearranged or guaranteed in extreme market conditions. Even if an FMI does not have access to routine central bank credit, it should still take account of what collateral is typically accepted by the relevant central bank, as such assets may be more likely to be liquid in stressed circumstances. An FMI should not assume the availability of emergency central bank credit as a part of its liquidity plan.*
7. *An FMI should obtain a high degree of confidence, through rigorous due diligence, that each provider of its minimum required qualifying liquid resources, whether a participant of the FMI or an external party, has sufficient information to understand and to manage its associated liquidity risks, and that it has the capacity to perform as required under its commitment. Where relevant to assessing a liquidity provider's performance reliability with respect to a particular currency, a liquidity provider's potential access to credit from the central bank of issue may be taken into account. An FMI should regularly test its procedures for accessing its liquid resources at a liquidity provider.*

8. *An FMI with access to central bank accounts, payment services, or securities services should use these services, where practical, to enhance its management of liquidity risk.*
9. *An FMI should determine the amount and regularly test the sufficiency of its liquid resources through rigorous stress testing. An FMI should have clear procedures to report the results of its stress tests to appropriate decision makers at the FMI and to use these results to evaluate the adequacy of and adjust its liquidity risk-management framework. In conducting stress testing, an FMI should consider a wide range of relevant scenarios. Scenarios should include relevant peak historic price volatilities, shifts in other market factors such as price determinants and yield curves, multiple defaults over various time horizons, simultaneous pressures in funding and asset markets, and a spectrum of forward-looking stress scenarios in a variety of extreme but plausible market conditions. Scenarios should also take into account the design and operation of the FMI, include all entities that might pose material liquidity risks to the FMI (such as settlement banks, nostro agents, custodian banks, liquidity providers, and linked FMIs), and where appropriate, cover a multiday period. In all cases, an FMI should document its supporting rationale for, and should have appropriate governance arrangements relating to, the amount and form of total liquid resources it maintains.*

5.3.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, the CCPs considered in this review have made important and meaningful progress towards meeting the standards of Principle 7.⁴⁰ All CCPs state that they have established policies and procedures that are designed to settle payment obligations on time with a high degree of confidence. The approaches to liquidity risk management vary across the CCPs, in many areas reflecting the characteristics of the products cleared and particular features of each CCP's operating environment.

In considering consistency with standards in the PFMI and across CCPs, the following high-level observations are made:

- *Principle 7, KC 4.* All CCPs report that they set coverage targets to maintain liquid resources at least sufficient to meet payment obligations on time with a high degree of confidence under a wide range of potential stress scenarios that include the default of the participant and its affiliates that would generate the largest aggregate payment obligation to the CCP in extreme but plausible market conditions (Cover 1 liquidity). Many CCPs set their coverage targets to at least meet their payment obligations under a Cover 2 liquidity scenario. In general, the CCPs tend to use the same coverage target to size resources to address liquidity risks as they use to cover credit risks. As of June 2015, all CCPs stated that they maintained adequate qualifying liquid resources to at least meet these coverage targets and they had not identified a liquidity shortfall, although the IMSG has not collected sufficient quantitative information to be able to independently verify this. The CCPs have taken different approaches to determining which currencies should be included in liquidity stress testing: some CCPs with multicurrency operations include all currencies cleared in their stress testing framework, while others include only currencies that they consider to be "material". Omitting certain currencies from stress testing could have resilience implications for the CCP. In particular, the CCP may not be able to identify important exposures in some currencies; it may also increase the probability that the CCP is unable to meet all of its payment obligations on time with a high degree of confidence.

⁴⁰ Since the effective date of the assessment preceded the issuance on 5 February 2016 of the statement on clearing of deliverable FX instruments, which clarified the requirement for CCPs to maintain qualifying liquid resources even when using a 'paired delivery' settlement process, this assessment did not take that statement into consideration; future assessments will do so.

- *Principle 7, KC 5 and 6.* Most CCPs concentrate their qualifying liquid resources in a small number of categories of liquid resources. For some, the main category of resources is central bank deposits. For others, the main category is highly marketable – often central bank eligible – collateral assets held in custody and investments that they report are readily available and convertible into cash with prearranged and highly reliable funding arrangements, even in extreme but plausible market conditions. And for others, the main category is committed lines of credit. CCPs typically then diversify their sources of liquidity within each type of private sector resource. At least some CCPs maintain qualifying liquid resources in all currencies that they clear; the IMSG has been unable to verify that this is the case for all CCPs, particularly where CCPs stress test only those currencies that they deem to be “material”.⁴¹ Most CCPs also maintain supplementary liquid resources. There is variation, however, in the types of resources each CCP considers to be “qualifying” versus “supplementary”. This variation may not have a material impact on the CCPs’ resilience, particularly to the extent that the CCPs maintain sufficient qualifying liquid resources to cover their minimum liquidity requirements.
- *Principle 7, KC 7.* All CCPs have liquidity arrangements with commercial banks or the central bank of issue, and in many cases, liquidity providers are participants of the CCP. All CCPs that have established arrangements to access liquidity from private sector liquidity providers report that they assess their liquidity providers’ capacities to perform and regularly test their operational procedures for accessing liquid resources from these liquidity providers. The frequency of these tests varies from once a day to once a year, and the scope of the tests and involvement of stakeholders also varies. Some of the CCPs that have access to central bank liquidity also explicitly state that they test access to this liquidity resource. There is considerable variation, however, in the amount of due diligence conducted by the CCPs to obtain a high degree of confidence that each liquidity provider has sufficient information to understand and manage the liquidity risks associated with its commitments. Most CCPs take limited action in this regard. Where liquidity providers have insufficient information to understand their potential exposures and commitments, they may not be able to manage their own liquid resources effectively to meet their obligations to the CCP. It may also be more difficult for these liquidity providers to assess their total obligations across multiple CCPs.
- *Principle 7, KC 8.* Most CCPs have access to, and use, certain central bank services (eg deposit accounts and securities accounts). They tend to use these services when provided by their home central bank, but some also make use of services provided by host (ie foreign) central banks. Where the CCPs do not use central bank services, it is either because the relevant central bank does not provide access to the CCP or the CCP does not consider the use of these services to be practical.
- *Principle 7, KC 9.* The scenarios and assumptions that are used to stress-test the size and adequacy of liquid resources are generally similar to those used in credit stress testing (see Section 5.2.2). Accordingly, many of the issues identified in relation to credit stress testing also apply to liquidity stress testing. The CCPs use different lookback periods, closeout periods and conduct stress testing on different frequencies, with most CCPs carrying out daily tests. CCPs use different methodologies to model payment obligations over a multiday period and to model liquidity needs arising from payment obligations to non-defaulting participants in periods of stress. Some CCPs do not identify liquidity exposures that could arise independently of a credit exposure in their liquidity stress testing scenarios; and, as in the case of credit stress testing, some CCPs do not appear adequately to supplement the stress testing of their liquidity

⁴¹ The CPMI and IOSCO note that the failure to maintain qualifying liquid resources in all relevant currencies could have resilience implications. However, given the desktop nature of this review, the IMSG did not collect sufficiently detailed information to determine whether or not all CCPs maintain sufficient qualifying liquid resources in all relevant currencies.

exposures with stress testing of their liquid resources. Failure to include a wide range of relevant liquidity-specific scenarios, such as simultaneous pressures in funding and asset markets and stressed payment outflows to non-defaulting clearing participants, could reduce the effectiveness of the CCP's overall approach to liquidity risk management, with potentially adverse implications for its resilience.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of any gaps and shortcomings relative to standards in the PFMI and observed differences across CCPs.

5.3.2 Key findings

The key findings relevant to CCPs' implementation outcomes in the area of liquidity risk management are described below. For some CCPs, gaps and shortcomings relative to the standards in the PFMI have been identified that are considered to be issues of concern. The most serious of these issues of concern relates to some CCPs' failure to include sufficient liquidity-specific scenarios in stress tests. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

5.3.2.1 Approaches and key model parameters used to determine the amount and to test the sufficiency of liquid resources (Principle 7, KC 9)

All CCPs determine the amount and test the sufficiency of their liquid resources through stress testing. Table 7 shows some of the key characteristics of the approaches taken by different CCPs in their liquidity stress testing. As noted in Section 5.2.2.3, the PFMI does not prescriptively define the assumptions and model parameters that CCPs should use in stress testing, either for credit risk or liquidity risk. The CCPs have adopted materially different approaches to liquidity stress testing, which may in part reflect different interpretations of Principle 7 and the development of more sophisticated liquidity stress testing approaches at particular CCPs. The key observations and areas of variation are described below.

Table 7: Key elements of CCPs' liquidity stress testing models and approaches

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
Target coverage level	Cover 1	Cover 1	Cover 2	Cover 2	Cover 2	Cover 2	Cover 1	Cover 2	Cover 2	Cover 1
Lookback period	N/A	20 years	Since 2002	30 years	10 years	5 years	20 years	20 years	30 years	30 years
Currencies included in stress testing⁴²	All	All	All	Only material	All	Only material	All	Only material	All ⁴³	All
Some examples of scenarios and assumptions to stress liquid resources	CCP reported that this was N/A	Substitution of cash collateral by clearing participants	Default of participants with highest amount of illiquid collateral, delays in collateral execution process	Downward shock to value of collateral assets	Major depository defaulting, unavailability of the market for repurchase agreements	Base, market disruption and idiosyncratic scenarios for each currency	Non-provision of liquidity by a defaulting clearing participant that is also a liquidity provider	None	Closure of parts of the market for repurchase agreements	Non-provision of liquidity by a defaulting clearing participant that is also a liquidity provider

⁴² One CCP cleared only one currency, as at 30 June 2015.

⁴³ This CCP includes all currencies that it clears in an aggregated stress test and stress tests material currencies separately.

The CCPs define “extreme but plausible” market conditions in different ways, using different assumptions and scenarios that may have an impact on the level of stress applied to both the CCP’s payment obligations and the liquid resources held to cover its stressed exposure. The scenarios and assumptions that are used to stress test the size and adequacy of liquid resources are generally similar to those used in credit stress testing (see Section 5.2.2). Accordingly, many of the issues identified in relation to credit stress testing also apply to liquidity stress testing. Notably, as in the case of credit stress testing, a number of the CCPs do not appear adequately to supplement the stress testing of their liquidity exposures with stress testing of their liquid resources. The discussion in this section focuses on the liquidity-specific aspects of CCPs’ liquidity stress testing frameworks.

Given the nature of this review, the IMSG has not examined a detailed evidence base to validate the assumptions used by the CCPs. The following observations are nevertheless made:

Stress testing of liquidity exposures

The most significant payment obligation for a derivatives CCP is typically daily variation margin payments on any contract for which the mark-to-market value has changed. In ordinary circumstances, the CCP will operate with a matched book and will therefore use payments received from clearing participants on one side of the transaction to make payments to those on the other. In the event that a clearing participant defaults, the CCP no longer has a matched book, but retains the obligation to make variation margin payments to those participants on the other side of the defaulted participant’s transactions. Additional payment obligations may also arise from other sources, such as transaction costs, foreign exchange costs or bid/offer spreads associated with liquidating or hedging the portfolio of cleared products in extreme but plausible market conditions.

The survey responses indicate that all but one CCP use their credit stress testing scenarios to calculate the size of the variation margin payment that the CCP may have to pay out until it is able to restore a matched book; the remaining CCP uses its initial margin requirement to model variation margin payments.

KC 9 states that CCPs’ liquidity stress testing scenarios should “where appropriate, cover a multiday period”. There are variations in how CCPs model payment obligations over time in their liquidity stress testing. Some CCPs assume that all payments must be made on the first day following the default of a clearing participant. Others model the payments that must be made over a certain time horizon, given the obligations due on each day.

A CCP’s ordinary liquidity needs include routine obligations to return initial margin posted in cash to its participants, for instance if a clearing participant: requests the return of any initial margin cash in excess of its minimum margin requirement; requests a substitution between non-cash margin and cash margin; or reduces the size of its positions.

It is possible that in stressed conditions – for instance in the event of a participant default – surviving participants may choose to withdraw excess collateral or to accelerate the closeout of their positions. This could be an additional source of stressed liquidity need. The CCP’s rules may impact on the extent to which the CCP is exposed to such a liquidity risk. For instance, some CCPs report that they have rules that require notice for members to withdraw or substitute their posted margin, or rules that give the CCP some discretion to refuse such requests. The CCPs’ rules, however, do not completely remove the need for the CCP to consider payment obligations to non-defaulting participants, for instance in a situation where participants accelerate the closeout of their positions.

The CCPs adopt different approaches to modelling their payment obligations to non-defaulting participants, including in stressed conditions. Some CCPs model their obligations based on historical experience. For instance, one CCP includes the peak margin outflow from the previous 12 months in its minimum liquidity requirement. Another CCP requires its overnight investments or cash held to be sized to cover two times the largest one-day cash withdrawal by a clearing participant experienced over the

previous 12 months. Such short lookback periods may be sufficient to ensure that the CCPs can meet their ordinary liquidity needs, but are unlikely to adequately reflect the CCPs' potential payment obligations to non-defaulting clearing participants in stressed conditions. To fully capture stressed conditions, a CCP may need to use a lookback period that includes periods of stress, or to otherwise model potential stresses. Other CCPs did not provide sufficiently detailed responses to explain how they modelled liquidity needs that could arise from non-defaulting participants.

Omitting potential stressed liquidity obligations to non-defaulting participants from the liquidity risk framework could affect the resilience of the CCP, since it may be plausible – or, in some cases, even likely – that non-default liquidity needs arise at the same time as the default of a participant.

Stress testing liquid resources

There is significant variation in the extent to which CCPs consider liquidity-specific scenarios that stress their liquid resources. KC 9 states that scenarios should include, for example, “simultaneous pressures in funding and asset markets” and should “include all entities that might pose material liquidity risks to the CCP (such as settlement banks, nostro agents, custodian banks, liquidity providers and linked FMIs)”. There is significant variation in the extent to which such scenarios are taken into account, as well as the extent to which other relevant stresses to liquid resources are considered, such as changes in collateral values, increases in haircuts and restricted access to liquidity providers.

The IMSG did not verify whether the CCPs include a wide range of scenarios for each and every type of liquid resource held. However, some observations are nevertheless made.

- Some CCPs report that they include additional, liquidity-specific stress scenarios that consider potential stresses to some of their liquid resources, together with their stressed exposures. For example, one CCP includes a scenario in which the clearing participant with the most illiquid collateral defaults; another CCP includes a general downward shock to the value of its collateral held. Some CCPs also consider the unavailability of important funding markets, such as the market for repurchase agreements.
- CCPs that rely on private sector credit lines from liquidity providers report that, if a liquidity provider was among the largest one or two participants (as applicable given the CCP's liquidity coverage target), the CCP would assume that it could not access the liquid resources that would otherwise have been contributed by that liquidity provider.
- Some CCPs report that they do not include any additional, liquidity-specific stress scenarios that would affect their liquid resources, beyond assuming the default of a clearing participant that was also a liquidity provider (discussed above). Indeed, at least one CCP does not use post-haircut values when calculating the value of its invested cash collateral.

CCPs that do not include a range of liquidity-specific stress scenarios and assumptions, as relevant given the composition of their liquid resources, may not give adequate consideration to circumstances in which those resources would be insufficient to meet their payment obligations. Failure to include a wide range of relevant scenarios, such as simultaneous pressures in funding and asset markets, could reduce the effectiveness of the CCP's overall approach to liquidity risk management, with potentially adverse implications for its resilience.

Stress testing assumptions

a) Lookback periods

In most cases, the CCPs consider in their liquidity stress testing lookback periods that are at least as long as those used in their credit stress testing (see Section 5.2.2.5). However, one CCP appears to use a substantially shorter lookback period for its liquidity stress testing and another CCP uses a lookback period that is shorter than the maximum lookback period that it considers for credit stress testing. In the

latter case, this is because this CCP calculates its credit needs at the level of the clearing service, but calculates its liquidity needs at the level of the CCP.

b) *Frequency of stress tests*

KC 9 states that a CCP should “regularly test the sufficiency of its liquid resources through rigorous stress testing”, and explanatory note 3.7.17 elaborates that CCPs should perform liquidity stress testing on a daily basis.

All but one CCP test the sufficiency of liquid resources on a daily basis, while some CCPs additionally test sufficiency on an intraday basis. However, one CCP tests the sufficiency of its liquid resources only on a monthly, rather than a daily, basis. All else equal, exposures to large stressed payment obligations could arise between monthly stress tests. Should they arise, such exposures would not be identified on a timely basis and could remain uncovered until the next month’s stress test.

5.3.2.2 *Scope of liquidity risk management framework and relevant currencies (Principle 7, KC 4)*

KC 4 states that CCPs “should maintain sufficient liquid resources in all relevant currencies to... make required variation margin payments, and meet other payment obligations on time and with a high degree of confidence...”. Most CCPs provide clearing services for products denominated in more than one currency, up to a maximum of seventeen currencies.⁴⁴

Table 7 shows that most CCPs carry out stress testing in respect of all the currencies they clear, while some CCPs only carry out stress testing in respect of those currencies that they deem to be material. These CCPs use different metrics to determine materiality, including the absolute size of the obligation in the currency, the size of the obligation relative to the CCP’s total payment obligations across currencies, and the size of the obligation relative to typical turnover in that currency in the FX spot market.

Stress testing liquidity needs in material currencies only could have resilience implications for the CCP. While it is acceptable for a CCP’s liquidity arrangements to differ across currencies, stress testing is an important component of determining the materiality of exposures in a currency. Omitting non-material currencies from stress testing may leave the CCP unable to identify potentially important exposures in particular currencies and it may also increase the probability that it is unable to meet all of its payment obligations on time and with a high degree of confidence (whether those obligations are material or not). This could have adverse implications for the CCP’s resilience. This could also potentially affect outcomes in some jurisdictions; even if a CCP’s activities in a certain currency are deemed not to be material to the CCP, they may nevertheless be important to the stability of the financial system in a particular host jurisdiction.⁴⁵

5.3.3 Other findings relevant to consistency of outcomes

In addition to the potential issues of concern detailed above, the IMSG’s findings also include a number of other findings relevant to an assessment of the consistency of outcomes.

5.3.3.1 *Coverage of liquid resources (Principle 7, KC 4)*

Under the PFMI, a CCP is expected to “maintain sufficient liquid resources in all relevant currencies to... make required variation margin payments, and meet other payment obligations on time with a high

⁴⁴ The other CCP introduced clearing of multicurrency products in September 2015 (which is after the as-of date of this report).

⁴⁵ The CPMI and IOSCO note that the failure to maintain qualifying liquid resources in all relevant currencies could similarly have resilience implications. However, given the desktop nature of this review, the IMSG did not collect sufficiently detailed information to determine whether or not all CCPs maintain sufficient qualifying liquid resources in all relevant currencies.

degree of confidence under a wide range of potential scenarios, that should include the default of the participant and its affiliates that would generate the largest aggregate payment obligation to the CCP in extreme but plausible market conditions” (Cover 1 liquidity). In addition, a CCP that is “involved in activities with a more complex risk profile or that is systemically important in multiple jurisdictions should consider maintaining additional liquid resources sufficient to cover a wider range of potential stress scenarios that should include... the default of the two participants... that would generate the largest aggregate payment obligation...” (Cover 2 liquidity).

All CCPs set coverage targets to maintain liquid resources at least sufficient to meet Cover 1 liquidity; and many CCPs set their coverage targets to at least meet their payment obligations under Cover 2 liquidity.

Although under the PFMI, CCPs are not expected to use the same coverage target for liquidity risk as for credit risk, most CCPs target the same coverage (see Section 5.2 on credit risk management). One CCP sets a coverage target of Cover 1 for liquidity purposes, but targets Cover 2 for credit risk purposes. Another CCP sets its coverage target at customer level for credit risk and at clearing participant level for liquidity risk. This variation may reflect differences in CCPs’ liquidity risk tolerance, or the particular implementation of the relevant KC in the legal and regulatory framework of each jurisdiction.

All CCPs set their coverage targets at the CCP level, such that they expect to be able to cover payment obligations arising in the event of the default of the largest one or two participants and, in most cases (see below), their affiliates in aggregate across all clearing services. Some CCPs additionally set a coverage target that exceeds their Cover 2 standard by a small percentage, to provide a buffer to their liquidity coverage. Some CCPs that target Cover 1 liquidity also consider Cover 2 liquidity as part of their stress testing, but do not maintain this standard as their explicit target coverage (although they may meet this coverage level in practice).

One CCP does not consider affiliates of its clearing participants in testing the sufficiency of its liquid resources, which does not appear to be fully consistent with the standard in KC 4. A potential consequence is that this CCP may be unaware of important liquidity exposures created by the affiliates of its clearing participants.

As of June 2015, all CCPs stated that they maintained adequate qualifying liquid resources to at least meet their coverage targets and that they had not identified a liquidity shortfall. The IMSG did not collect quantitative information to independently verify this.

5.3.3.2 Mitigating risks associated with access to qualifying liquid resources when needed (Principle 7, KC 5 and KC 7)

KC 5 states that “all [qualifying liquid] resources should be available when needed”. The CCPs identified a number of risks associated with the availability of their resources when needed, including non-performance on prearrangements for converting non-cash assets into cash and non-performance on prearrangements for converting cash denominated in one currency into another currency. The CCPs generally have liquidity arrangements with multiple commercial banks and/or the central bank of issue, which may allow them to avoid excessive exposure to any one entity and to reduce the risk of material non-performance. As is discussed in more detail in Section 5.6.2.2, there are a range of approaches to address these risks, and a range of approaches to address unforeseen and potentially uncovered liquidity shortfalls.

Most CCPs would use private sector (ie non-central bank) liquidity providers to meet at least part of their minimum required qualifying liquid resources. (One of these, however, maintains prefunded, earmarked funds from its liquidity providers in designated central bank accounts at all times.) Half of the CCPs have access to routine credit at the central bank of issue. A small number of these CCPs maintain

their liquid resources almost exclusively in central bank-eligible collateral assets and would rely on access to routine credit at the central bank of issue if they could not liquidate such assets in the market.

KC 7 outlines three ways that a CCP may obtain a high degree of confidence that liquidity providers will perform on their obligations to the CCP. First, it states that a CCP “should obtain a high degree of confidence, through rigorous due diligence, that each provider of its minimum required qualifying liquid resources... has sufficient information to understand and to manage its associated liquidity risks and that it has the capacity to perform as required under its commitment”. Second, it states that, when “assessing a liquidity provider’s performance reliability with respect to a particular currency, a liquidity provider’s potential access to credit from the central bank of issue may be taken into account”. Third, it states that a CCP should “regularly test its procedures for accessing its liquid resources at a liquidity provider”.

In reviewing the CCPs’ responses regarding their due diligence of liquidity providers on each of these aspects, the IMSG has made the following observations. Some of these could have implications for some CCPs’ confidence in the availability and reliability of access to qualifying liquid resources:

a) Liquidity providers’ access to information

There is considerable variation in the amount of due diligence conducted by CCPs to obtain a high degree of confidence that each liquidity provider has sufficient information to understand and manage the liquidity risks associated with its commitments.

The PFMI do not detail the actions a CCP might take to determine whether a liquidity provider has sufficient information. As part of its regular testing programme, one CCP provides information to counterparties under its uncommitted repo arrangements by requesting quotes in amounts that reflect potential peak obligations in a participant default scenario. Another CCP meets with counterparties to its committed lines of credit to ensure that they have a good understanding of the types of circumstances in which the CCP could draw down the credit line.

Most CCPs, however, take limited action to ensure their private sector liquidity providers have sufficient information to understand and manage their associated liquidity risk. For example, one CCP responded that the conditions of the commitment, such as the maximum amount, time frame, acceptable collateral and haircuts, are clearly outlined in a contract. Another CCP states that it is the liquidity providers’ responsibility to assess the CCP’s creditworthiness by looking at publicly available information as well as information provided by the CCP on its creditworthiness when deciding whether to provide a committed arrangement.

Such approaches would seem to fall short of the expectations under KC 7. If liquidity providers have insufficient information to understand their potential exposures and commitments to the CCP, they may not be able effectively to manage their own liquid resources to meet their obligations to the CCP. It may also be more difficult for liquidity providers to assess their total obligations across multiple CCPs.

b) Liquidity providers’ capacity to perform

All CCPs that access liquidity through private sector liquidity providers report that they assess their liquidity providers’ capacities to perform. At a minimum, these CCPs conduct an internal credit assessment. Most of these CCPs consider liquidity providers’ access to liquidity from the central bank of issue to assess their performance reliability. In addition, some CCPs consider ratings from external credit rating agencies. A small number of CCPs require their liquidity providers to be supervised by the central bank or relevant regulator in their jurisdiction.

c) Testing of procedures for accessing liquid resources at a liquidity provider

KC 7 states that a CCP should regularly test its procedures for accessing its liquid resources at a liquidity provider. Regular and thorough testing is an important part of the due diligence on a liquidity provider’s capacity to perform, and also helps to increase the CCP’s own familiarity with its arrangements to access

liquidity should it be needed. All CCPs that have arrangements with private sector liquidity providers report that they periodically test their operational procedures for accessing liquid resources at a liquidity provider. Among those CCPs for which the central bank is a liquidity provider, only a subset report that they routinely test their procedures for accessing liquid resources at the central bank.

The PFMI do not define the frequency of “regular” testing of procedures to access liquid resources. Accordingly, there is variation in the frequency of these tests. Some CCPs conduct annual testing; one conducts testing three or four times a year; one conducts quarterly testing; and one conducts monthly testing. All CCPs report that they include their liquidity providers in their testing exercises, and some also include clearing participants and collateral liquidation agents, where relevant. Furthermore, all CCPs consider qualitative metrics in these tests with respect to timeliness and reliability, and most CCPs have quantitative metrics with respect to timeliness. For example, three CCPs have limits on the amount of time it should take to access the liquid resources after making a request to draw funds; these range from a few minutes to one hour.

5.3.3.3 Responses to breaches of coverage (Principle 7, KC 9)

KC 9 states that a CCP should have clear procedures to report the results of its stress tests to appropriate decision-makers at the CCP and to use these results to evaluate its liquidity risk management framework and make appropriate adjustments.

All CCPs state that they have documented arrangements in place to report the results of their liquidity stress tests to senior management in their risk or finance departments on a daily, weekly or monthly basis. Results are then reported to the CCPs’ boards on a less frequent basis, often either quarterly or annually.

All CCPs note that they have procedures in place to report identified breaches of liquidity to senior management, ie where the CCP’s stress test reveals that it does not have sufficient resources to meet its coverage target. However, as discussed earlier, CCPs that have less sophisticated liquidity stress testing frameworks may have less ability to identify potential breaches in liquidity coverage.

Furthermore, only some CCPs have predetermined procedures or rules that state how they would respond to identified breaches of liquidity. This includes requirements to consider triggering additional funding and to review their liquidity risk management (for instance, the models, parameters and scenarios used).

Most CCPs appear instead to have discretion to choose an appropriate response to adjust liquid resources in response to a breach. Observed potential responses include: amending limits on the use of illiquid collateral; requesting additional liquidity from liquidity providers; increasing the CCP’s contribution of its own liquid resources; intra-group funding; allowing investments to mature; and selling or funding through repurchase agreements with non-cash collateral held in investment. Some of the credit risk tools noted in Section 5.2 on credit risk management, such as calling additional initial margin from clearing participants, may also provide some additional liquidity in response to a breach.

Stress testing model review and validation (Principle 7, KC 9)

PFMI explanatory note 3.7.17 elaborates that a CCP should, on at least a monthly basis, perform a comprehensive analysis of its stress testing scenarios, models and underlying parameters and assumptions, and on at least an annual basis, perform a full validation of its liquidity risk management model. All CCPs state that they conduct a full validation of their liquidity risk management framework at least annually, and this validation is typically conducted by an internal department in the CCP – although some CCPs undertake both internal and external validations. By contrast, some CCPs conduct a review of specific factors such as models, parameters and scenarios less frequently than on a monthly basis.

5.3.4 Other observations

Finally, the IMSG has made some additional observations on differences in CCPs' implementation outcomes. Particularly when considered alongside other elements of CCPs' risk frameworks, these differences may not give rise to material differences in resilience. They may nevertheless be noteworthy.

5.3.4.1 *Qualifying liquid resources (Principle 7, KC 5)*

Composition of qualifying liquid resources

KC 5 outlines the types of qualifying liquid resources that a CCP should maintain for the purpose of meeting its minimum liquid resource requirement.

Table 8 shows that the composition of qualifying liquid resources that CCPs use to meet their minimum requirements varies substantially across CCPs. The precise composition of CCPs' resources appears to reflect, among other things: jurisdictional differences in access to central bank facilities; differences in each jurisdiction's implementation of the PFMI; the size of the liquidity requirement (which will be a function of the CCP's coverage target and stress testing approach, the products cleared and the size of the business); and the CCP's own commercial decisions and preferences.

Half of the CCPs report that they meet their minimum liquidity requirements by maintaining the majority of their qualifying liquid resources in cash that is either deposited at central banks or that is deposited at commercial banks on a secured or unsecured basis.

The other CCPs maintain the majority of their qualifying liquid resources in secured committed lines of credit or highly marketable collateral held in custody and investments that they report are readily available and convertible into cash with prearranged and highly reliable funding arrangements even in extreme but plausible market conditions. One of the CCPs that maintains a significant proportion of "highly marketable collateral" notes that this collateral is routinely eligible for repo to the central bank, which it regards as a highly reliable funding arrangement.

Another interesting observation highlighted in Table 8 is that most CCPs concentrate their qualifying liquid resources in a small number of the broad categories listed as eligible under Principle 7, KC 5; ie either in cash deposited at central banks, cash deposited at commercial banks, committed lines of credit (including committed FX swaps and committed repos) or highly marketable collateral that is readily available and convertible into cash with prearranged and highly reliable funding arrangements, even in extreme but plausible market conditions. Half of the CCPs report that they meet over 70% of their minimum liquidity requirements by maintaining resources in a single category. One CCP reports that it maintains 100% of its qualifying liquid resources as committed lines of credit. The IMSG notes that this CCP also maintains other resources that could potentially be regarded as "qualifying" resources, but the CCP considers these as "supplemental" resources (see Section 5.3.4.2).

Most CCPs note that they diversify their private sector resources to increase the probability that such resources are "available when needed". For instance, CCPs that use committed lines of credit typically source this credit from four to five banks⁴⁶, and one CCP notes that no single provider contributes more than 7% of its total line of credit.

⁴⁶ As of November 2015, one of these CCPs no longer has access to a committed line of credit.

Composition of qualifying liquid resources used to meet the CCP's minimum liquid resource requirement, as at 30 June 2015⁴⁷

Table 8

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
(a) Cash deposited at a central bank of issue of the currency concerned	0.4%	-	58.9%	-	72.0%	0.3%	-	-	3.9%	-
(b) Cash deposited at other central banks	-	-	-	-	-	-	-	-	-	-
(c) Secured cash deposited at commercial banks (including reverse repo)	-	53.0%	41.1%	-	23.0%	-	-	-	47.4%	<0.1%
(d) Unsecured cash deposited at commercial banks	14.1%	19.6%	-	20.0%	1.0%	12.9%	83.7%	-	1.3%	-
(e) secured committed lines of credit (ie those for which collateral/security will be provided by the CCP if drawn) including committed foreign exchange swaps and committed repos	48.2%	-	-	16.5%	-	-	-	100%	-	86.6%
(f) unsecured committed lines of credit (ie which the CCP may draw without providing collateral/security)	20.9%	-	-	-	4.0%	-	4.4%	-	-	13.3%
(g) highly marketable collateral held in custody and investments that are readily available and convertible into cash with prearranged and highly reliable funding arrangements even in extreme but plausible market conditions	16.4%	27.4%	-	63.5%	-	86.9%	11.9%	-	47.4%	<0.1%

⁴⁷ The table presents information based on the aggregate qualifying resources that the CCP holds across all currencies. Some CCPs may have "supplemental" liquid resources that are not included in this table which may also meet the requirements for "qualifying" liquid resources.

Change in composition of qualifying liquid resources over time

The CCPs report that the size and composition of their qualifying liquid resources vary slightly over time. The two most common reasons cited for such variation include: changes in clearing volumes (due, in part, to the introduction of mandatory clearing for certain products), and participants' changing preferences between cash and non-cash collateral. Other reasons cited include changes in the margin requirements for certain derivative products, changes in the lines of credit provided to the CCP, and changes in cash collateral investment opportunities for the CCP.

Access to routine credit at the central bank of issue

The composition of qualifying liquid resources reflects, to an extent, differences in CCPs' access to routine credit at the central bank of issue across jurisdictions. Some CCPs do not have access to routine credit from the relevant central bank, whereas other CCPs do have such access; a subset of these rely on this provision in their daily liquidity management. Some of these CCPs are licensed as banks in their jurisdiction. One CCP has indirect access to central bank credit through an affiliated special purpose bank, the only function of which is to provide settlement and liquidity services to the CCP.

The CCPs' access to routine central bank credit is always collateralised and takes place through repos or collateral pledge.

5.3.4.2 Supplemental liquid resources (Principle 7, KC 6)

KC 6 states that a CCP may choose to supplement its qualifying liquid resources with other forms of liquid resources; in the case that a CCP chooses to maintain supplemental resources, they should be in the form of assets that are likely to be saleable or acceptable as collateral for lines of credit, swaps, or repos on an ad hoc basis when needed.

Most CCPs report that they maintain some form of supplemental liquid resources in addition to their qualifying liquid resources. The CCPs that do not report supplemental liquid resources regard all of their liquid resources as "qualifying" and state that they maintain a substantial amount of qualifying resources above the minimum requirement.

There is variation, however, in the types of resources that CCPs consider to be supplemental resources. One CCP notes that it maintains uncommitted lines of credit with commercial banks, while others hold securities that they consider would be likely to be saleable or acceptable as collateral for lines of credit, swaps, or repos on an ad hoc basis following a default, even if this could not be reliably prearranged or guaranteed in extreme market conditions. Some other CCPs' supplemental resources appear to be capable of meeting the criteria for qualifying liquid resources. For instance, some CCPs consider cash deposits, cash received through intraday margin calls, and the CCP's own cash to be supplemental.

In other cases, CCPs describe resources that might not even meet the criteria for "supplemental liquid resources" under KC 6. In one case, these resources include assets that are neither likely to be sufficiently liquid nor eligible to be pledged at the relevant central bank. In another case, a CCP lists unfunded ex post assessments, which would commonly be considered a mechanism for allocating unfunded losses or liquidity shortfalls rather than supplemental liquid resources (see Section 5.6 on default management and recovery planning).

While perhaps making comparisons across CCPs more difficult at the margin, the different interpretations and categorisations of supplemental liquid resources would not be expected to have a material impact on the CCPs' resilience, particularly to the extent that the CCPs state that they maintain sufficient qualifying liquid resources to cover their minimum liquidity requirements.

5.3.4.3 Access to and use of central bank accounts and services (Principle 7, KC 8)

KC 8 states that where a CCP has access to central bank accounts, payment services, or securities services it should use these services, where practical, to enhance its management of liquidity risk. However, the use of central bank services is subject to the relevant legal framework and the policies and discretion of the relevant central bank.

Most CCPs have access to central bank services. The services offered usually entail payment and settlement accounts provided by the central bank in the CCP's home jurisdiction, although one CCP also has access to central bank securities settlement services.

The CCPs appear less likely to use services provided by central banks from host jurisdictions, in some cases due to a judgment on the practicality of using such services relative to using settlement banks, and in other cases due to the absence of a framework to support CCPs' access to the relevant central bank services. A small number of CCPs do nevertheless use such services in host jurisdictions.

5.4 Margin practices

This section considers CCPs' implementation outcomes in respect of the following margin-related standards in Principle 6 of the PFMI, which states that "a CCP should cover its credit exposures to its participants for all products through an effective margin system that is risk-based and regularly reviewed".

The KCs that have been considered for Principle 6 are:

1. *A CCP should have a margin system that establishes margin levels commensurate with the risks and particular attributes of each product, portfolio, and market it serves.*
2. *A CCP should have a reliable source of timely price data for its margin system. A CCP should also have procedures and sound valuation models for addressing circumstances in which pricing data are not readily available or reliable.*
3. *A CCP should adopt initial margin models and parameters that are risk-based and generate margin requirements sufficient to cover its potential future exposure to participants in the interval between the last margin collection and the close out of positions following a participant default. Initial margin should meet an established single-tailed confidence level of at least 99 percent with respect to the estimated distribution of future exposure. For a CCP that calculates margin at the portfolio level, this requirement applies to each portfolio's distribution of future exposure. For a CCP that calculates margin at more-granular levels, such as at the subportfolio level or by product, the requirement must be met for the corresponding distributions of future exposure. The model should (a) use a conservative estimate of the time horizons for the effective hedging or close out of the particular types of products cleared by the CCP (including in stressed market conditions), (b) have an appropriate method for measuring credit exposure that accounts for relevant product risk factors and portfolio effects across products, and (c) to the extent practicable and prudent, limit the need for destabilising, procyclical changes.*
4. *A CCP should mark participant positions to market and collect variation margin at least daily to limit the build-up of current exposures. A CCP should have the authority and operational capacity to make intraday margin calls and payments, both scheduled and unscheduled, to participants.*
5. *In calculating margin requirements, a CCP may allow offsets or reductions in required margin across products that it clears or between products that it and another CCP clear, if the risk of one product is significantly and reliably correlated with the risk of the other product. Where two or more CCPs are authorised to offer cross-margining, they must have appropriate safeguards and harmonised overall risk-management systems.*

6. *A CCP should analyse and monitor its model performance and overall margin coverage by conducting rigorous daily backtesting and at least monthly, and more frequent where appropriate, sensitivity analysis. A CCP should regularly conduct an assessment of the theoretical and empirical properties of its margin model for all products it clears. In conducting sensitivity analysis of the model's coverage, a CCP should take into account a wide range of parameters and assumptions that reflect possible market conditions, including the most-volatile periods that have been experienced by the markets it serves and extreme changes in the correlations between prices.*
7. *A CCP should regularly review and validate its margin system.*

5.4.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, CCPs have made important and meaningful progress towards meeting the standards of Principle 6. All CCPs have established arrangements to cover both current and potential future exposures, through the use of variation and initial margin, respectively. The precise models and arrangements applied differ among the CCPs, reflecting the characteristics of the products cleared, participant profiles and particular features of each CCP's operating environment, including local regulatory requirements. In some cases, differences reflect arrangements that particular CCPs had in place prior to introduction of the PFMI. In other cases, they may also reflect different interpretations of the PFMI.

All CCPs disclose publicly information on their margin methodologies. The key elements of CCPs' margin models and approaches are set out in Table 9. One observation from Table 9 is the difference in margin approaches between exchange-traded derivatives and OTC derivatives.

In considering consistency of outcomes with standards in the PFMI and across CCPs, the following high-level observations are made:

- *Principle 6, KC 1.* All CCPs apply initial and variation margin to derivatives exposures, using margin systems that in their judgment reflect the particular attributes of the cleared products. Among the CCPs, the most common margin methodology for exchange-traded derivatives is the Standardised Portfolio Analysis of Risk (SPAN) model (or other similar models), while for OTC markets most CCPs use variants of the value-at-risk (VaR) model. These models differ in a number of important respects: the SPAN model is parametric in nature and calculates margin requirements at the contract level, while allowing for portfolio offsets between selected contracts; VaR-based models are typically based on non-parametric simulations and calculate margin at the full portfolio level within a given product class or related product classes. However, the CCPs' survey responses suggest that some CCPs may not systematically take into account all relevant factors in selecting from among alternative modelling approaches, or examine potential trade-offs between these factors.
- *Principle 6, KC 2.* Pricing sources for margin calculations differ across the product classes, reflecting differences in trading arrangements, standardisation and market liquidity. Timely and reliable price data are generally available from the relevant trading venue for exchange-traded derivatives products. The CCPs typically support these price data with data from other sources when venue prices are not available. A range of sources, including third-party vendors, internal models, participant polls and dealer quotes are used for OTC products. All CCPs report that they have arrangements in place for validation of pricing sources and valuation models.
- *Principle 6, KC 3.* In respect of KC 3, the following high-level observations are made:
 - *Target coverage.* All CCPs set initial margin coverage targets consistent with a single-tailed confidence level of at least 99% of the estimated distribution of future exposure across derivatives products. CCPs often target higher margin coverage for OTC derivatives, the

median coverage target for OTC derivatives being 99.5% compared with 99% for exchange-traded derivatives.

- *Closeout and lookback periods.* A wide range of closeout periods and lookback periods are applied (see Table 9). Some CCPs apply a much shorter lookback period in calculating margin requirements for exchange-traded derivatives as compared with that for OTC derivatives, as well as shorter closeout periods. Some CCPs, for both exchange-traded derivatives and OTC derivatives, allow for a longer closeout period for customer positions. Some assumptions are more conservative than others, and some CCPs could do more to demonstrate they have an appropriate method for measuring credit exposure that accounts for relevant product risk factors.
- *Add-ons.* One aspect of model design highlighted in CCPs' survey responses is the use of margin "add-ons"; that is, incremental margin requirements to reflect particular characteristics of products or positions that are not captured directly in the initial margin model requirements. This is one of a number of aspects of the margin-setting process in which some CCPs exercise discretion. In some cases add-ons are used as an important component of the modelling framework. There are a variety of approaches to the use of add-ons – including in the circumstances in which they are used and in the governance and review processes applied to their use. Factors commonly addressed by add-ons include concentration and liquidity, which are difficult to capture in the initial margin model.
- *Procyclicality.* CCPs are expected, to the extent practicable and prudent, to limit the need for destabilising, procyclical changes. CCPs take different approaches to dealing with procyclicality. For OTC derivatives, a typical approach is to include stressed periods within the historical lookback period. For exchange-traded derivatives, a variety of approaches are used, often including the use of floors on the margin requirement based on a longer lookback period.
- *Wrong-way risk.* CCPs identified a number of potential sources of wrong-way risk, the most common arising from correlation between the default of participant and the value of the collateral that it has posted. CCPs that clear CDS also have frameworks in place to identify and manage specific wrong-way risk arising from self-referencing positions.
- *Account structure.* All CCPs that permit customer clearing report that they calculate margin requirements separately for segregated participant and customer portfolios – and at the individual customer portfolio level where relevant.
- *Principle 6, KC 4.* All CCPs apply initial and variation margin to derivatives positions daily, and all report that they have the operational capability to call intraday margin on either a scheduled or as-needed basis. A variety of approaches to monitoring intraday exposures and calling for intraday margin are observed. In some cases, intraday margin collection is scheduled for particular times during the day, while in other cases intraday calls are more ad hoc and dependent on observed initial margin erosion. Routine scheduled intraday margin recalculations are common for exchange-traded derivatives services, but less so for OTC services. Minimum margin call thresholds typically apply. Those CCPs that monitor closely changes in prices and positions and that have a clear and transparent framework for responding to margin erosion may achieve more resilient outcomes.
- *Principle 6, KC 5.* All CCPs apply methodologies to take account of portfolio effects; for those that use parametric models, such as SPAN, offset parameters are applied to take account of observed and reliable co-movement (often with a cap), while portfolio effects are inherently reflected in the margin calculation where non-parametric VaR-based models are used. Among the CCPs, some also permit offsets between specified interest rate futures and OTC-IRD, typically by including the futures subject to offset within the OTC portfolio VaR calculation. In

describing their policies, some CCPs have gone further than merely ensuring the significance and reliability of correlations, as expected under KC 5, with some CCPs also explicitly requiring that positions should only be margined together if, in the event of a default, these positions would be closed out as a portfolio. Adherence to such a policy is consistent with the intent of KC 5 and could improve resilience.

- *Principle 6, KC 6.* All CCPs report that they perform daily, and often also more detailed periodic, backtesting of their margin models to assess the adequacy of initial margin against the targeted level of coverage. Most CCPs also undertake monthly sensitivity analysis to validate key model assumptions. The depth and sophistication of this testing and analysis varies, however. For instance, some CCPs perform a very wide range of tests, using both actual and hypothetical portfolios and a range of lookback periods, and have backtesting and sensitivity analysis fully integrated into their model review processes. Those CCPs that conduct more sophisticated and extensive testing may be able to demonstrate more convincingly that margin coverage targets are met.
- *Principle 6, KC 7.* All CCPs report that they have procedures in place for regular reviews and most report that they carry out independent validation of their margin models annually. Most submit their models to external validation. The responses suggest that some CCPs' model reviews and validation exercises are limited such that they do not comprehensively assess on an ongoing basis whether the chosen model continues to achieve an appropriate balance between the factors relevant to model choice.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of observed differences across CCPs.

Key elements of CCPs' margin models and approaches

Table 9

	CCP ¹	Model choice ²	Target coverage (%)	Backtesting result ³ (%)	Lookback period	Closeout assumption ⁴	Procyclicality
Exchange-traded derivatives services	CCP 1	HVaR/ SPAN-like	99.0	99.59 (fixed income) 99.80 (equity) ⁵	3 years plus 1 year stressed	2–4 days	Stressed sample, volatility flooring
	CCP 2	SPAN	99.0	99.95	Multiple (60, 252 days)	1–2 days	Margin floor (extended sample)
	CCP 3	Proprietary	99.96	99.96	14 years	2–10 days	Stressed sample
	CCP 4	SPAN	99.0	99.45	33 weeks	1 day	None
	CCP 5	SPAN	99.7	99.95	Multiple (to 10 years)	Min. 2 days	Margin floor (extended sample)
	CCP 6	SPAN	99.0	99.98	Multiple (to 10 years)	1 day	Input floor (extended sample)
	CCP 7	SPAN	99.0	99.92	Multiple (to 12 months)	1–2 days	Margin floor and limit

OTC interest rate, commodity and FX derivatives services	CCP 1	HVaR (ES)	99.7	99.96	10 years	5 days	Margin floor (unscaled sample)
	CCP 2	HVaR	99.0	99.92	5 years incl. 1 year stressed	5 days	Stressed sample
	CCP 3	HVaR	99.0	100	500 days	2 days	Margin floor
	CCP 4	HVaR	99.5	99.75	Fixed from 2008	5 days	Stressed sample, input floor
	CCP 5	Proprietary	99.96	99.96	14 years	10 days	Stressed sample
	CCP 6	HVaR	99.0	100	5 years (incl. stress)	5 days	Input floor
	CCP 7	HVaR (ES)	99.5	99.68	1250 days	5 days	Stressed sample
	CCP 8	HVaR	99.5	99.37	3 years, plus 1 year stressed	5 days	Stressed sample, volatility flooring
OTC CDS services	CCP 1	Proprietary	99.0	100	Fixed from 2007	Min. 5 days	Margin and volatility floors (stressed sample)
	CCP 2	Proprietary	99.0	100	3 years	5 days	Input floor (extended sample)
	CCP 3	HVaR (ES)	99.5	100	750 days	5 days	Stressed sample
	CCP 4	HVaR (ES)	99.7	100	10 years	5 days	Margin floor (unscaled sample)

¹ Table 2 lists the services reviewed for this exercise for each CCP. The ordering of CCPs is random within each service line grouping.

² SPAN = Standardised Portfolio Analysis of Risk; HVaR = Historical Simulation Value-at-Risk; HVaR (ES) = Historical Simulation Value-at-Risk (Expected Shortfall)

³ Results of initial margin model backtesting (during the past 12 months ending 30 June 2015)

⁴ For house positions, some CCPs extend the closeout assumption for customer positions to allow for a "window" for consideration of the scope to port customer positions to another clearing participant.

⁵ This CCP conducts backtesting per liquidation group split.

5.4.2 Key findings

The key findings relevant to CCPs' implementation outcomes in the area of margin practices are described below. These relate primarily to observed variation in the outcomes of implementation across CCPs.

5.4.2.1 Choice of margin model (Principle 6, KC 1)

The CCPs have selected margin models that in their judgment address the standard under KC 1 that a CCP "have a margin system that establishes margin levels commensurate with the risks and particular attributes of each product, portfolio and market it serves". Indeed, a noteworthy feature of the review of margin practices is the observation that the choice of margin model differs markedly across products.

The most commonly observed models are:

- *Standardised Portfolio Analysis of Risk (SPAN)*. SPAN is a parametric model that relies on the calibration of a number of parameters. These are: the price scanning range (PSR), volatility scanning range (VSR), intra-commodity spread charges, inter-commodity spread concessions, and some other adjustments that account for specific features of the correlation between products. SPAN is typically used to margin a range of exchange-traded derivatives products. A typical stated benefit of parametric models such as SPAN is that they provide transparency and replicability, as well as increased flexibility in determining margin requirements, for example when market changes are event-driven.
- *Value-at-risk (VaR)*. VaR is a statistical modelling approach that measures the worst potential loss in value on a product or portfolio over an assumed closeout period for a given confidence interval. While the VaR approach can be applied on either a parametric, or a non-parametric basis, non-parametric Historical Simulation VaR (HVaR) models are most commonly observed in the sample. This approach is commonly used among the CCPs that clear OTC-IRD products. This reflects a general view that parametric modelling of multiple risk factors, such as volatilities and correlations interacting across different tenors, may result in less reliable performance than non-parametric estimation. In its purest form, the VaR approach relies on the observed properties of the data over an historical lookback period, with no need to make assumptions about the interaction between multiple risk factors, or to impose a structure on the data. However, in practice, CCPs typically use filtering and scaling approaches – for instance to adjust for observed changes in volatility over time. One variant of the VaR methodology that is used by a number of CCPs that clear OTC derivatives is the Expected Shortfall (ES) approach. ES is a conditional VaR model; ie it estimates the potential loss in value over an assumed closeout period, conditional on the loss being greater than some defined percentile of the loss distribution. For a given choice of percentile, ES is inherently more conservative than the traditional VaR model, since it takes the conditional mean of extreme values beyond the specified percentile loss.

One CCP applies a proprietary methodology to calculate margin across all exchange-traded and OTC derivatives product classes that it clears.⁴⁸

For CDS, two basic approaches are observed among the four CCPs in the sample that offer CDS clearing services: customised VaR- or Expected Shortfall-based models, and proprietary simulation-based factor models. Widespread central clearing of CDS only emerged in the wake of the global financial crisis and techniques in this area may still be evolving. The more proprietary, bespoke nature of

⁴⁸ This CCP's proprietary margining system calculates margin requirements using an extreme value approach that assesses potential portfolio losses and gains under a range of risk scenarios, taking into account both stresses to primitive risk factors and potential losses associated with the portfolio closeout process.

models for this product class may reflect its complexity and the characteristics of the price distribution which exhibits non-linearities and features such as “jump-to-default”.

Also noteworthy is that while the SPAN model remains widely used across the sample of CCPs for exchange-traded derivatives, some CCPs have transitioned from SPAN to other models. Another CCP is in the process of transitioning from SPAN to a VaR based model and now applies a SPAN-like model to only a subset of its exchange-traded derivatives.

CCPs’ survey responses on determinants of the choice of margin model were instructive. The key factors identified include: the number and interdependence of risk factors; data availability/reliability; the characteristics of the data (eg non-linearities, seasonality); model performance; model stability; flexibility and scalability; independence of errors/breaches; and transparency, predictability and replicability.

Clearly, there may be trade-offs between these characteristics. For instance, in the presence of multiple risk factors, CCPs typically prefer a non-parametric model. In the case of IRD, for instance, the multiple risk factors driving changes in the level, shape and slope of the yield curve may not easily be captured in a parametric model. However, non-parametric models may be less transparent, predictable and replicable than parametric models.

Analysis of the survey responses suggests that some CCPs do not systematically take into account all of the relevant factors cited above, or examine potential trade-offs between all of these factors, to ensure that they select and develop a margin model that best captures the risks and particular attributes of each product, portfolio and market they serve.

Furthermore, under KC 6, “a CCP should regularly conduct an assessment of the theoretical and empirical properties of its margin model for all products it clears”. An important part of this assessment would seem to be to consideration of whether the properties of the chosen model continue to provide an appropriate balance between the relevant factors (see Section 5.4.2.4).

5.4.2.2 Key model parameters (Principle 6, KC 3)

Lookback periods

There is considerable variability in the lookback periods applied by the CCPs. This seems to be associated with both product characteristics and model choice. The measures applied to deal with potential procyclicality also vary across the sample.

To assist in interpreting the standards in KC 3 related to the selection of model parameters, PFMI explanatory note 3.6.8 observes that “a CCP should select an appropriate sample period...[that] should be carefully examined based on the theoretical properties of the margin model and empirical tests on these properties using historical data”. Explanatory note 3.6.10 goes on to say that “to the extent practicable and prudent, a CCP should adopt forward-looking and relatively stable margin requirements”.

Given the nature of this review, the IMSG has not examined a detailed evidence base to justify the sample periods applied by each CCP. The following observations are nevertheless made:

- Lookback periods are typically shorter for exchange-traded derivatives, particularly where SPAN models are used. For these products, parameter inputs are often derived using multiple lookback periods (eg taking the most conservative parameter value calculated using two different lookback periods), but in several cases these are one year or less. One CCP that uses SPAN for exchange-traded products differentiates between financial and commodity derivatives contracts, applying shorter lookback periods for commodity contracts that exhibit strong seasonality. Another CCP considers data over multiple years to identify seasonality in energy markets.

- For OTC derivatives markets, the typical lookback period is at least five years, with most CCPs in the sample explicitly including within the sample the stressed market conditions of 2008. At least two CCPs do not use a rolling lookback period, but rather set a fixed starting point and allow the lookback period to increase over time. One of these CCPs, for instance, applies a lookback period with a fixed start date of 2002 for all products, including exchange-traded derivatives.
- For OTC derivatives products, most CCPs apply volatility scaling or other weighting schemes to best reflect prevailing market conditions. Other CCPs that use VaR-based models for exchange-traded derivatives also typically apply volatility scaling. Such mechanisms are not generally applied where SPAN models are used.

Particularly where lookback periods are shorter, mechanisms to address procyclicality potentially become more important (see Section 5.4.2.3). Some CCPs could do more to demonstrate that their approaches to setting lookback periods appropriately account for relevant product risk factors.

Closeout periods

Another key parameter identified as varying significantly by product and by CCP is the assumed closeout period. The standard in Principle 6, KC 3 is that the margin model should “use a conservative estimate of the time horizons for effective hedging or closeout of the particular types of products cleared by the CCP (including in stressed market conditions)”. In reviewing CCPs’ approaches in the light of this standard, the following observations are made:

- *Exchange-traded derivatives.* Two CCPs have an assumed closeout period of one day, justifying this in terms of the structure and reported depth of liquidity of the underlying market. Three CCPs apply a more conservative closeout period of at least two days, with this for some products extending to as much as 10 days to reflect the particular characteristics of individual products and potential liquidity in a closeout scenario; and two CCPs set margin requirements at a level consistent with the highest potential future exposure over either a one- or two-day closeout period. Observed differences may in part reflect specific regulatory requirements in some jurisdictions, including a minimum assumed closeout period of two days for exchange-traded derivatives in the European Union. As in the case of lookback periods, some CCPs could do more to demonstrate that their models use a sufficiently conservative estimate of the time horizons for effective hedging or closeout of the particular types of products cleared by the CCP (including in stressed market conditions), for instance by differentiating more between products (or contracts), and articulating the evidence base applied in setting their closeout period assumptions.
- *OTC derivatives.* All but one of the eight CCPs that clear OTC interest rate or foreign exchange derivatives, and all four CCPs that clear CDS apply at least a five-day closeout period for these products. One of these CCPs stresses that this is a minimum and may be higher for less actively traded products, or those for which time-zone frictions could create challenges in a closeout scenario. Longer assumed closeout periods reflect the lower liquidity of these products and the likely default management approach. In particular, while in exchange-traded derivatives markets, CCPs would often expect to closeout exposures in the market via default brokers, the typical approach in OTC derivatives markets would be to auction a defaulted participant’s portfolio to surviving participants. This could take some time to arrange. Testing is typically used to validate the assumed timeframe for default management actions. Application of at least a five-day closeout period for OTC derivatives may in some cases also reflect jurisdiction-specific regulatory requirements.
- *Porting window for customer positions.* Some CCPs apply an extended closeout period for customer positions – for instance, applying an additional two days or scaling up the margin

requirement by a factor. The intent here is generally to provide a “window” in which, working with the CCP, customers of a defaulted clearing participant could identify an alternative clearing participant to whom their positions and collateral could be transferred (or ported) before the CCP proceeded to closeout. Notably, however, such a porting window is observed only among CCPs that clear OTC derivatives products, and not in exchange-traded derivatives markets. One CCP that applies the same closeout period for both house and customer positions in OTC derivatives markets as well as exchange-traded derivatives markets justifies this approach with reference to other compensating protections in the risk framework; notably, gross margining of customer positions (see Section 5.4.4.3, below). This CCP also notes that it is confident that, with early warning of a CCP participant’s distress, it could take preparatory steps to identify a potential transferee clearing participant.

5.4.2.3 *Procyclicality (Principle 6, KC 3)*

One consideration relevant to the selection and calibration of model parameters is procyclicality. In KC 3, a CCP should, in its model design, “to the extent practicable and prudent, limit the need for destabilising, procyclical changes”. PFMI explanatory note 3.6.10 provides some useful guidance to CCPs.

In response to the standard in Principle 6 KC 3 to reduce the need for “destabilising, procyclical changes,” many CCPs calibrate margin requirements using extended lookback periods – often spanning periods of stress or spikes in volatility (see Table 9). One CCP, for instance, calculates margin using an extended lookback period that overweights the stressed period of 2007–12. Extended lookback periods are often combined with a margin floor. One CCP also applies a “procyclicality buffer” if margin requirements are calculated using a shorter lookback period. For certain product types, CCPs apply floors to parameter inputs, such as the volatility scaling factor.

Two CCPs explicitly note additional measures operating in the other direction; that is, limits to provide for more measured increases in margin requirements as volatility rises: one CCP applies a discretionary margin limit, while ensuring that the target level of margin coverage is maintained; another implements any required margin increases incrementally to avoid exacerbating market stress in periods of heightened volatility.

Since the effective date of the exercise, at least two CCPs have more fully elaborated their procyclicality frameworks, also identifying quantitative metrics to measure procyclicality.

5.4.2.4 *Review, backtesting, sensitivity analysis and model validation (Principle 6, KC 6 and KC 7)*

KC 6 states that “a CCP should analyse and monitor its model performance and overall margin coverage by conducting rigorous daily backtesting and at least monthly, and more frequent where appropriate, sensitivity analysis.” KC 7 goes on to state that “a CCP should regularly review and validate its margin system”, with explanatory note 3.6.18 elaborating that “a CCP’s margin methodology should be reviewed and validated by a qualified and independent party at least annually, or more frequently if there are material market developments.”

All CCPs report that they conduct daily backtesting and the majority submit their models for independent annual validation. Most CCPs also have frameworks in place for regular sensitivity analysis, although this is not always conducted on a monthly basis as expected under KC 6. However, the breadth and depth of model testing and review processes differ markedly across CCPs.

- *Daily backtesting.* Across the sample of CCPs, daily backtesting focuses primarily on the identification of mark-to-market losses on portfolios that exceed the target level of initial margin coverage over the assumed closeout period. Where detailed information on daily backtesting results was provided in CCPs’ survey responses, it has been observed that backtested losses on portfolios over the 12 months ending 30 June 2015 were in line with the target coverages of the

initial margin models. As expected, given the “jump-to-default” characteristics of the relevant products, the four CCPs that clear CDS report that their initial margin models achieve 100% coverage. All CCPs conduct backtesting at the most granular subportfolio level. Most CCPs also consider “near misses”, or use so-called “traffic light” tests to identify losses relative to margin coverage of increasing severity; some also examine model performance on both individual days and across the closeout period. One CCP systematically simulates the default of each participant and verifies the adequacy of resources to meet any losses arising in the closeout process. There is significant variability in the lookback period for backtesting; one to three years is most common, with one CCP using a lookback period with a fixed start date in 2011 and another using a lookback period with a fixed start date in 2002.

- *More detailed backtesting analysis.* Most CCPs supplement the daily analysis using actual portfolios with less frequent but more sophisticated and detailed tests, often also using hypothetical portfolios, extended or stressed lookback periods, and sometimes including backtesting of parameter inputs (see also the discussion of sensitivity analysis, below). Two CCPs, for instance, carry out “crisis replay” exercises designed to examine in detail the performance of the model in periods of heightened market stress. Across the sample, such more detailed tests are carried out at a variety of frequencies: in some cases, monthly; in others, quarterly or every four months; and in at least one case, annually.
- *Sensitivity analysis.* Most CCPs report that they conduct sensitivity analysis on a monthly basis, consistent with expectations in KC 6, though at least one does so quarterly and a couple do so annually. Two CCPs conduct some sensitivity analysis monthly, with some additional tests carried out on a quarterly basis. One CCP does not currently conduct sensitivity analysis but is in the process of developing an approach. The typical approach in sensitivity analysis is to consider the impact on model performance from varying key model parameters – such as closeout periods, lookback periods, confidence intervals, volatility scaling parameters, floors, and in the case of CCPs that clear CDS, jump-to-default assumptions – either individually or in combination. The model parameters considered in sensitivity analysis typically include (depending on the model type) closeout periods, lookback periods, offset parameters, floors, volatility scaling or decay factors. Some CCPs also specifically review model performance in historical or hypothetical stress periods. One CCP conducts reviews of statistical estimation techniques and risk estimation methods as part of its sensitivity analysis. Another CCP also conducts a test of how “conservative” the model is. In this test, the CCP calculates the maximum factor by which losses may be scaled until the number of outliers or breaches exceeds the frequency consistent with the target level of portfolio coverage. In the spirit of a reverse stress test, this CCP also seeks to quantify the impact in terms of required recourse to the default fund.
- *Model validation.* The more comprehensive review of methodologies, processes and the theoretical and analytical properties of CCPs’ margin models is more commonly carried out as part of the annual independent model validation exercise. These validations typically consider the analytical robustness of the model framework modelling processes, data inputs, underlying assumptions, model limitations and biases. In at least one case, the validation process has included a benchmarking exercise against other CCPs’ models or emerging best practice. The majority of CCPs submit their models to validation on an annual basis, though one CCP⁴⁹ currently has its model reviewed by an independent external party once every two years and another does not have a formal independent validation process in place other than via its

⁴⁹ Since the effective date of the exercise, this CCP has increased the frequency of its external reviews of risk processes to annual.

annual external audit. Most CCPs have established an internal model validation team, independent of the team that developed and maintains the model, to conduct the majority of validations, although specific models may be reviewed solely or additionally by external experts.

All CCPs describe arrangements for the results of backtesting, sensitivity analysis and model validation to be reported to relevant decision-makers and governance bodies, often including the board or a board-level committee. An analysis of daily breaches is typically packaged into a periodic – often monthly – report for relevant risk governance committees. This is generally also made available to the CCP’s supervisor and in some cases to participants. Across the CCPs, escalation processes are in place for remedial action to be taken in the event of material backtesting breaches or apparent model shortcomings. Such action may include recalibration of key parameters or an in-depth investigation into a particular aspect of the model. One CCP explicitly notes in its survey response that backtesting and sensitivity analysis outcomes are used to explain changes in margin rates or model parameters.

As is clear from the survey responses summarised above, the depth and sophistication of these testing and review processes vary considerably across the CCPs. Some CCPs perform a very wide range of tests, using both actual and hypothetical portfolios and a range of lookback periods, and have backtesting and sensitivity analysis fully integrated into their model review processes. Those CCPs that conduct more sophisticated and extensive testing may be able to demonstrate more convincingly that margin coverage targets are met.

5.4.3 Other findings relevant to consistency of outcomes

In addition to the key findings detailed above, the IMSG’s findings also include a number of other observations relevant to an assessment of the consistency of outcomes. These include the following.

5.4.3.1 Margin add-ons (Principle 6, KC 3)

The PFMI do not provide explicit guidance on the use of add-ons. The IMSG has, however, reviewed CCPs’ approaches to setting add-ons within the context of the general expectation that the margin system establish “margin levels commensurate with the risks and particular attributes of each product, portfolio and market” served by the CCP (KC 1). Therefore, to the extent that the initial margin system cannot adequately capture all relevant product, portfolio and market factors, the use of add-ons may be important in ensuring that such additional risk concerns are addressed. Add-ons for concentration risk, for instance, may not reasonably be incorporated into the initial margin model, but may nevertheless be important in capturing the challenges that could arise in closing out concentrated exposures in the event of a default. Such add-ons may also be a means of incentivising participants to manage the risks they bring to the CCP.

In considering the use of add-ons, the IMSG has identified a variety of approaches – including in relation to the circumstances in which add-ons are used and the governance and review processes applied to their use. Overall, factors commonly addressed by add-ons include concentration and liquidity, which are difficult to capture in the initial margin model.

In particular, the IMSG has made the following observations:

- Even where CCPs clear similar products or markets, different approaches to add-ons are often observed.
- By far the most common add-ons applied for both exchange-traded and OTC derivatives are add-ons to account for concentration in a participant’s portfolio (as measured, for instance, by the participant’s share of total exposure across participants) or underlying liquidity in the relevant product. Most CCPs apply some form of concentration or liquidity add-ons in respect of OTC derivatives products. The practice is more varied for exchange-traded derivatives, where in some cases these add-ons are either not applied or at least not applied on a routine basis.

- Other categories of add-ons include those for: country risk; wrong-way risk; breach of position or other exposure limits (including limits on stress test exposures); tenor basis risk; jump-to-default risk; recovery rate risk; participant credit risk; and short option risk. Some of these add-ons are applied by relatively few CCPs in the sample. At least two CCPs also apply add-ons for unreliable pricing.
- Where detailed data on add-ons were provided in CCPs' survey responses, in most cases add-ons were found to account for a relatively small proportion of the total margin requirement. For example, among a group of CCPs that clear both exchange-traded derivatives and OTC-IRD add-ons were reported to be around 2 to 3% of the total initial margin requirement on average.
- For some CCPs, however, particularly those that clear OTC derivatives products, add-ons are sometimes a much higher proportion of the total initial margin requirement. This would seem to reflect both the nature of the product and the design of the margin model. In the case of one CCP, for instance, add-ons account for an average of around 35% of the total initial margin requirement for OTC-IRD. Among a subset of the CCPs that clear CDS, add-ons of around 15% of the total initial margin requirement were reported.
- All CCPs report that they have in place governance frameworks to promote integrity, reliability and transparency in the application of margin add-ons, including review and approval processes via the relevant management committee. In most cases, the use of add-ons is transparent to participants via disclosure of rules or policies.
- As noted, the most commonly observed margin add-ons are those that are applied to capture additional risks directly related to the closeout process and the profile of positions that would need to be closed out (eg concentration or liquidity risk). The events that these add-ons aim to address are unlikely to have been observed in the lookback period used in backtesting. It is unsurprising, therefore, that the CCPs generally note that they do not integrate such add-ons into their backtesting analyses.⁵⁰

5.4.3.2 Portfolio margining (Principle 6, KC 5)

Principle 6, KC 5 sets clear expectations around the application of portfolio offsets in a CCP's margin model. That is, offsets may be permitted only "if the risk of one product is significantly and reliably correlated with the risk of the other product". The survey responses indicate that all CCPs have articulated policies on portfolio margining that appear consistent with this high-level standard, although given the nature of the exercise the IMSG has not examined a quantitative evidence base on the significance and reliability of correlations.

- Where CCPs use VaR-based models, portfolio offsets are inherent in the margin calculation. That is, all positions included in the VaR analysis are treated as a single portfolio, so that historically observed price correlations between the relevant positions (eg OTC-IRD of different tenors) are captured in the margin calculation.
- In SPAN-based models for exchange-traded derivatives, portfolio effects are recognised by the CCP via explicit adjustment parameters. The most relevant parameters are the "intra-commodity spread charge" and the "inter-commodity spread concession". These adjustments capture, respectively, the association between different maturities of the same contract, and that between different but highly correlated contracts. These parameters are typically calibrated based on data over the same historical lookback period as the price and volatility scanning

⁵⁰ For example, it would not be meaningful to include margin that was designed to cover concentration risk in a backtest that did not include a period in which a large share of positions in the relevant market were closed out.

ranges. Some CCPs set a cap on the extent to which correlation between different contracts is recognised. Where applied, such a cap is commonly set at 80%, consistent with jurisdiction-specific regulatory limits on portfolio margining in the European Union.

- In some cases, portfolio offsets between OTC-IRD and interest rate futures are also recognised. Futures positions subject to offset are margined together with OTC-IRD positions and margined as a single portfolio on a VaR basis.

Consistent with PFMI explanatory note 3.6.12, CCPs' policies commonly seek to establish an underpinning economic justification for an association between products subject to portfolio margining (eg an interest rate swap and an interest rate future that reference the same underlying term structure; or futures contracts that reference two grades of oil) and aim to validate that the observed correlation will continue to hold in periods of stress.

In articulating their policies, some CCPs go further still to require explicitly that "positions that are margined together should default together" or equivalently allow portfolio margining only in defined "liquidation groups"; that is, even if highly and reliably correlated, positions should only be margined as a portfolio if in the event of a default they would be closed out as a portfolio. Adherence to such a policy is consistent with the intent of KC 5 and could improve resilience.

Finally, among the CCPs in the review, only one currently has cross-margining arrangements in place with other CCPs. These arrangements are in respect of futures and options on equity indices, and between certain interest rate futures and fixed income securities. Since this is not a widely observed practice among the CCPs, the IMSG has not examined closely the arrangements in place. At a high level, the reviewed CCP conducts due diligence on the risk management framework of the relevant cross-margining CCPs, and monitors closely the offsets generated by the cross-margining arrangement. These offsets are subject to backtesting.

5.4.3.3 *Timing and frequency of margin calls (Principle 6, KC 4)*

Consistent with Principle 6, KC 4, all CCPs "collect variation margin at least daily" and report that they "have the authority and operational capacity to make intraday margin calls and payments". In respect of intraday margining frameworks, the PFMI provide relatively high-level guidance. As might be expected, therefore, the approaches observed differ across CCPs, particularly in terms of: the degree of formalisation in arrangements for recalculating and calling for margin intraday; the frequency of intraday recalculations and calls; triggers for a margin call; and the extent to which prefunding is required for new trades. Practices also differ across products, in part reflecting the frequency of pricing updates, which tend to be lower for some OTC derivatives products. The IMSG has made a number of observations.

- *Exchange-traded derivatives.* In some cases, margin requirements are recalculated frequently or near-continuously intraday or at scheduled intervals during the day, which range from once to every hour. Calls may then be made "as needed", often with reference to a specified degree of erosion of margin cover that takes into account not only intraday changes in prices, but also intraday changes in positions; calls therefore include both variation margin and initial margin obligations. Generally, CCPs' intraday margin calls are only "one way"; that is, the CCP collects initial and variation margin from participants, but does not pay out intraday.

Some CCPs also note that calls are only made when the size of the call exceeded a given value threshold, with one CCP linking the value threshold to the creditworthiness of the participant (as reflected in an internal credit rating). As an example of the differences in practices, one CCP recalculates participant exposures near real time with every price change or when a new position is established. A margin call is made following a recalculation if one of the following events takes place: a shortfall in coverage of greater than 10% of the margin requirement at the end of the last business day; or the shortfall exceeds a fixed "minimum transfer amount". Another CCP, makes a scheduled intraday call at 1:30 pm each day and additionally recalculates

portfolio exposures hourly (for equity and index derivatives), making calls as required. Another CCP monitors intra-day exposures near-real-time, and makes a scheduled mid-day call for, and payment of, variation margin. Another CCP calculates intraday margins on an ad-hoc (as well as on a scheduled) basis.

- *OTC-IRD*. Some CCPs have a similar approach to intraday margining for OTC-IRD as for exchange-traded derivatives. Others, by contrast, have a distinct process. One CCP, for instance, recalculates margin requirements for OTC-IRD more frequently intraday and applies a smaller erosion threshold before a call is made. Another CCP has no routine scheduled process for intraday margin calls in the case of exchange-traded derivatives but nevertheless makes routine intraday margin calls twice a day for OTC-IRD.
- *OTC credit derivatives*. Three of the four CCPs that clear CDS do not make routine intraday calls. However, all report that they have the operational capacity and authority to do so and can run ad hoc recalculation cycles if necessary. Further, in the case of one CCP, participants are required to fund any margin shortfall that exceeds a specified limit before it will accept new trades. The fourth CCP recalculates exposure each time a new trade is novated in addition to three scheduled intraday margin calls each day.

While the principles-based approach of the PFMI allows for such variability in approaches, CCPs that monitor closely intraday changes in prices and positions and have a clear and transparent framework for responding to margin erosion may be expected to achieve more resilient outcomes.

5.4.4 Other observations

Finally, the IMSG has made some additional observations on differences in CCPs' implementation outcomes. While these differences may not give rise to material differences in resilience, they may nevertheless be noteworthy.

5.4.4.1 Price information (Principle 6, KC 2)

The PFMI state "A CCP should have a reliable source of timely price data for its margin system". The primary sources of prices for CCPs that clear exchange-traded derivatives are the venues on which the relevant products are traded. These sources are, consistent with explanatory note 3.6.4, typically regarded as "continuous, transparent and liquid".

Some CCPs provide details of the arrangements they have in place to review and validate the quality of venue-sourced prices – for instance, checks for "stale" or outlier prices. And most CCPs describe arrangements to supplement pricing data from market venues with data from other sources when venue prices are "not readily available or reliable". These typically include third-party vendor prices, model-based prices, or, exceptionally, dealer quotes or member polls.

For OTC-IRD, most CCPs source data from a third-party vendor, in some cases supplemented with price quotes sourced from dealer polls or participant submissions. Model-based prices may also be applied, for instance to construct the full yield curve from a selection of price points. Typically, CCPs use a variety of sources to cross-check the accuracy of the data. Consistent with explanatory note 3.6.4, one CCP notes that, where model prices are used, it applies a larger haircut to take into account model risk. Another notes that model uncertainty would be accounted for adequately in calibrating the liquidity add-on for such a product, while two others note more generally that unreliable pricing would attract a margin add-on (see Section 5.4.3.1 above).

All CCPs that clear OTC CDS report that they determine daily CDS settlement prices via clearing participant submissions or dealer quotes. One common practice among CCPs that rely on participant submissions is to impose a penalty on clearing participants that submit outlier prices. One CCP specifies that prices submitted by participants must be executable prices.

Across products, where the relevant price sources are considered unreliable, some CCPs may revert to the previous day's settlement price.

Explanatory note 3.6.4 states "a CCP should have its valuation models validated under a variety of market scenarios at least annually by a qualified and independent party to ensure that its model accurately produces appropriate prices". All CCPs report that they have arrangements in place for such validation. In some cases, these are carried out by an independent internal team; in others, models are validated by an external expert. In some cases, the review and validation of pricing sources and models are carried out as part of the more comprehensive annual validation of the relevant margin model (see also Section 5.4.2.4, above).

5.4.4.2 Target coverage (Principle 6, KC 3)

KC 3 clearly states that "initial margin should meet an established single-tailed confidence interval of at least 99% with respect to the estimated distribution of future exposure". The stated coverage targets for each of the CCPs in the sample, across products, are – consistent with this standard – at least 99% (see Table 9).

There is, however, a marked difference in coverage targets between products, with five of the eight CCPs in the sample that clear exchange-traded derivatives targeting 99% coverage, and four of the eight CCPs that clear OTC interest rate (or foreign exchange) derivatives targeting at least 99.5%. This may in part reflect jurisdiction-specific regulatory requirements in the European Union, which set a higher minimum margin coverage target for OTC derivatives. These requirements have in some cases also been adopted by CCPs that provide services to EU-headquartered participants. However, it may also reflect market-specific arrangements in place prior to implementation of the PFMI, or the preferences of participants in the OTC derivatives market. In particular, given the participation structure of OTC derivatives markets, these participants may favour a balance in favour of "defaulter-pays" protection vis-à-vis mutualisation.

One CCP aims to cover stressed market conditions predominantly via margin rather than mutualised financial resources. One implication of a greater emphasis on margin relative to mutualised resources is that this CCP maintains a correspondingly smaller default fund; there is accordingly a smaller prefunded mutualised "buffer" should the calculated margin for a defaulted participant prove insufficient in a particular set of circumstances. Nevertheless, according to reported backtesting outcomes, margin coverage of 99.96% was achieved in the 12 months to 30 June 2015.

Finally, there is a link to the earlier discussion of model choice. Given the structure of SPAN models, it is not possible to reliably target a particular confidence interval for the relevant distribution. Instead, CCPs target confidence intervals for the key parameter inputs – eg the price and volatility scanning ranges – and then confirm coverage outcomes using backtesting.⁵¹ This gives backtesting an even more prominent role in the modelling process (see Section 5.4.2.4, above). Coverage targets can, by contrast, be applied more directly in VaR-based models.

5.4.4.3 Account structures (Principle 6, KC 3)

Under Principle 6, KC 3, margin requirements should be set with reference to the distribution of future exposure at the relevant portfolio or subportfolio level. Where, in accordance with Principle 14, a CCP segregates participant and customer positions and collateral, the relevant portfolio will reflect that segregation. In some cases, customer positions and collateral are held in an omnibus account; in others, customer positions and collateral are individually segregated (in some cases, through a "legally segregated, operationally commingled" arrangement).

⁵¹ For instance, at least one CCP applies a confidence interval of 99.7% in setting its price scanning range, which is higher than its overall coverage target of 99%.

All CCPs that permit customer clearing report that they calculate margin requirements separately for segregated participant and customer portfolios – and at the individual customer portfolio level where relevant, consistent with the standards under KC 3. Where customer positions and collateral are held in an omnibus account, however, there is some variation in the extent to which, in setting margin requirements, positions are netted across individual customers. Some CCPs set margin requirements in omnibus accounts on a gross basis, with no netting across individual customers. This provides a “cushion” in the omnibus customer account, since in a default scenario any positions that could not be ported would be expected to be closed out on a net basis. Some other CCPs have both gross and net omnibus customer account options, while others offer only net omnibus accounts.

5.4.4.4 *Discretion (Principle 6, KC 3)*

Most CCPs in the sample allow for the exercise of some discretion in setting margin requirements. One CCP emphasised that discretion is allowed only in the direction of increasing margin requirements. The PFMI do not provide explicit guidance on either the circumstances in which discretion should be applied or the bounds within which it should be exercised.

Among the CCPs, discretion to deviate from the model-generated margin requirement is typically exercised in one or more of the following circumstances: to supplement historical inputs with forward-looking analysis, including potential “event risk”; to deal with new products; to take account of seasonal factors not adequately captured by the modelling methodology; or to deal with insufficient or unreliable historical data. Another discretionary adjustment to model-based margin requirements observed for some CCPs is the application of margin add-ons (see Section 5.4.3.1, above).

Across the CCPs, where discretion is exercised, it is subject to a formal governance process. In their responses, several CCPs explicitly note that discretionary adjustments to material model parameters or application of discretionary add-ons must be approved by a margin review committee or similar body.

5.4.4.5 *Wrong-way risk (Principle 6, KC 3)*

PFMI explanatory note 3.6.9 provides some guidance on dealing with wrong-way risk, noting that “a CCP should identify and mitigate any credit exposure that may give rise to specific wrong-way risk”, defining this as the risk that arises where “exposure to a counterparty is highly likely to increase when the creditworthiness of that counterparty is deteriorating”.

CCPs identified a number of potential sources of wrong-way risk, the most common being correlation between the default of a participant and the value of collateral that it has posted – perhaps due to a direct affiliation with the collateral issuer or a geographical association. Another common source of wrong-way risk identified – particularly by the CCPs that clear CDS – is correlation between the default of a participant and the value of the positions in its portfolio with the CCP. This could include “self-referencing” positions, or other portfolio positions that may be highly correlated with the participant’s own creditworthiness.

Specific measures to mitigate wrong-way risk are therefore most commonly applied by CCPs that clear CDS. All four CCPs that clear CDS report that they have frameworks in place to identify self-referencing positions and other positions that may be highly correlated with the participant’s own creditworthiness. These may include, for instance, correlated positions referenced to the country of domicile of the participant. However, the particular frameworks in place differ. One CCP has a framework in which self-referencing positions that exceed a given threshold must be fully collateralised. Two of the four CCPs that clear CDS have a special tranche of the default fund to mutualise risks associated with self-referencing positions. And one CCP assesses “contagion” risk based on an analysis of default and near-default of financial entities over the past 10 years.

Some CCPs report having a specific wrong-way risk framework for exchange-traded derivatives. At least two CCPs consider the potential implications for their exchange-traded financial derivatives of a drop in the share price of the participant. Otherwise, the typical mitigant to wrong-way risk is the CCP's collateral eligibility criteria. That is, participants are not permitted to post as collateral securities issued by themselves or by affiliated entities.

5.5 Collateral policy and investments

This section considers the reviewed CCPs' implementation outcomes in respect of the following collateral-related standards in Principle 5 of the PFMI, which states that "An FMI that requires collateral to manage its or its participants' credit exposure should accept collateral with low credit, liquidity, and market risks. An FMI should also set and enforce appropriately conservative haircuts and concentration limits".

The KCs that have been considered under Principle 5 are:

1. *An FMI should generally limit the assets it (routinely) accepts as collateral to those with low credit, liquidity, and market risks.*
2. *A CCP should establish prudent valuation practices and develop haircuts that are regularly tested and take into account stressed market conditions.*
3. *In order to reduce the need for procyclical adjustments, a CCP should establish stable and conservative haircuts that are calibrated to include periods of stressed market conditions, to the extent practicable and prudent.*
4. *A CCP should avoid concentrated holdings of certain assets where this would significantly impair the ability to liquidate such assets quickly without significant adverse price effects.*
5. *A CCP that accepts cross-border collateral should mitigate the risks associated with its use and ensure that the collateral can be used in a timely manner.*

In addition, Principle 16 of the PFMI sets out further standards for FMIs' investments. This Principle states: "An FMI should safeguard its own and its participants' assets and minimise the risk of loss on and delay in access to these assets. An FMI's investments should be in instruments with minimal credit, market, and liquidity risks". The IMSG's review has considered the following KC:

4. *An FMI's investment strategy should be consistent with its overall risk-management strategy and fully disclosed to its participants, and investments should be secured by, or be claims on, high-quality obligors. These investments should allow for quick liquidation with little, if any, adverse price effect.*

5.5.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, the CCPs considered in this review have made important and meaningful progress towards implementing standards in the PFMI relevant to collateral policy and investments. All CCPs report that they have adopted collateral policies that seek to ensure that the collateral accepted displays low credit, liquidity and market risks, in order to allow prompt liquidation in stressed market conditions with little adverse effect on prices. However, there is some variation in the range of specific assets considered as eligible. Differences are also observed in the degree of discretion CCPs may exercise in situations where they determine prices do not reflect the true value of the collateral, or in the parameters they consider in performing alternative valuations.

All CCPs aim to set sufficiently conservative haircut levels so as to reduce the need for procyclical adjustments, although they appear to apply different approaches in adjusting collateral

haircuts (ie automatic changes versus discretionary changes). Most CCPs report that they have established arrangements – such as concentration limits – to support effective liquidation of collateral, including cross-border collateral.

Finally, all CCPs state that they place a higher priority on minimising credit and liquidity risks over maximising investment returns. However, the CCPs adopt a variety of approaches to the investment of cash collateral.

In considering consistency of outcomes with standards in the PFMI and across CCPs, the following high-level observations are made:

- *Principle 5, KC 1.* All CCPs report that they have established a collateral policy consistent with their respective risk appetite and have defined assets eligible as collateral by taking into account the credit, liquidity and market risk of the assets. CCPs generally have a strong preference for accepting cash collateral denominated in the currency issued by the central banks to which they have access. However, all accept both cash and non-cash assets. While some CCPs may accept assets that are otherwise ineligible on an exceptional basis, such acceptance is subject to an ad hoc assessment and the approval of the risk committee; in practice, the CCPs report that they have not made use of this flexibility. At least one CCP accepts letters of credit as part of its list of eligible collateral, although this is subject to a number of restrictions.⁵² All CCPs have wrong-way risk management frameworks in place, which either prevent clearing participants from posting self-issued securities (or securities issued by a related entity) as collateral or require higher haircuts. Since the eligibility of particular assets to be posted as collateral depends on market conditions, CCPs have arrangements that allow clearing participants to replace the collateral they have provided in the event it no longer meets eligibility requirements. Most CCPs have flexibility to exercise some discretion in determining the timing of such replacements.
- *Principle 5, KC 2.* All CCPs report that they mark their collateral to market at least daily. Most CCPs report that they have established valuation practices that seek to identify whether the market prices of assets represent their “true value”. Valuation practices vary across CCPs, in particular in the parameters that are used to estimate whether asset valuations appropriately reflect fundamentals. There is also some variation in the degree of discretion afforded to CCPs in valuing assets accepted as collateral (for example, some CCPs have the discretion to assign a zero value to illiquid collateral; others have alternative pricing methods for revaluing assets). Some CCPs do not have transparent and predefined policies for performing alternative valuations; all of these CCPs state that they can exercise discretion, but the degree of discretion appears to vary across CCPs.
- *Principle 5, KC 3.* All CCPs report that they aim to set conservative haircuts, which contribute to mitigating potential procyclical adjustments under stressed market conditions. Some CCPs also set a floor for collateral haircut levels as an additional tool to mitigate procyclicality. VaR is the most widely used methodology for calibrating haircuts. Although the choice of parameters varies across CCPs, all CCPs report that they use at least a 99% confidence interval and a three-day holding period. There is also variation across the sample of CCPs in the frequency at which the sufficiency of haircuts is assessed, as well as the processes for adjusting collateral haircuts over time (eg automatic changes based on stress testing results, discretionary changes, risk

⁵² The guidance on the use of bank guarantees as collateral is described under Principle 5 footnote 63 of the PFMI, “In general, guarantees are not acceptable collateral. However, in rare circumstances and subject to regulatory approval, a guarantee fully backed by collateral that is realisable on a same-day basis may serve as acceptable collateral. An explicit guarantee from the relevant central bank of issue would constitute acceptable collateral providing it is supported by the legal framework applicable to and the policies of the central bank”.

committee decision). Some CCPs phase in changes to haircuts over time to limit procyclicality. However, as in the case of CCPs' margin frameworks (see Section 5.4 on margin practices), there was little evidence as at the effective date of this exercise that CCPs had developed either fully articulated frameworks to address procyclicality or metrics to be used in systematically monitoring procyclicality.

- *Principle 5, KC 4.* Most CCPs state that they apply concentration limits to their collateral holdings, with a view to minimising credit, liquidity and market risks. These limits are set with reference to multiple factors, such as asset type, issuer and issue. A small number of CCPs have not established such concentration limits, as in practice non-cash collateral makes up a small proportion of the total collateral they receive.
- *Principle 5, KC 5.* All CCPs report that they have arrangements to control legal, operational and market risks when accepting cross-border collateral. These arrangements seek to ensure that such collateral can be used in a timely manner.
- *Principle 16, KC 4.* CCPs adopt a variety of approaches to the investment of cash collateral.⁵³ All CCPs state that they prioritise the minimisation of credit and liquidity risk over investment returns. The CCPs invest cash collateral in different combinations of central bank deposits, commercial bank deposits, government bonds, reverse repurchase agreements, and other short-term instruments. These different approaches could involve different degrees of credit, market and liquidity risks.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of observed differences across CCPs.

5.5.2 Key findings

The key findings relevant to CCPs' implementation outcomes in the area of collateral and investments are described below. These relate primarily to the consistency of outcomes of implementation across CCPs.

5.5.2.1 Investment strategy (Principle 16, KC 4)

All CCPs invest cash collateral in securities, other instruments, or in deposits at commercial or central banks (hereinafter, "cash collateral investment"; see footnote 53), and note that they conduct regular monitoring of their investments. All CCPs state that they have established cash collateral investment policies that prioritise the minimisation of credit and liquidity risk over investment returns. The CCPs' cash collateral investment portfolios are summarised in Table 10.

Key characteristics of the CCPs' collateral investment strategies include:

- *Composition of cash collateral investments.* Various approaches are taken to ensure the "quick liquidation of investments with little, if any, adverse price effect", as expected under KC 4.
 - Most of the CCPs invest most of their cash collateral in reverse repurchase agreements, secured deposits, government bonds and other, often short-term, high-quality fixed income securities.
 - Two CCPs deposit a significant proportion of cash collateral at the central bank in their home jurisdictions; indeed, one of these CCPs currently deposits more than 90% of its

⁵³ For the purposes of this report, "cash collateral investment" includes investment in securities and other instruments as well as deposits at commercial and central banks. Whether or not a deposit is considered an "investment" would depend on the applicable legal framework.

invested cash with its central bank of issue of the currency, which is also the central bank of its home jurisdiction.

- Some CCPs deposit between a third and 100% of their invested cash collateral in unsecured accounts with commercial banks. For some, this is the primary choice of cash collateral investment.
- *Considerations in cash collateral investment.* When implementing their investment strategies, CCPs consider a range of factors, including: the creditworthiness of their counterparties; the maturity of investments; the type of security; and the transaction type. Some CCPs report that the profile of investments, including investment types and counterparties/obligors, is subject to home regulatory requirements.
- *Concentration and exposure limits.* Most CCPs apply concentration limits and other investment limits (for example, maturity limits) to mitigate liquidity, credit and market risk arising from their investments. Most CCPs aim to control their overall exposure to individual investment counterparties/obligors by setting concentration limits, taking into account their creditworthiness. Most CCPs take into account whether an obligor is also a clearing participant or its affiliate (to avoid creating additional exposures, such as wrong-way risk). CCPs' concentration or investment counterparty/obligor exposure limits are set in various ways: some set the exposure limit against capital; one CCP sets a limit against its overall investment portfolio; while two other CCPs apply a combination of the two approaches.
- *Capital against investment losses.* CCPs generally reserve part of their capital to withstand losses associated with their cash collateral investments. There is some variation in how to determine the amount of such capital: some CCPs secure capital in accordance with home jurisdiction regulatory requirements, whereas others define an absolute amount of capital they should hold. In some cases, the capital allocated to investment losses is linked to the CCP's rules on allocation of investment losses to clearing participants (see Section 5.6 on default management and recovery planning).
- *Disclosure.* At the effective date of the review, most CCPs disclosed some information on their investment strategies to their clearing participants. Since the effective date, such information is now routinely provided in the context of CCPs' disclosures in accordance with CPMI-IOSCO public quantitative disclosure standards.⁵⁴ Some CCPs publicly disclose, typically on their websites, key information regarding their investment strategies. All CCPs that allocate investment losses to clearing participants disclose some amount of information to enable clearing participants to calculate the size and likelihood of incurring investment losses, though with some variation in the level of detail (see Section 5.6 on default management and recovery planning).

It is clear from the foregoing that the CCPs adopt a variety of different approaches in their investment of cash collateral. These different approaches could involve different degrees of credit, market and liquidity risks.

⁵⁴ CPMI-IOSCO, *Public quantitative disclosures for central counterparties*, February 2015, www.bis.org/cpmi/publ/d125.pdf.

Composition of cash collateral invested⁵⁵

Table 10

CCP	Cash deposits at central banks of issue of the currency deposited	Cash deposits at commercial banks (Secured, including reverse repo)	Cash deposits at commercial banks (Unsecured)	Domestic sovereign government bonds	Others
CCP 1					
CCP 2	0.0%	-	34.3%	-	65.7%
CCP 3	91.2%	8.5%	0.0%	-	
CCP 4	52.3%	14.4%	-	25.3%	8.1%
CCP 5	-	84.6%	0.4%	-	15.0%
CCP 6	N/A	N/A	N/A	N/A	N/A
CCP 7	-	-	100%		
CCP 8	-	3.5%	61.8%	29.2%	5.5%
CCP 9	4.6%	-	66.7%	28.8%	-
CCP 10	4.7%	71.1%	0.4%	2.0%	21.8%

Source: Quantitative Disclosures, as of Q3 2015 and Q2 2015 for one CCP.

* Pre-haircut basis.

** For those CCPs that disclose data by service line, percentages are calculated using the sum of cash collateral invested across all service lines considered in this exercise (see Table 2). Some CCPs do not disclose the data by service line, and at least one CCP clears both cash and derivatives in the same service line). Therefore, the above figure may include data on collateral for cash products.

*** "Others" includes cash in money market funds, cash in other forms, agency bonds, state/municipal bonds, other instruments.

5.5.2.2 *Setting haircuts and reducing the need for procyclical adjustments* (Principle 5, KC 2 and KC 3)

All CCPs state that their haircuts are set in a prudent manner, using conservative lookback periods that incorporate stressed market conditions (the sufficiency of collateral haircuts is also discussed in Section 5.2 on credit risk management). There is a degree of variation in the parameters used by CCPs to calibrate haircuts.

Key observations include:

- The VaR methodology is the most widely used; one CCP uses the more conservative of VaR and expected shortfall, while another CCP uses the haircuts applied by its domestic central bank as a floor. Those that report specific parameters use at least a 99% confidence interval (some use 99.9%) and most assume a three-day holding period.
- The length of historical lookback periods used to determine haircuts varies quite substantially across CCPs, ranging from one year to 20 years.

⁵⁵ The figures in the rows may not sum to exactly 100% due to rounding.

- CCPs apply different haircut methodologies depending on type of asset (eg bonds, equities, other). In this respect, it should be noted that, where accepted, most CCPs use fixed haircuts for all equities (for example, 30%), calculated with reference to observed price moves over a specified lookback period. Some CCPs also note that they apply haircuts to account for any mismatch between the currency of assets posted as collateral and the currency of exposure.

Overall, CCPs' responses do not suggest a significant degree of involvement of clearing participants in setting haircuts. In at least two cases, certain clearing participants have a role in setting haircuts due to the involvement of the CCPs' participant risk committees in reviewing haircut methodologies. Some CCPs apply predefined and transparent methodologies that leave little room for clearing participant involvement. There is also a degree of variation across CCPs regarding the frequency at which the sufficiency of haircuts is assessed, with some assessing sufficiency daily or monthly and others assessing sufficiency quarterly or annually. Another CCP engages with an independent agent in an annual liquidation exercise to test the appropriateness of its haircuts.

In addition to the observation that a number of CCPs apply lookback periods that incorporate stressed market conditions, two CCPs set floors on their collateral haircut levels as a further mitigant against procyclicality. Two other CCPs explicitly analyse haircut changes for procyclical effects.

The CCPs also apply different approaches to adjusting collateral haircuts, which could have different implications on procyclicality. While two CCPs apply automatic haircut changes in response to market shifts according to predefined methodologies, at least one uses phase-in approaches to change haircuts gradually. There may be trade-offs between the predictability of a non-discretionary approach and the potential flexibility benefits of a discretionary approach.

These findings are similar to those concerning the procyclicality of margin practices. That is, while CCPs seek to limit procyclicality via stable and prudent haircuts, there was no evidence as of the effective date of this exercise that CCPs had developed fully articulated frameworks to address procyclicality, or metrics to be used in systematically monitoring procyclicality.

5.5.3 Other findings relevant to consistency of outcomes

In addition to the key findings detailed above, the IMSG's findings also include a number of other observations relevant to an assessment of the consistency of outcomes. These include the following.

5.5.3.1 Valuation methods (Principle 5, KC 2)

All CCPs report that they mark their collateral to market at least daily. At least two CCPs have the ability to mark collateral intraday; another has implemented intraday marking to market since the effective date of the exercise. One CCP has the option of marking to model when reliable data are not available.

Most CCPs have processes to monitor whether market prices represent the true value of an asset (as suggested in explanatory note 3.5.5). These CCPs cite a range of indicators in this regard, such as frequency of trading, frequency of price changes, significant percentage price changes and the price of the product relative to those of comparable products. One CCP sets a specific price movement threshold, which would trigger further inquiry if breached. Another CCP does not report any specific criteria for monitoring the validity of collateral prices, while yet another does not believe such monitoring is necessary due to the highly liquid nature of collateral accepted. This CCP would review the need for such monitoring should the criteria for acceptable collateral change. Variation in the approaches employed by CCPs to monitor asset valuation might be partly explained by the types of assets they accept as collateral, which display varying risk characteristics (see Section 5.5.4.1).

In describing potential implementation measures for Principle 5, explanatory note 3.5.5 states that "an FMI should have the authority to exercise discretion in valuing assets according to predefined and transparent methods". All CCPs provide for some discretion in valuing the assets they accept as

collateral. Some CCPs have established processes for exercising such discretion: two CCPs may assign a zero value to collateral assets that display a “stale price” or a price that no longer reflects fair market value; while other CCPs revalue collateral based on alternative methods (such as theoretical prices, prices from alternative pricing sources, or prices established drawing on market expertise). By contrast, some CCPs do not appear to have specific policies and procedures regarding the discretionary valuation of collateral. For these CCPs, alternative valuation methods are more ad hoc, which may be challenging in stressed market conditions.

5.5.4 Other observations

Finally, the IMSG has made some additional observations on differences in CCPs’ implementation outcomes. While these differences may not give rise to material differences in resilience, they may nevertheless be noteworthy.

5.5.4.1 Assets accepted (Principle 5, KC 1)

CCPs report that they tailor their collateral policies to fit their risk appetite, and state that they “restrict the assets (routinely) accepted as collateral to those with low credit, liquidity and market risks”.

While all CCPs accept cash and sovereign bonds with some accepting equities, some CCPs accept less widely used types of collateral (for example, at least one CCP accepts letters of credit, though with some limitations). While some CCPs may accept assets that are otherwise ineligible on an exceptional basis, such acceptance is subject to an ad hoc assessment and the approval of the executive risk committee. In practice, these CCPs have not made use of this flexibility.

Some CCPs receive predominantly cash collateral from their clearing participants (as at 30 September 2015, some CCPs had received more than half of their collateral in cash for at least one clearing service; see Table 11). In the case of cash collateral, CCPs have a strong preference for accepting currencies issued by a central bank to which they have access, but may accept other currencies as well, as long as foreign exchange risks and counterparty risk are adequately mitigated in line with their risk policies. For most CCPs, sovereign government bonds comprise the majority of non-cash collateral posted by participants. However, for a small number of CCPs, other forms of collateral (eg corporate or agency bonds, equities) collectively comprise the majority of non-cash collateral.

All CCPs report that they monitor the eligibility of collateral, and have established procedures for clearing participants to replace assets that are no longer eligible as collateral (and hence are assigned a zero value). All CCPs allow for some flexibility in their rules regarding the time frame in which members must replace collateral that is no longer eligible. Such procedures and associated flexibility limit the potential procyclical implications of changes to collateral eligibility. In particular, these procedures aim to balance the need for the CCP to cover fully its credit exposures to each clearing participant using high-quality collateral while also seeking, to the extent possible, to allow clearing participants sufficient time to replace ineligible collateral.

All CCPs have established wrong-way risk management frameworks. In some cases, these frameworks prevent clearing participants from posting securities they have issued themselves (or which have been issued by a related entity). Wrong-way risk is also minimised through each CCPs’ choice of eligible collateral (for example, by accepting only cash and sovereign bonds. One CCP also prohibits clearing participants from posting collateral issued by the CCP’s critical service providers.

Composition of posted collateral⁵⁶

Table 11

CCP	Cash	Domestic sovereign government bonds	Foreign sovereign government bonds	Other securities
CCP 1	41.3%	13.0%	44.3%	1.5%
CCP 2	40.8%	5.9%	26.2%	27.1%
CCP 3	76.9%	23.1%	0.0%	0.0%
CCP 4	2.1%	97.3%	0.6%	0.0%
CCP 5	0.7%	86.0%	1.35	12.0%
CCP 6	87.2%	0.2%	12.5%	0.0%
CCP 7	68.1%	8.2%	16.5%	7.2%
CCP 8	35.8%	48.1%	3.2%	13.0%
CCP 9	47.7%	28.0%	0.0%	24.3%
CCP 10	87.1%	6.8%	0.0%	6.1%

Source: Quantitative Disclosure, as of Q4 2015. Figures for one CCP are based on the survey response.

* Pre-haircut basis.

** For those CCPs that disclose data by service line, percentages are calculated using the sum of cash collateral invested across across all service lines considered in this exercise (see Table 2). Some CCPs do not disclose the data by service line, and at least one CCP clears both cash and derivatives in the same service line). Therefore, the above figure may include data on collateral for cash products.

*** One CCP's data relate to domestic currency collateral only.

5.5.4.2 Concentration limits (Principle 5, KC 4)

Most CCPs have policies for addressing risks linked to concentrated collateral holdings: these policies establish concentration limits generally based on asset type, issuer or issue.

Most CCPs consider credit, liquidity and market risks when determining these policies. Two CCPs⁵⁷ refer only to liquidity risk. Other factors mentioned by CCPs as relevant when setting concentration limits include internal credit scores, bid-ask spreads, yield spreads, price volatility, maturities and notional outstanding at the ISIN level. At least one CCP obtains further information from its liquidation agent.

Three CCPs have country limits for concentrated holdings, in addition to other concentration limits. Another CCP has concentration limits only for equities. All other limits reported by CCPs are specified as a percentage of either margins or outstanding issues.

⁵⁶ The figures in the rows may not sum to exactly 100% due to rounding.

⁵⁷ One of these CCPs accepts only cash and Government securities as collateral.

All but one CCP have separate units responsible for reviewing and evaluating concentration risks at least annually.

Among those CCPs that do not have fixed concentration limits, one has a currency-specific cash liquidity threshold and considers setting concentration limits (based on market structure and liquidity) whenever a new collateral type is added as acceptable. Two CCPs do not have fixed concentration limits for non-cash collateral holdings. One of these CCPs cites the small portion of non-cash collateral in total collateral received. The other receives predominantly domestic sovereign government bonds as collateral.

5.5.4.3 Cross-border collateral (Principle 5, KC 5)

According to PFMI footnote 68, cross-border collateral has at least one of the following foreign attributes: (a) the currency of denomination, (b) the jurisdiction in which the assets are located, or (c) the jurisdiction in which the issuer is established. All CCPs accept some form of cross-border collateral on this definition.

All CCPs report that they have systems in place to use collateral in a timely manner, such as by using foreign exchange swaps to facilitate the timely use of cross-border collateral. They do so either by limiting accepted cross-border collateral types in advance, or by establishing other types of arrangements that allow them to use cross-border collateral in a timely manner.

All CCPs report that they take into account the feasibility to liquidate cross-border collateral promptly. Liquidity, market and credit risks were cited by some CCPs as the main considerations in determining whether to accept cross-border collateral. One CCP explicitly cites the timely liquidation of such assets and the realisation of the value of collateral during both normal and volatile market conditions as the principal risks arising from acceptance of cross-border collateral. Two other CCPs emphasise the importance of monitoring or preventing wrong-way risk in a clearing participant's collateral pool, where for instance correlated country/currency risk would impair the value of the collateral in the event of the relevant clearing participant's default.

5.6 Default management and recovery planning

This section considers the CCPs' implementation outcomes in respect of certain default management-related standards in Principle 13 and recovery planning-related standards in Principles 3, 4, 7, and 15 of the PFMI.

The relevant standards for Principles 3, 4, 7, 13 and 15 are set out below. This report also considers implementation outcomes in the context of the Recovery Report, as described below.

The default management-related KCs that have been considered under Principle 13 are:

1. *An FMI should have default rules and procedures that enable the FMI to continue to meet its obligations in the event of a participant default and that address the replenishment of resources following a default.*
4. *An FMI should involve its participants and other stakeholders in the testing and review of the FMI's default procedures, including any close-out procedures. Such testing and review should be conducted at least annually or following material changes to the rules and procedures to ensure that they are practical and effective.*

The recovery-related KCs that have been considered under Principles 3, 4, 7 and 15 are:

- 3(4). *An FMI should identify scenarios that may potentially prevent it from being able to provide its critical operations and services as a going concern and assess the effectiveness of a full range of options for recovery or orderly wind-down. An FMI should prepare appropriate plans for its*

recovery or orderly wind-down based on the results of that assessment. Where applicable, an FMI should also provide relevant authorities with the information needed for purposes of resolution planning.

- 4(7). *An FMI should establish explicit rules and procedures that address fully any credit losses it may face as a result of any individual or combined default among its participants with respect to any of their obligations to the FMI. These rules and procedures should address how potentially uncovered credit losses would be allocated, including the repayment of any funds an FMI may borrow from liquidity providers. These rules and procedures should also indicate the FMI's process to replenish any financial resources that the FMI may employ during a stress event, so that the FMI can continue to operate in a safe and sound manner.*
- 7(10). *An FMI should establish explicit rules and procedures that enable the FMI to effect same-day and, where appropriate, intraday and multiday settlement of payment obligations on time following any individual or combined default among its participants. These rules and procedures should address unforeseen and potentially uncovered liquidity shortfalls and should aim to avoid unwinding, revoking, or delaying the same-day settlement of payment obligations. These rules and procedures should also indicate the FMI's process to replenish any liquidity resources it may employ during a stress event, so that it can continue to operate in a safe and sound manner.*
- 15(3). *An FMI should maintain a viable recovery or orderly wind-down plan and should hold sufficient liquid net assets funded by equity to implement this plan. At a minimum, an FMI should hold liquid net assets funded by equity equal to at least six months of current operating expenses. These assets are in addition to resources held to cover participant defaults or other risks covered under the financial resources principles. However, equity held under international risk-based capital standards can be included where relevant and appropriate to avoid duplicate capital requirements.*
- 15(4). *Assets held to cover general business risk should be of high quality and sufficiently liquid in order to allow the FMI to meet its current and projected operating expenses under a range of scenarios, including in adverse market conditions.*
- 15(5). *An FMI should maintain a viable plan for raising additional equity should its equity fall close to or below the amount needed. This plan should be approved by the board of directors and updated regularly.*

In considering the outcomes of implementation in respect of recovery, the IMSG has also been informed by the Recovery Report. The purpose of the Recovery Report is "to provide guidance for FMIs on the development of comprehensive and effective recovery plans". The Report "is not intended to create additional standards for FMIs or authorities beyond those set out in the PFMI, but rather to provide supplemental guidance on, and a menu of tools for, observance of the PFMI". The IMSG has considered both the Report's menu of recovery tools and its list of characteristics that "will help an FMI evaluate the strengths and weaknesses of tools so that it can choose the set most appropriate for each relevant recovery scenario, including the sequence in which they should be used". The characteristics listed in the Recovery Report are:

- i. *Comprehensive. The set of tools should comprehensively address how the FMI would continue to provide critical services in all relevant scenarios.*
- ii. *Effective. Each tool should be reliable, timely, and have a strong legal basis.*
- iii. *Transparent, measurable, manageable and controllable. Tools should be transparent and designed to allow those who would bear losses and liquidity shortfalls to measure, manage and control their potential losses and liquidity shortfalls.*

- iv. *Create appropriate incentives. The tools should create appropriate incentives for the FMI's owners, direct and indirect, and other relevant stakeholders.*
- v. *Minimise negative impact. The tools should be designed to minimise the negative impact on direct and indirect participants and the financial system more broadly.*

The Recovery Report further states that an "FMI should endeavour to develop a set of tools, including the sequence in which they would be used, that exhibits these characteristics to the greatest extent possible. However, because no set of tools may fully satisfy all the characteristics, an FMI will need to determine which set achieves the best trade-off."

5.6.1 Overview of implementation measures and consistency of implementation outcomes with the PFMI and across CCPs

In general, CCPs have made important and meaningful progress towards meeting standards in the PFMI related to default management. All CCPs report that they have established policies and procedures to manage clearing participant defaults. Default management policies and procedures differ somewhat across the CCPs, reflecting the characteristics of the products cleared, clearing participant profiles and particular features of each CCP's operating environment. Nearly all CCPs report that they conduct regular default management testing. Most such CCPs perform default tests at least annually. The degree of clearing participant and other market participant involvement in such testing varies.

With respect to default management, in considering the consistency of outcomes both with standards in the PFMI and across CCPs, the following high-level observations are made:

- *Principle 13, KC 1.* All CCPs report having default management policies and procedures in place. CCPs appear to have significant discretion regarding when to declare a clearing participant default and which steps to take to hedge and close out the defaulter's portfolio. CCPs generally have less discretion regarding the application of resources in their default waterfalls, the order of which is specified in the CCP's rules.
- *Principle 13, KC 4.* Nearly all CCPs report that they conduct default management testing, and most CCPs perform tests at least annually. All CCPs that conduct default management tests state that they share all test results with their risk committees. In addition, some CCPs share all default management test results with their boards of directors. Other CCPs state that they share default management test results with their boards only if there are significant issues or decisions requiring board approval.

In respect of recovery planning, however, some CCPs' progress in implementation has been significantly slower and a number of serious issues of concern have been identified. While a small number of CCPs had completed their recovery plans by the effective date of the IMSG's review, for most CCPs recovery planning is a fairly new and challenging exercise and experiences continue to evolve. Even among those CCPs that had detailed plans, relatively few considered their plans to be fully consistent with the PFMI. Nearly all are planning enhancements to their recovery plans to reflect the guidance in the Recovery Report. Two CCPs do not have recovery or orderly wind-down plans, and one of these CCPs does not have immediate plans to develop one. Key features of CCPs' plans as at the effective date of the review are summarised in Table 12. From the information obtained in respect of related work carried out by the PSG, it is understood that the findings in this report are generally consistent with observations across a broader sample of CCPs and clearing services.

While the additional guidance in the Recovery Report was published only eight months before the effective date of the L3 review, the specific standards related to recovery planning were already established in the PFMI. The CPMI and IOSCO reiterate the importance of developing comprehensive and effective recovery plans, consistent with the standards in the PFMI and associated guidance in the Recovery Report. Accordingly, the CPMI and IOSCO expect CCPs with gaps and shortcomings in their

recovery plans to accord the highest priority to developing and completing their plans. It is expected that these CCPs will have done so by 31 December 2016.

- *Principle 3, KC 4.* Most CCPs have developed recovery and/or orderly wind-down plans, and many of these CCPs are planning enhancements to their plans. Two CCPs do not have any plan in place, and one of these CCPs does not have immediate plans to develop one.
- *Principle 4, KC 7.* In respect of KC 7, the following high-level observations can be made:
 - *Allocation of potentially uncovered credit losses and tools to restore a matched book.* Most CCPs have at least some arrangements in place to allocate potentially uncovered credit losses to participants, most commonly assessments (or cash calls) on surviving participants. In some cases, this is supplemented with variation margin gains (or other payments) haircutting. Most CCPs cap their participant default-related assessments or replenishment obligations on surviving clearing participants, though there are a variety of approaches to setting such caps (eg variation in cap amount, structure and duration).⁵⁸ Most CCPs also employ either a service tear-up (ie termination of all open contracts in the affected service and subsequent service termination) or forced allocation as their final recovery tool for at least one of their clearing services. About half of the CCPs either have or are considering the adoption of a more limited form of tear-up that would not result in service termination as another tool to restore a matched book. For the CCPs that do not have an uncapped loss allocation tool (whether through assessments, gains-based haircutting or service tear-up), it is unclear whether their plans would comprehensively address uncovered credit losses. For CCPs that do not have tear-up or forced allocation measures in place, it is unclear whether their plans would permit them, in all cases, to restore a matched book.
 - *Replenishment of financial resources.* Most CCPs have arrangements in place to replenish prefunded financial resources in the event of a drawdown following a participant default. There is a wide variation in the details of such arrangements, however, including in the timing of replenishment and the setting of caps on replenishment obligations. In some cases, there is also no clear distinction between assessments on participants for the purposes of loss allocation and assessments to replenish resources. Some CCPs have established delayed, phased or discretionary replenishment deadlines. While some of these CCPs have put in place interim measures to ensure that they can nevertheless continue to meet coverage standards, others have not; for these CCPs, it is unclear how they would ensure a timely return to full coverage following a depletion of resources. Such interim measures include calls for additional initial margin until replenishment of mutualised prefunded resources is complete.
- *Principle 7, KC 10.* Relatively few CCPs have specific tools in place to cover liquidity shortfalls with specific liquidity resources or the liquidity generated by credit loss allocation tools. Some CCPs refer in their responses to the tools in place to avoid unforeseen and potentially uncovered liquidity shortfalls, but do not appear to have arrangements to deal with liquidity shortfalls should they actually arise. Even where arrangements are in place, some of these do not appear to meet the criteria for tools set out in the Recovery Report.
- *Principle 15, KC 3.* Addressing non-default losses, such as investment losses and other general business risk losses, is an area where practices are still evolving. Most CCPs would rely on insurance policies or capital injections from holding companies or shareholders as tools to address uncovered non-default losses. Some have also developed arrangements to allocate

⁵⁸ While some CCPs may use assessment rights both to address uncovered losses and to replenish depleted financial resources, other CCPs have separate rules for replenishment.

certain general business risk losses – principally, investment losses – to participants beyond a certain threshold. Where insurance is considered in recovery plans, this is generally viewed as a means of reducing potential losses rather than as a resource to fund those losses. A number of CCPs plan to develop their recovery plans further to more comprehensively address non-default losses.

- *Principle 15, KC 4.* The CCPs generally consider that they maintain liquid net assets funded by equity in high-quality and sufficiently liquid assets. However, the CCPs tend to have interpreted “sufficiently liquid” in very different ways. Interpretations vary from overnight reverse repurchase agreements to receivables convertible up to 60 days.
- *Principle 15, KC 5.* For CCPs that are wholly owned by a holding company, additional equity would typically be directly injected by the holding company using either existing resources or new resources raised by the holding company and “downstreamed” to the CCP. For most such CCPs, it appears that both the CCP board and the holding company board must approve the equity raise or capital injection. There is significant variation in the options contemplated by CCPs and their holding companies for raising resources to fund equity injections; some of these options may be more viable than others and may have differing implications for resilience.

The observations introduced above are discussed in more detail in the remainder of this section, beginning with the most noteworthy findings relevant to consistency of outcomes. To the extent possible, the discussion considers the materiality for resilience of any gaps and shortcomings relative to standards in the PFMI and observed differences across CCPs.

Table 12: Available recovery-related tools across CCPs as of 30 June 2015

	CCP 1	CCP 2	CCP 3	CCP 4	CCP 5	CCP 6	CCP 7	CCP 8	CCP 9	CCP 10
Assessment ⁵⁹	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Variation margin gains haircutting	No	Yes	Under consideration	Yes (OTC only), under consideration for exchange-traded	Under consideration	Under consideration	Yes (OTC (CDS) only)	Yes	Yes (OTC only)	No
Initial margin haircutting	No	No	Under consideration	No	Under consideration	No	No	No	No	No
Forced allocation	One CCP would use forced allocation as a tool to return to a matched book									
Tear-up										
Subset tear-up ⁶⁰	No	No	Under consideration	Under consideration	Yes	Under consideration	No	Yes	No	Yes
Service tear-up ⁶¹	No	Yes	No	Yes (OTC only)	No	Yes	Yes	Yes	Yes (OTC only)	No

⁵⁹ While some CCPs may use assessment rights both to address uncovered losses and to replenish depleted financial resources, some CCPs have separate rules for replenishment. In addition, some CCPs expressly noted the option to call for voluntary contributions from clearing participants.

⁶⁰ The selection of the subset of positions to tear up depends on each CCP's rules and circumstances.

⁶¹ Multi-service tear-up can be effectively a complete tear-up. Some CCPs expressly noted the ability to tear up all open contracts in all services (ie complete tear-up) as a last resort for restoring a matched book.

Equity raising plan to support recovery plan implementation ⁶²	Equity raising plan under development	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cash calls to address losses not caused by clearing participant default	No	Yes (for investment losses)	Yes (for general business losses)	No	Yes (for custody and investment losses)	No	Yes (for custody and investment losses)	Yes (for investment losses)	Yes (for investment losses)	No
Insurance to address general business risk	No	Yes	No	Yes	Yes	No	Yes	Yes	No	No

⁶² Most CCPs noted that an equity injection by their parent companies, obtained via internal (eg surplus parent company capital or predetermined funds) or external sources (eg tapping into lines of credit or using proceeds from issuance of parent shares or debt), would be the primary method for raising equity. Apart from an equity injection by their parent companies, some CCPs noted the possibility of reducing dividends or other payments if the CCP does not have sufficient equity. One also noted the possible but unlikely option of issuing CCP equity to external investors. One noted the existence of a capital plan but provided no details. In addition to raising equity to cover potential general business losses, some CCPs noted that they would also raise equity for the purpose of replenishing their own contribution to prefunded resources.

5.6.2 Key findings

The key findings relevant to CCPs' implementation outcomes in default management and recovery planning are described below. For some CCPs, these are considered to be serious issues of concern that should be addressed with the highest priority.

5.6.2.1 *Appropriate plans for recovery or orderly wind-down (Principle 3, KC 4)*

Principle 3, KC 4 states "an FMI should identify scenarios that may potentially prevent it from being able to provide its critical operations and services as a going concern and assess the effectiveness of a full range of options for recovery or orderly wind-down. An FMI should prepare appropriate plans for its recovery or orderly wind-down based on the results of that assessment. Where applicable, an FMI should also provide relevant authorities with the information needed for purposes of resolution planning."

The majority of CCPs have some form of recovery and/or orderly wind-down plans, and all of these CCPs are considering enhancements to elements of their plans to reflect the guidance in the Recovery Report. Two CCPs do not yet have recovery or orderly wind-down plans, and one of these CCPs does not have immediate plans to develop one.

The characteristics of CCPs' current recovery or orderly wind-down plans vary considerably, which is likely attributable to differences in the operating environment, regulations or market expectations. Furthermore, the plans themselves are relatively new and continue to evolve.

The Recovery Report states that when a CCP identifies scenarios that may prevent it from being able to provide its critical services as a going concern, the scenarios "should take into account the various risks to which the FMI is exposed... They should also include the risk associated with the failure of a third party to perform a critical function for the FMI (eg the failure of a settlement bank, liquidity provider or other service provider)." All CCPs that have developed recovery or orderly wind-down plans have identified scenarios that may prevent them from providing critical operations and services. In their responses, all CCPs identify non-default losses, and clearing participant default, as relevant scenarios. Most CCPs consider both independent risks to which the CCPs are exposed and risks the CCPs bear as a result of interdependencies in developing their scenarios. The most common third-party entities considered are clearing participants, custodians, settlement banks and CSDs. About half of the CCPs specifically consider the multiple roles that could be played by a single counterparty (eg clearing participant, custodian, settlement bank) in their scenarios. All CCPs with recovery plans identify the operations and services essential to the continued running of their clearing business as critical. Only a few CCPs describe the criteria applied to identify critical operations and services; these CCPs refer to definitions or guidance from the CPMI and IOSCO, and the FSB.

In accordance with the specific expectation in KC 4 that CCPs provide relevant authorities with the information needed for the purposes of resolution planning, some CCPs discuss matters relevant to resolution in their recovery plans. One of these CCPs has identified possible trigger points for resolution. Other CCPs are awaiting the passage of resolution legislation in their home jurisdictions. In its responses, one CCP cites the existence of resolution powers in its home jurisdiction. However, at the time of the survey this CCP had yet to have detailed discussions with its home resolution authority.

General characteristics of the CCPs' recovery plans include:

- The set of recovery tools to allocate uncovered credit losses and liquidity shortfalls, to replenish financial resources, to restore a matched book, and to address losses not caused by a clearing participant default varies by CCP. These tools are discussed in detail later in this section.
- Most CCPs establish the legal basis for their plans with reference to external counsel and legal opinions.

- Most CCPs employ quantitative and qualitative triggers for entry into recovery (eg depletion of the default fund and losses related to operational or general business events).
- Most CCPs' survey responses do not include details on how costs and benefits have been assessed in developing their recovery or orderly wind-down plans.
- Most CCPs may exercise some discretion in accordance with predetermined governance processes. Some CCPs establish the scope for discretion in their rules, while others specify this only in internally documented procedures that are not shared with clearing participants. This reduces the level of transparency and information available to clearing participants.
- Most CCPs anticipate continued discussion and communication with relevant authorities regarding their recovery plans as the plans are further refined. Further, as resolution frameworks are developed across jurisdictions, it may reasonably be expected that CCPs will begin to provide relevant authorities with the information needed for the purposes of resolution planning.

Where CCPs comment on the circumstances in which their orderly wind-down plans might be executed, all agree that wind-down would occur when: (i) the CCP wished to discontinue business for commercial or other reasons or (ii) participant defaults or participant exits made the continued provision of services unviable. Some CCPs further state that wind-down would be executed if their recovery plan failed. In the event of wind-down, some CCPs specify that they would expect to provide services for a limited period (prescribed in some cases, but not in others) to provide for orderly closure.

Regarding the CCPs' efforts to mitigate the marketwide impact of their recovery plans, some, mostly globally active, CCPs mention prevention, early recovery, provision of information and consultation with clearing participants on recovery plans. The CCPs state that they have arrangements in place to review and update their recovery and wind-down plans annually, and their boards have final approval. All CCPs with a recovery plan state that they either conduct or plan to conduct a crisis management exercise annually and use the results of such exercises for the review and update of the plans. These CCPs do not clarify whether such annual exercises are integrated with their annual default management tests or are separate recovery-focused exercises.

5.6.2.2 Addressing unforeseen potentially uncovered liquidity shortfalls; Replenishment of liquidity resources (Principle 7, KC 10)

Principle 7 KC 10 states that an "FMI should establish explicit rules and procedures that enable the FMI to effect...payment obligations on time following any individual or combined default among its clearing participants. These rules and procedures should address unforeseen and potentially uncovered liquidity shortfalls and should aim to avoid unwinding, revoking, or delaying the same-day settlement of payment obligations".

CCPs' arrangements for the allocation of liquidity shortfalls are among the least developed elements of recovery plans. More than half of the CCPs refer in their responses primarily to the tools in place to *avoid* liquidity shortfalls, such as policies to monitor liquidity risk, stress testing and liquidity facilities — including routine access to central bank facilities — rather than tools to deal with unforeseen and potentially uncovered liquidity shortfalls should they nevertheless arise. Some CCPs with routine access to central bank facilities maintain that such access ensures they would never experience a liquidity shortfall. Notably, some of the CCPs that focus primarily on their tools to avoid liquidity shortfalls do not appear to consider scenarios in which such tools would prove insufficient, and therefore result in unforeseen and uncovered liquidity shortfalls. For example, access to liquidity facilities – including routine access to central bank facilities – might fail to provide sufficient liquidity if a CCP did not have enough central bank-eligible collateral to support the borrowing necessary to avoid a liquidity shortfall. In such a case, a CCP's tools to reduce the likelihood of a liquidity shortfall would not address an unforeseen liquidity shortfall.

Most remaining CCPs refer to the use of clearing participants' assets (including limiting withdrawal of excess collateral and limiting or requiring substitution of certain types of collateral), committed credit lines, or loan agreements with banks or parent companies to cover an unforeseen liquidity shortfall. One CCP mentions the liquidity generated by credit loss allocation tools, including assessments and variation margin gains and other payment haircutting. Some CCPs have the capability to satisfy payment obligations in different currencies in exceptional circumstances, such as in recovery. Some CCPs also appear to have discretion regarding the use of liquidity tools. Only one CCP describes its governance arrangements for the use of such tools.

Even where arrangements to address uncovered liquidity shortfalls are in place, some of these do not appear to meet the criteria set out in the Recovery Report. In considering the consistency of tools to address uncovered liquidity shortfalls with the various characteristics set out in the Recovery Report, the CCPs' responses emphasise the following (these largely mirror responses provided regarding tools to allocate potentially uncovered credit losses; see Section 5.6.2.3):

- Some CCPs cite their routine stress tests, haircuts, default management tests and actual crisis management experience as evidence of the comprehensiveness and effectiveness of their tools to address unforeseen and potentially uncovered liquidity shortfalls. However, as noted, in many cases the evidence cited is more relevant to validating the adequacy of tools to mitigate the risk of shortfalls, rather than the comprehensiveness and effectiveness of tools to address a liquidity shortfall should this arise.
- Regarding transparency, measurability, manageability and controllability, the vast majority of CCPs emphasise: the clarity and transparency of arrangements as reflected in the CCP's rules, contracts and procedures (based on the local legal framework); and, the predictability and measurability of contingent obligations under tools that are linked to participants' open positions or risk exposure. One CCP expressly mentions in its responses that relevant rules are discussed with clearing participants. The CCPs do not appear to provide any clearing participant-specific quantitative data related to potential liquidity shortfall allocations to clearing participants; rather, the CCPs appear to provide clearing participants the rules and principles upon which the CCP will act.⁶³

Principle 7, KC 10 states that an FMI's "rules and procedures should also indicate the FMI's process to replenish any liquidity resources it may employ during a stress event, so that it can continue to operate in a safe and sound manner." Most CCPs refer to replenishment of liquidity resources via the use of default management proceeds, tools to address potentially uncovered credit losses (ie assessment powers) and liquidity generated by replenishment of prefunded financial resources in the default waterfall. One CCP contemplates different replenishment options with different time horizons, including the possibility of seeking intragroup funding to bolster the CCP's liquidity position. Some CCPs appear to have discretion regarding the timing of liquidity replenishment and the sequencing of tools to replenish liquidity resources.

5.6.2.3 Allocation of potentially uncovered credit losses (Principle 4, KC 7)

Principle 4, KC 7 states that an FMI's "rules and procedures should address how potentially uncovered credit losses would be allocated, including the repayment of any funds an FMI may borrow from liquidity providers. These rules and procedures should also indicate the FMI's process to replenish any financial

⁶³ To the extent that CCPs would employ the same tools to address uncovered credit losses and liquidity shortfalls, information provided to clearing participants regarding potential credit loss-related obligations may also be applicable to potential liquidity shortfall allocations.

resources that the FMI may employ during a stress event, so that the FMI can continue to operate in a safe and sound manner.”

When describing their tools to allocate potentially uncovered credit losses, nearly all CCPs cited assessments as their primary tool to allocate losses that would not be covered by the prefunded resources in the default waterfall (see Table 13). One CCP, however, does not have assessment powers. Most of the CCPs either have or are considering adopting additional tools to allocate uncovered losses beyond assessment powers, including variation margin gains and other payment haircutting and voluntary payments. Some CCPs either have or are considering using initial margin haircuts, or capital injection from a parent holding company, to allocate losses. Of the CCPs considering additional tools beyond assessments, most CCPs plan to use their assessment powers before employing the additional tools. Most CCPs have relatively limited discretion regarding the use of assessment powers and other recovery tools to allocate uncovered losses.

Most CCPs include complete contract tear-up (ie tear-up of all contracts in the affected service, allocation of all remaining losses *pro rata*, and subsequent closure of the service) as a “last resort” tool to allocate losses (and restore a matched book). Some CCPs only have such a tool in place for a subset of their clearing services.⁶⁴

For the CCPs that do not have an uncapped last-resort tool (whether through assessments, gains-based haircutting or service tear-up) in place for the clearing services covered in this exercise, it is unclear whether their plans would comprehensively address uncovered credit losses (see also the discussion on restoring a matched book, Section 5.6.2.4).

Nearly all CCPs that have assessment powers place a cap on required assessments; for these CCPs assessment powers alone cannot be assured of being comprehensive and other tools, such as gains-based haircutting, will be necessary. Some CCPs do not cap their assessment powers for a subset of clearing services, or under certain circumstances. Among CCPs with capped assessment powers, there is variation in cap amount, structure, and duration. For example, some CCPs set an assessment cap as a percentage of each individual clearing participant’s default fund contribution (typically one or two times the clearing participant’s contribution), while others set the cap based on a multiple of the aggregate default fund (ranging from one to five times the aggregate default fund). Some CCPs also specify a currency-specific cap amount, therefore making the cap amount the lower of: (a) the percentage-based or aggregate cap amount; and (b) the maximum currency-specific cap amount. Most CCPs cap assessment powers during a limited period of time – the “limited contribution period” – that begins, depending on the CCP, either when a default is first declared or when the default management process concludes.⁶⁵ Some CCPs’ capped periods will extend – or “roll” – if additional defaults occur during the capped period.

Following a depletion of the prefunded default waterfall, CCPs impose replenishment obligations on their participants. These obligations require clearing participants to contribute resources to restore the adequacy of prefunded resources in the default waterfall. Some CCPs do not distinguish clearly between assessments for the purposes of loss allocation and cash calls for replenishment purposes. In such cases, some CCPs set a single cap on a clearing participant’s overall obligations to the

⁶⁴ When applied to a single-service CCP or all of a CCP’s services, service tear-up can be effectively a complete tear-up. Some CCPs expressly note the option to tear up all open contracts in all services (ie complete tear-up) as a last resort for allocation of losses and restoring a matched book.

⁶⁵ A “limited contribution period” is a period during which the CCP expects clearing participants to contribute default-related resources up to a specific limit. Such resources could include assessments, replenishment requirements, or, in the case of CCPs that only cap clearing participants’ total obligations to the CCP, both. Note that this concept is distinct in many CCPs from a separately prescribed time period during which no replenishment calls would be made, but during which the CCP may nevertheless call for assessments.

CCP (ie a single cap on both assessment and replenishment obligations together).⁶⁶ For more details on replenishment obligations, see Section 5.6.2.5 below.

Where a clear distinction is made between loss allocation assessments and replenishment obligations, some CCPs only cap loss allocation assessments, while others impose separate caps on loss allocation assessments and replenishment obligations. Also, some CCPs prescribe a time period during which the CCP may call for assessments to allocate losses, but not for replenishment. At the end of the prescribed time period, the CCP calls on clearing participants to replenish their prefunded default resources. Similar to limited contribution periods, such a prescribed time period can roll; ie the period extends if additional defaults occur before the prescribed time period ends. Given the complex and evolving nature of recovery plans, CCPs that set distinct assessment obligations for the purposes of loss allocation and for replenishment – including distinct payment deadlines, limits and limited contribution periods versus prescribed time periods during which replenishment calls may not be made – provide better transparency and predictability of payment obligations to their clearing participants and the markets they serve.

Among the CCPs that either include or are considering additional loss allocation tools in their recovery plans, such as variation margin and other payment haircuts, some either place or would expect to place caps or other limits on the use of the tool. For instance, they would limit haircuts to a specified time period or particular settlement cycle. One CCP would not cap the tool, while at least two other CCPs would do so. One of the CCPs that plans to rely on CCP or holding company capital to allocate potentially uncovered credit losses states that such capital is capped. None of the CCPs considering voluntary tools (such as voluntary payments) describe potential caps on those tools.

In considering the consistency of tools to address potentially uncovered credit losses with characteristics set out in the Recovery Report, the CCPs' responses emphasise the following:

- Some CCPs state that placing caps on tools such as assessment powers and variation margin gains haircutting ensures the transparency, measurability, manageability and controllability of the tools. On the other hand, some CCPs acknowledge that caps would also limit the comprehensiveness of those tools.
- Some CCPs state that their inclusion of tear-up as a last resort tool ensures the recovery plan would comprehensively address potentially uncovered credit losses. Some CCPs also consider that such tools create appropriate incentives by limiting moral hazard on the part of clearing participants (eg members might be more likely to ensure a successful closeout and CCP recovery if the alternative was service closure), and mitigate negative impacts to the extent that a service tear-up allows a CCP's other services to remain open.
- For the CCPs that have no uncapped tools (whether through assessments, gains-based haircuts or service tear-up) to address potentially uncovered credit losses, the CCPs' current tools may not comprehensively allocate uncovered credit losses. Acknowledging this, these CCPs are considering additional credit loss allocation tools.
- Regarding the information made available to clearing participants to provide greater transparency and predictability, practices vary among the CCPs. At least two CCPs plan to provide a significant volume of detailed tool-related and stress testing information, while others primarily provide information on default fund obligations. CCPs with recovery tools that are explicitly capped typically disclose information related to cap sizing to clearing participants on a

⁶⁶ While some CCPs may use assessment rights both to address uncovered losses and to replenish depleted financial resources, other CCPs have separate rules for assessment and replenishment requirements. Some CCPs without separate rules for assessment and replenishment requirements appear to cap clearing participants' total loss allocation obligations to the CCP (ie a single limit applies for assessments plus replenishment requirements).

regular basis. CCPs that employ variation margin gains or other payment haircuts do not describe any tool-specific information currently provided to clearing participants.

Table 13: Post-default assessment rights for continuing clearing participants^{67, 68}

Cap for single default	The most common cap is 1x the individual default fund per limited contribution period, but practices range from 0.5x the individual default fund contribution, to 2.75x the aggregate default fund (for one of a different CCP's services) to no cap (for one of a CCP's services). One CCP's cap is the lower of a default fund multiple or a currency-specific cap.
Cap for multiple defaults	Specific caps or rules for multiple defaults are in place at five of the CCPs. Practices range from 2x the individual default fund per limited contribution period to no cap on assessments when multiple defaults occur.
Limited contribution period⁶⁹	Most CCPs employ a limited contribution period of some length, ranging from five business days after default to 25 business days after default (rolling); other CCPs' formulations may extend beyond 25 business days. Two CCPs do not employ a limited contribution period because their caps apply per default. One CCP's limited contribution period only applies to multiple defaults because its single default cap applies per default.
Payment deadline	Most CCPs require payment within one business day after the call is made. Two CCPs require same day payment.

⁶⁷ While some CCPs may use assessment rights both to address uncovered losses and to replenish depleted financial resources, other CCPs have separate rules for assessment and replenishment requirements. Some CCPs without separate rules for assessment and replenishment requirements appear to cap clearing participants' total loss allocation obligations to the CCP (ie a single limit applies for assessments plus replenishment requirements).

⁶⁸ For CCPs with assessment caps that are based on aggregate default fund contributions, individual clearing participant assessment allocations are typically calculated pro rata based on the clearing participant's cleared portfolio.

⁶⁹ For the purposes of this report, a "limited contribution period" is a period during which the CCP expects clearing participants to contribute default-related resources up to a specific limit. Such resources could include assessments, replenishment requirements, or, in the case of CCPs that only cap clearing participants' total obligations to the CCP, both. A limited contribution period can roll (ie the period extends if additional defaults occur before the period ends).

5.6.2.4 Tools to re-establish a matched book following clearing participant default (Principle 4, KC 7)

The choice of voluntary measures included in CCPs' recovery plans to restore a matched book seems largely to depend on the nature of the products cleared. For exchange-traded products, CCPs generally have the ability to conduct offsetting transactions in the relevant markets without mandatory or incentivised involvement of non-defaulting clearing participants. For OTC products, by contrast, most CCPs employ an auction or position-transfer mechanism in their default management processes. Most CCPs have requirements and/or incentives to encourage clearing participant participation in auctions.⁷⁰ For more detail on participant-default rules and procedures, see the discussion in Section 5.6.4.1.

According to the Recovery Report, "to address the likelihood that voluntary methods might prove insufficient to re-establish a matched book, a CCP will need to have a mandatory, ex ante agreed mechanism to do so, such as forced allocation or termination of contracts. Even though such tools carry potentially severe drawbacks and risks, a CCP should identify in its rules which mandatory tool(s) it would use to re-establish a fully matched book should voluntary mechanisms fail to do so." If market transactions or auction mechanisms fail to re-establish a matched book for the CCP, about half of the CCPs either have rules in place or are considering rules that would allow the mandatory tear-up of a subset of contracts. Some CCPs contemplate performing partial tear-ups on a pro rata basis among non-defaulting clearing participants who hold positions opposite to the defaulter's positions. Others are considering a wider variety of partial tear-up structures. Most CCPs state they would plan to tear up contracts at the current market value, acknowledging that there may be challenges in establishing such value in the prevailing circumstances. Many CCPs state their final tool to restore a matched book would be to impose a service tear-up. One CCP may forcibly allocate a defaulting clearing participant's positions (at the current market price) to surviving clearing participants. Some CCPs require agreement from all clearing participants in order to use or continue using certain recovery tools.

The CCPs generally view their tools for restoring a matched book as consistent with the characteristics set out in the Recovery Report. Most CCPs employ either a form of partial or service tear-up or forced allocation as their final recovery tool for at least one of their clearing services. However, the CCPs do not consistently employ the same tools for exchange-traded versus OTC services. At the time of the survey, some CCPs did not appear to use any of these tools for at least one of their derivatives clearing services.⁷¹

More specifically, in considering the consistency of tools to restore a matched book with characteristics set out in the Recovery Report, the CCPs' responses emphasised the following:

- Some CCPs state that the use of tear-up tools could involve significant trade-offs, since their use could result in the closure of the cleared market for the products in question.
- Among the CCPs that do not have such final tools in place for the clearing services covered in this exercise, it is unclear whether some CCPs' plans would restore a matched book.
- As noted in the context of loss allocation, some CCPs explicitly mention in their survey responses that the use of service tear-up as the final recovery tool could provide a strong incentive for clearing participants to support other recovery actions.
- As noted in the case of allocation of liquidity shortfalls, the vast majority of CCPs consider that the inclusion of tear-up provisions in their rules, contracts and procedures provides adequate

⁷⁰ Incentives may, for instance, include "juniorisation", whereby in the event of a loss in excess of the defaulted participant's initial margin and default fund contribution, the default fund contributions of participants that bid least competitively in an auction would be drawn on ahead of those that bid more competitively.

⁷¹ At least one CCP that does not have tear-up or forced allocation arrangements to restore a matched book may be able to withstand protracted losses during the close-out period using uncapped loss allocation tools.

transparency and clarity. Since each participant's exposure to tear-up is linked to its open positions, CCPs generally consider that participants can manage the potential impacts by managing their own open positions.

5.6.2.5 Replenishment of financial resources (Principle 4, KC 7)

Principle 4, KC 7 states that an FMI's "rules and procedures should also indicate the FMI's process to replenish any financial resources that the FMI may employ during a stress event, so that the FMI can continue to operate in a safe and sound manner." Some CCPs require replenishment of default fund resources within one business day after default fund resources have been utilised. Other CCPs, however, employ a multi-stage replenishment arrangements, a discretionary replenishment deadline, or a prescribed time period post-default during which assessments may be called but the CCP will not seek participant contributions to the replenishment of prefunded resources in the default waterfall.

Only a subset of the CCPs with delayed, phased, or discretionary replenishment deadlines describe interim measures that they would take to ensure they continued to meet coverage standards and operate in a safe and sound manner.⁷² For CCPs without such measures, it is unclear how they would ensure a timely return to full coverage following exhaustion of default resources. This has evident resilience implications. Some CCPs state they would call for additional initial margin to cover any additional default losses that may be incurred prior to full default fund replenishment. One other CCP would call for a special type of default-related charge. Such measures may reflect a desire by CCPs or clearing participants to return to full coverage quickly while limiting additional contributions to mutualised resources immediately following a default. However, heavy reliance on additional initial margin as an interim measure could potentially have procyclicality implications by imposing a significant liquidity obligation on clearing participants.⁷³

At least two CCPs that have both exchange-traded and OTC derivatives clearing services have different replenishment obligations for these clearing services. For at least one of these CCPs, surviving clearing participants are required to replenish default fund resources used to cover losses in exchange-traded products within one business day after the utilisation of the default fund resources; replenishment related to OTC products is subject to a prescribed time period during which no replenishment calls would be made. Another CCP imposes different caps and prescribed periods, but not different payment deadlines, for exchange-traded versus OTC products.

Most CCPs cap or are considering capping replenishment obligations on surviving clearing participants. As noted in Section 5.6.2.3, some CCPs limit total obligations – loss allocation assessments and replenishment together. Some CCPs⁷⁴ have no cap on replenishment obligations; one other does not clearly distinguish between assessments and replenishment, but does not appear to cap replenishment. There is variation in the rules regarding such caps. For example, some replenishment caps are explicitly tied to a specific number of defaults (eg a clearing participant must replenish its resources only once per default); some replenishment caps are only applied during a limited contribution period (eg a clearing participant must replenish its default resources only twice during the 20 days after a default occurs, and additional replenishment may be called after the limited contribution

⁷² See Section 5.2 on credit risk management for more information on how CCPs ensure that they meet coverage requirements on an ongoing basis.

⁷³ At least one CCP has since the effective date of the review developed new replenishment arrangements to address this concern.

⁷⁴ Unless the clearing participant resigns.

period,⁷⁵ and other replenishment caps are tied to a prescribed time period during which no replenishment calls would be made (eg a limited replenishment amount is required at the end of the prescribed time period).

Most CCPs appear to allow clearing participants to cap their exposure to replenishments by closing out positions and exiting the CCP.⁷⁶ The CCPs' rules differ, however, in the timing and requirements clearing participants must meet in order to do so. For example, among CCPs that have prescribed periods during which no replenishment calls would be made, some allow a clearing participant to exit the service during that prescribed period unless another default occurs within the period. In that case, the clearing participant will be required to continue to pay any obligations due to the new default. Other CCPs only allow clearing participants to withdraw after that prescribed period ends, or require withdrawing clearing participants to pay all obligations arising during the prescribed time period even if the clearing participant withdraws before the obligations are called. Some CCPs explicitly cap obligations for withdrawing clearing participants.⁷⁷

Several CCPs appear to have little discretion regarding the use of replenishment tools, as replenishment processes are established clearly in their rules. Regarding replenishment of the CCP's own contribution to prefunded financial resources in the default waterfall, some CCPs adhere to specific regulatory requirements in their home jurisdiction (eg European CCPs are required to replenish their contributions within one month), while others review their commitments on an annual cycle. The remaining CCPs did not comment specifically in their responses on these matters.

Of the CCPs that have capped replenishment obligations or link replenishment obligations to clearing participants' contributions to prefunded resources, it appears that all provide information about default fund requirements – typically including details on routine stress testing and default fund requirement allocation methods – which clearing participants could use to estimate the size and likelihood of replenishment obligations. Most CCPs state that, because clearing participants' replenishment obligations are tied to the amount of risk they bring to the CCP, the clearing participants are incentivised to control the amount of risk they bring to the CCP. A few CCPs state that clearing participants are also incentivised to monitor the CCP's risk management activities, including the default management process, to ensure potential replenishments are minimised.

⁷⁵ For the purposes of this report, a "limited contribution period" is a period during which the CCP expects clearing participants to contribute default-related resources up to a specific limit. Such resources could include assessments, replenishment requirements, or both. Note that this concept is distinct in many CCPs from a separately prescribed time period during which no replenishment calls would be made, but during which the CCP may nevertheless call for assessments.

⁷⁶ For CCPs that do not appear to fully distinguish between assessment and replenishment powers, withdrawal provisions may limit clearing participants' obligations with regard to assessments and/or replenishment. For this reason, the paragraph refers generically to "obligations".

⁷⁷ For instance, one CCP's cap for withdrawing members is no more than twice the initial default fund contribution, in the event of a multiple default scenario.

Table 14: Post-default replenishment obligations for continuing clearing participants⁷⁸

Cap for single default	<p>Five CCPs cap replenishment requirements at 1x a clearing participant’s individual default fund contribution per default. Two other CCPs appear to require that a specific replenishment amount be provided only at the end of a prescribed time period during which no replenishment calls would be made. Four other CCPs appear to allow replenishment to occur during a limited contribution period, subject to caps on total obligations to the CCP; these caps range from 1x the individual default fund contribution to 2.75x the aggregate default fund. The remaining CCP has no cap on replenishment.</p> <p>Two CCPs consider monetary limits when setting their caps.</p> <p>One CCP specifies that replenished resources can only be used to cover future defaults.</p>
Cap for multiple defaults	<p>Caps or rules for multiple defaults are in place at nine of the CCPs. Most of these CCPs apply the same cap on replenishment regardless of whether one default or multiple defaults occur. Among CCPs with different replenishment caps for single versus multiple defaults, practices for multiple defaults range from 3x the individual default fund per limited contribution period to no cap on assessments.</p>
Limited contribution period⁷⁹	<p>Four CCPs employ a limited contribution period of some length, ranging from five business days after default to 25 business days after default (rolling); other CCPs’ formulations may extend beyond 25 business days. Two CCPs employ a two-phase replenishment after the completion of default management, with partial replenishment required within two business days (i.e., a limited contribution period) and full replenishment required after a longer period (i.e., a prescribed time period during which no replenishment calls would be made).</p>
Payment deadline or prescribed time period during which no replenishment calls would be made	<p>Two CCPs appear to require that a specific replenishment amount be provided only at the end of a roughly month-long prescribed time period during which no replenishment calls would be made. Four other CCPs appear to allow replenishment to occur during a limited contribution period (with full replenishment required at the end of the period if it is not achieved earlier), and two other CCPs use a phased replenishment model. Among the CCPs that do not use a prescribed time period during which no replenishment calls would be made, payment is typically required within one business day after a call is made.</p>
Call for additional IM before full replenishment⁸⁰	<p>Four CCPs can call for additional initial margin prior to achieving full replenishment of their default resources.</p>

⁷⁸ While some CCPs may use assessment rights both to address uncovered losses and to replenish depleted financial resources, other CCPs have separate rules for assessment and replenishment requirements. Some CCPs without separate rules for assessment and replenishment requirements appear to cap clearing participants’ total loss allocation obligations to the CCP (ie a single limit applies for assessments plus replenishment requirements).

⁷⁹ A “limited contribution period” is a period during which the CCP expects clearing participants to contribute default-related resources up to a specific limit. Such resources could include assessments, replenishment requirements, or, in the case of CCPs that only cap clearing participants’ total obligations to the CCP, both. Note that this concept is distinct in many CCPs from a separately prescribed time period during which no replenishment calls would be made, but during which the CCP may nevertheless call for assessments. A limited contribution period can roll (ie the period extends if additional defaults occur before the period ends).

⁸⁰ Some CCPs that delay replenishment may call for additional IM resources to meet coverage requirements until the default fund is replenished.

5.6.2.6 *Tools to address losses not caused by clearing participant default (Principle 15, KC 3)*

Principle 15, KC 3 states “An FMI should maintain a viable recovery or orderly wind-down plan and should hold sufficient liquid net assets funded by equity to implement this plan. At a minimum, an FMI should hold liquid net assets funded by equity equal to at least six months of current operating expenses. These assets are in addition to resources held to cover defaults or other risks covered under the financial resources principles. However, equity held under international risk-based capital standards can be included where relevant and appropriate to avoid duplicate capital requirements.” The Recovery Report states that an “FMI will need to be able to recover from an extraordinary one-off loss or recurring losses from general business, custody and investment risks. To that end, an FMI needs to have both sufficient capital and a viable plan to recapitalize in circumstances where the FMI’s capital is used to absorb such losses. An FMI should also consider having explicit insurance or indemnity agreements to cover such losses.”

Most CCPs have at least some tools in place to address losses that are not caused by clearing participant default (ie non-default losses), although not all of these tools are formally part of the CCPs’ recovery plans. Most CCPs would rely on some form of capital injection from shareholders or holding companies, or insurance policies to address uncovered non-default losses. Insurance is not regarded as a type of liquid net asset funded by equity, held to meet the standard, but rather is considered as a means of reducing potential losses. Some CCPs rely or are considering relying on clearing participant contributions to cover non-default losses stemming from investment risk. Some CCPs state that their recovery plans address non-default losses but do not describe how the plans do so in much detail. The remaining CCPs have no tools in place to address non-default losses. Several CCPs plan to develop their recovery plans further to address non-default losses.

For CCPs that have specific tools to address non-default losses in their recovery plans, all appear to have complete or significant discretion on the use and sequencing of these tools, and all maintain that their tools adhere to the characteristics identified in the Recovery Report. One of the CCPs that allocates investment losses to participants seems to provide some amount of information to enable clearing participants to calculate the size and likelihood of incurring non-default loss-related obligations. Another CCP appears to provide a more limited amount of information, and another CCP intends to enhance its disclosures to participants on portfolio investments to support their management of contingent obligations in respect of investment-related non-default losses.

5.6.3 Other findings relevant to consistency of outcomes

In addition to the key findings detailed above, the IMSG’s findings also include a number of other observations relevant to the assessment of the consistency of outcomes. These include the following.

5.6.3.1 *Testing and review of clearing participant default rules and procedures (Principle 13, KC 4)*

Principle 13, KC 4 states that “An FMI should involve its clearing participants and other stakeholders in the testing and review of the FMI’s default procedures, including any closeout procedures. Such testing and review should be conducted at least annually or following material changes to the rules and procedures to ensure that they are practical and effective.” Nearly all CCPs report that they perform default management tests. One CCP recently began to perform such tests. Default management tests typically take the form of a full-scale default simulation conducted by the CCP. As part of their default management testing programme, some CCPs perform partial desktop exercises or multiple separate tests: an internal test for CCP staff, and an external test involving both the CCP and external parties.

All CCPs that perform default management tests involve external parties in testing of their default procedures, at least for a subset of products. The degree of involvement of external parties typically reflects the CCP’s default management plan. As noted, CCPs for exchange-traded derivatives

would often expect to conclude closeout activities in the market, rather than via auction, and therefore clearing participants might not be involved. In such cases, most CCPs involve default brokers in their tests. Where the CCP would expect to restore a matched book via auction to clearing participants, most CCPs would involve some or all clearing participants in their tests (eg clearing participants would second representatives to a default management committee in accordance with established rules and procedures). Only a few CCPs include market participants other than clearing participants in their tests (eg other FMIs).

Most CCPs report that they conduct default management tests at least annually. Another CCP states that it performs default management tests on a semi-annual basis.

The majority of the CCPs report that they share the results of all default management tests with their boards. Some CCPs share the test results with regulators either routinely or upon request, in some cases inviting the supervisor to sit in on the tests as an observer. Some CCPs share the results with their boards only if there are significant issues or decisions requiring board approval, but do regularly share test results with their risk committees. All CCPs state that they use, or expect to use, the test results to improve their default management procedures and rules. More generally, most CCPs involve external parties – most commonly clearing participants – in any review and refinement of default procedures and rules, usually through consultation processes.

Among the CCPs that conduct default management testing, such tests are generally based on a scenario in which the one or two largest clearing participants default. One CCP selects the defaulting clearing participant at random for its annual default tests. Some CCPs have scenarios of a member defaulting simultaneously across services. Some CCPs also have other scenarios that, for example, take into account multiple roles of a defaulting clearing participant.

Most CCPs do not take clearing participant resolution regimes into account in their default management tests, as they view that a defaulting clearing participant in resolution is not likely to affect the CCP's default management procedures. No CCP indicated that it would automatically declare the default of a clearing participant that has gone into resolution, as long as the clearing participant continued to meet its obligations to the CCP.

5.6.3.2 Composition of liquid net assets funded by equity (Principle 15, KC 4)

Principle 15, KC 4 states that "assets held to cover general business risk should be of high quality and sufficiently liquid in order to allow the FMI to meet its current and projected operating expenses under a range of scenarios, including in adverse market conditions." Most CCPs report that they have invested the assets they hold that are funded by equity in high-quality liquid assets. However, the definition of "liquid" varies considerably across CCPs. For example, one CCP maintains a significant portion of assets in accounts receivable that can be converted to cash in less than 60 days, while another holds the vast majority of liquid net assets in overnight reverse repo. Most CCPs hold cash or cash equivalents at commercial banks. The CCPs plan to liquidate non-cash assets on the market, through liquidity facilities, or through the relevant central bank (as appropriate).

5.6.3.3 Raising additional equity (Principle 15, KC 5)

Principle 15, KC 5 states that "An FMI should maintain a viable plan for raising additional equity should its equity fall close to or below the amount needed. This plan should be approved by the board of directors and updated regularly." For CCPs that are wholly owned by a holding company, additional equity typically would be directly injected by the holding company either using existing resources (eg surplus capital or predetermined funds) or raised by the holding company and downstreamed to the

CCP (eg proceeds from issuance of parent company shares or debt).⁸¹ There is significant variation in the options contemplated by CCPs and their holding companies in this regard. For example, in their responses, CCPs list a wide variety of actions their holding companies could take to raise resources for the CCP, including issuing shares, issuing debt, waiving fees, reducing dividends, accessing lines of credit, and merging or selling the CCP itself. Notably, some of these actions, such as issuing debt and accessing lines of credit, would appear to increase the holding company's debt. Accordingly, some of these options may be more viable than others and may have differing resilience implications.

Apart from an equity injection by their parent companies, some CCPs note the possibility of reducing dividends or other payments in case the CCP does not have sufficient equity. One also notes the possible, but perhaps challenging, option of issuing CCP equity to external investors, while one other would seek to draw on reserves or issue additional shares to shareholders.

Most CCPs explicitly note in their responses that they would take market conditions into account when selecting the appropriate recapitalisation option and a few CCPs discuss specific factors that could slow the realisation of losses or the raising of equity. Most CCPs have identified no legal restrictions to their equity-raising plans. However, some have identified dependencies on other parties (such as parent companies, shareholders and regulators) that could delay or possibly prevent the CCP from raising additional equity. Presumably, such dependencies exist for all CCPs that have equity raising plans, but not all CCPs identified these dependencies. At least one CCP is currently reviewing the timeliness and reliability of its recapitalisation options.

Among the CCPs or holding companies that contemplate raising equity, none appear to have put contractual arrangements in place to facilitate such actions. However, some CCPs cited their or their holding company's experience with and ready access to the relevant markets as providing sufficient preparation.

Some CCPs report that they review their equity-raising plans at least annually. Additionally, some CCPs monitor capital levels more frequently, although such monitoring does not appear to constitute a review of the plans to raise equity. All CCPs that have plans to raise equity require board approval for the equity raising. For CCPs owned by a holding company, it appears that both the CCP board and the holding company board must approve the equity raising. For CCPs with multiple owners, all owners must approve the equity raising.

5.6.4 Other observations

Finally, the IMSG has made some additional observations on differences in CCPs' implementation outcomes. These may not give rise to material differences in resilience. They may nevertheless be noteworthy.

5.6.4.1 *Clearing participant default rules and procedures and use of financial resources (Principle 13, KC 1)*

Principle 13, KC 1 states that an "FMI should have default rules and procedures that enable the FMI to continue to meet its obligations in the event of a default and that address the replenishment of resources following a default." All CCPs have provisions in their rules defining various types of default events, which differ in nature (eg operational events, financial events). In all cases, the definitions are sufficiently broad that the CCPs retain some flexibility in determining default events and, if necessary, can anticipate a default event before it occurs.

The CCPs' default rules and procedures contain mostly discretionary measures with the exceptions of declaring default in case of insolvency and employing the resources outlined in the CCP's

⁸¹ The remaining CCP describes similar actions to be taken by the CCP directly.

default waterfall in the event of a clearing participant default. Most CCPs can, at their discretion, decide to liquidate, hedge, or terminate a defaulted clearing participant's positions. Having reasonable discretion regarding default declarations and default management may allow CCPs to respond to the unique features of each default. However, such discretion could be harmful if applied in an unreasonable manner (eg declaring an event of default before it occurs). The rules describe the CCPs' default management actions, but the details of the CCPs' default management process, forums, and the main guidelines governing the decision-making processes (apart from minimising losses) are typically elaborated in a separate default management plan rather than the CCPs' rules or procedures. Some CCPs provide details regarding their probable sequencing of default management steps, while other CCPs refer generally to having flexibility in sequencing but do not describe how sequencing decisions are governed.

With respect to customer positions, all CCPs state that they would attempt to transfer all customer positions (assuming the default was not related to customer positions) to a surviving clearing participant, while proprietary positions were subject to closeout procedures. Should a transfer not prove possible, the CCP would proceed to liquidate customer positions (while leaving the proceeds of such liquidation untouched). Some CCPs specify a limited window of time during which the CCP would attempt to port customer positions, presumably to provide greater transparency to customers. This "porting window" is taken into account in setting the assumed closeout period in the CCPs' margining and stress testing frameworks (see Sections 5.4.2.2 and 5.2.2.3).

All CCPs report that they have rules and policies defining the roles, obligations and responsibilities of the various parties involved in default management, including surviving clearing participants. Almost all CCPs make use of some type of default management group or committee; at least for OTC derivatives products, the default management group typically consists of non-defaulting clearing participants who are seconded on a rotating basis to participate in at least part of the default management process. Such groups or committees provide advice on several aspects of portfolio closeout, including hedging and the execution of auctions. Arrangements often differ for exchange-traded products. Some CCPs would not plan to use auctions to close out positions in exchange-traded products. Others may use an auction for certain exchange-traded products, but would not rely on the default management group to advise on the auction process for these products. One CCP uses a default management group that does not contain clearing participants for exchange-traded products.

Regarding the order in which CCPs would use financial resources to cover losses following a clearing participant default, all CCPs have default waterfalls in their rules, which all rely on the same types of resources deployed in the same general order. One CCP seems to have discretion over the order of resources used.⁸² The CCPs would generally use default resources in the following order:

1. The defaulting clearing participant's margin and default fund contribution;
2. The CCP's contribution to default resources;
3. Default fund contributions from surviving clearing participants, which are typically allocated pro rata;
4. Loss allocation assessments and replenishment obligations from surviving clearing participants, which are typically allocated pro rata.

For more information on CCPs' own contributions to prefunded resources, see Section 5.2.3.2.

⁸² Specifically, it appears that this CCP's rules prescribe the order in which prefunded resources may be used, but do not prescribe an order for use of assessments.

5.6.4.2 Holding sufficient liquid net assets funded by equity to implement the recovery or orderly wind-down plan (Principle 15, KC 3)

Principle 15, KC 3 states “an FMI should maintain a viable recovery or orderly wind-down plan and should hold sufficient liquid net assets funded by equity to implement this plan. At a minimum, an FMI should hold liquid net assets funded by equity equal to at least six months of current operating expenses. These assets are in addition to resources held to cover clearing participant defaults or other risks covered under the financial resources principles. However, equity held under international risk-based capital standards can be included where relevant and appropriate to avoid duplicate capital requirements.” Most CCPs report that they hold liquid net assets funded by equity equal to at least six months of operating expenses. Some hold such assets to cover longer periods of operating expenses. For example, some CCPs hold such assets equivalent to 12 months of operating expenses, even though at least one CCP argues that recovering or winding down would take less than 12 months.

For most CCPs that hold liquid net assets funded by equity equal to at least six months of operating expenses, the actual amounts available would cover longer periods. Some CCPs report that they hold such assets sufficient to cover the greater of either six months of operating expenses or a modelled amount of such assets required to execute the recovery or orderly wind-down plan. At least one CCP holds liquid net assets funded by equity covering a significantly longer period. However, this amount is not based on the cost of executing a recovery or orderly wind-down plan, but rather the CCP’s capital needs more generally. Across all CCPs, the choice of how much liquid net assets funded by equity to hold seems to be driven by either requirements in national regulations or the minimum standard in the PFMI.

5.6.4.3 Consideration of insurance policies in the context of holding sufficient liquid net assets funded by equity to implement the recovery or orderly wind-down plan (Principle 15, KC 3)

Principle 15, KC 3 states “An FMI should maintain a viable recovery or orderly wind-down plan and should hold sufficient liquid net assets funded by equity to implement this plan.” The Recovery Report states that an “FMI will need to be able to recover from an extraordinary one-off loss or recurring losses from general business, custody and investment risks. To that end, an FMI needs to have both sufficient capital and a viable plan to recapitalise in circumstances where the FMI’s capital is used to absorb such losses. An FMI should also consider having explicit insurance or indemnity agreements to cover such losses.”

Several CCPs have insurance policies against some form of business risk loss. Of these CCPs, most do not consider their insurance policies when determining the whether they have sufficient liquid net assets funded by equity to implement their recovery or orderly wind-down plans, though some view insurance policies as providing supplemental assets above the assets required in Principle 15, KC 3. One CCP takes insurance into account in its calculation of the cost of implementing its recovery or orderly wind-down plans.

6. Summary and conclusions

This report has examined financial risk management and recovery practices in a diverse sample of CCPs.

Overall, the CCPs have made important and meaningful progress in implementing arrangements consistent with the financial risk management and recovery standards of the PFMI. Some gaps and shortcomings have nevertheless been identified relative to these standards. In the area of recovery planning, in particular, a number of CCPs have not yet put in place the full set of recovery rules and procedures envisaged in the PFMI. These CCPs, and their supervisors, regulators and overseers, should consider this to be a serious issue of concern that should be addressed with the highest priority.

Some gaps and shortcomings have also been identified in the areas of credit and liquidity risk management. Most notably: some CCPs have not yet put in place sufficient policies and procedures to maintain the required level of financial resources on an ongoing basis, including adequate arrangements to ensure a prompt return to the target level of coverage in the event of a breach; and some do not include sufficient liquidity-specific scenarios in their liquidity stress tests. Again, for such CCPs, these are serious issues of concern that should be addressed with the highest priority.

Relevant supervisors, regulators and overseers are encouraged to work with the CCPs for which they have responsibility to encourage prompt action in respect of these and any other issues of concern identified in this review that apply. From the information obtained in respect of related work carried out by the PSG, it is understood that the key findings are generally consistent with observations across a broader sample of CCPs and clearing services. Accordingly, while the report focuses on the sample of 10 CCPs that were assessed, other CCPs, as well as their supervisors, regulators and overseers, should also consider whether any issues of concern identified would be relevant to their circumstances. If so, prompt action should be taken to address them. In some cases, greater clarity and granularity to be provided by the CPMI and IOSCO in the additional guidance to the PFMI under development by the PSG will further assist the relevant CCPs in making the appropriate enhancements to their practices.

The IMSG has also identified a number of other material differences in the implementation outcomes achieved across the CCPs. Even where these are not regarded as issues of concern relative to standards under the PFMI, they may nevertheless reveal differences in interpretation or approach that could lead to material differences in resilience which may need to be addressed. Again, where this is the case, progress towards achieving greater consistency in outcomes will be further assisted by additional guidance to the PFMI. Of course, in some cases, variations exist because individual CCPs have chosen to exceed relevant minimum standards in the PFMI, or have done so in accordance with the specific implementation of the PFMI in their home jurisdiction.

The report has considered these findings in more detail and also discussed a number of other findings. Given that this first L3 assessment deals with matters relevant to ongoing work by the PSG on CCP resilience and recovery in the context of the CCP Workplan, the IMSG and PSG have coordinated their work. The findings of the L3 assessment have fed directly into the PSG's deliberations on additional guidance to the PFMI in this area.

The CPMI and IOSCO are committed to the ongoing monitoring of CCPs' progress towards full observance of the PFMI and the achievement of consistent outcomes across CCPs internationally. In the light of the findings of this review, the IMSG commits to a follow-up review, as set out below:

- In the first half of 2017, the IMSG commits to conducting a follow-up targeted review of CCPs' progress in addressing the most serious issues of concern identified in this review – ie in the areas of recovery planning, coverage of financial resources on an ongoing basis (including responses to breaches of target coverage), and the development of liquidity-specific scenarios in their stress testing framework. Where these issues of concern apply, CCPs are expected to make rapid progress in addressing them and are expected to have achieved outcomes of

implementation that are consistent with the PFMI by the effective date of this exercise. This will be 31 December 2016. In the case of recovery, the follow-up exercise will be informed by the Recovery Report.

This follow-up review is expected to cover a wider range of CCPs and product classes than have been considered in this exercise.

6.1 Governance of risk management

In general, the CCPs have made important and meaningful progress in the implementation of governance arrangements for financial risk management and recovery practices. All of the CCPs have documented and disclosed governance arrangements, approved by their respective boards. All report having risk management policies, procedures and systems to identify the range of risks to which they are potentially exposed, as well as frameworks and controls to ensure that risks are appropriately measured, monitored and managed.

The IMSG has just one key finding on variation in the outcomes of implementation across CCPs in the area of CCPs' governance of risk management.

- *Identification and consideration of stakeholder interests.* All CCPs have mechanisms in place for stakeholder engagement and disclosure of key risk management decisions. However, the scope of stakeholders captured by these arrangements, the role of stakeholders under these arrangements and the degree to which the board is bound by stakeholder views differ across CCPs. These differences may affect the effectiveness of these mechanisms.

6.2 Credit risk management

In general, the CCPs have made important and meaningful progress in the implementation of arrangements for the measurement, monitoring and management of credit exposures, in accordance with Principle 4. All of the CCPs collect margin and maintain other prefunded financial resources to cover participant exposures, with all but one reporting that they target a level of coverage consistent with relevant Cover 1 or Cover 2 standards in the PFMI. All use stress testing to determine the amount of prefunded resources held to cover participant default and have procedures to report the results of stress tests to relevant decision-makers. All but one of the CCPs perform daily stress testing to test the sufficiency of total prefunded financial resources.

However, in considering consistency of outcomes of implementation, the IMSG has identified a number of key findings. These represent issues of concern in some CCPs' implementation that should be addressed, as appropriate, to ensure full consistency with the PFMI. In particular:

- *Maintaining coverage on an ongoing basis.* The quantitative data suggest that in practice a small number of CCPs' prefunded financial resources may not be sized to meet the relevant target coverage on an ongoing basis. Furthermore, some CCPs do not have clear processes in place to promptly address any breach of target coverage.
- *Stress testing assumptions and processes.* In some cases, stress testing assumptions could be better calibrated to reflect more fully the challenges a CCP may face in managing a participant default in extreme but plausible market conditions. Most CCPs conduct a review of stress testing scenarios and parameters on at least a monthly basis, but some conduct such a review on a less frequent basis or on an ad hoc basis only.
- *Stress testing both exposures and financial resources.* In most cases the CCPs' stress testing focuses exclusively on exposures and does not additionally consider stresses to CCPs' financial

resources. This would not seem to meet the expectation in the PFMI to test the sufficiency of total financial resources under extreme but plausible market conditions.

- *Stress testing scenarios.* While the CCPs' stress testing frameworks generally include a wide range of historical and forward-looking scenarios, there are some material differences in CCPs' approaches:
 - All CCPs consider historical scenarios in stress testing, typically applying a specified lookback period. While some CCPs also include relevant peak volatilities outside of the lookback period, this is often not the case. This would not seem to be consistent with the intent of the relevant standard in the PFMI to consider *all* potentially relevant peak historical volatilities; some peaks are excluded simply because they no longer fall within the specified lookback period.
 - Some CCPs also consider theoretical (statistical analysis-based) scenarios and some additionally consider event-based hypothetical scenarios in their stress tests. Those CCPs that do not supplement historical scenarios with "a spectrum of forward-looking stress scenarios" would not be operating in accordance with the PFMI, with potential implications for financial resource sizing decisions.

The most serious of these issues of concern relates to the failure of some CCPs to establish sufficient policies and procedures to ensure that they maintain the target level of coverage on an ongoing basis, including adequate arrangements to promptly address any breach of target coverage. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

6.3 Liquidity risk management

In general, the CCPs have made important and meaningful progress towards meeting the standards of Principle 7. All CCPs set coverage targets to maintain liquid resources consistent with relevant Cover 1 or Cover 2 standards in the PFMI and use stress testing to assess the adequacy of their liquid resources.⁸³ As at June 2015, all CCPs stated that they maintained adequate qualifying liquid resources to at least meet their coverage targets and they had not identified a liquidity shortfall. However, the IMSG has identified a number of issues of concern in some CCPs' implementation of the PFMI. The IMSG's key findings in relation to liquidity risk management are:

- *Relevant currencies.* The CCPs have taken different approaches to determining which currencies should be included in liquidity stress testing. Some CCPs include only those currencies that they consider to be 'material'. However, failure to include all relevant currencies in stress testing could have resilience implications for the CCP.⁸⁴ In particular, the CCP may not be able to identify important exposures in some currencies; and the CCP may face a higher probability that it is unable to meet all of its payment obligations on time with a high degree of confidence.
- *Liquidity stress testing assumptions.* The scenarios and assumptions used by CCPs to stress test the size and adequacy of liquid resources are often similar to those used in credit stress testing.

⁸³ Since the effective date of the assessment preceded the issuance on 5 February 2016 of the statement on clearing of deliverable FX instruments, which clarified the requirement for CCPs to maintain qualifying liquid resources even when using a 'paired delivery' settlement process, this assessment did not take that statement into consideration; future assessments will do so.

⁸⁴ The CPMI and IOSCO note that the failure to maintain qualifying liquid resources in all relevant currencies could similarly have resilience implications. However, given the desktop nature of this review, the IMSG did not collect sufficiently detailed information to determine whether or not all CCPs maintain sufficient qualifying liquid resources in all relevant currencies.

Many of the issues identified in relation to credit stress testing – as summarised above – therefore apply equally to liquidity stress testing.

- *Liquidity-specific stress testing scenarios.* Some CCPs do not identify liquidity exposures that could arise independently of a credit exposure in their liquidity stress testing scenarios; and, as in the case of credit stress testing, some CCPs do not appear adequately to supplement the stress testing of their liquidity exposures with stress testing of their liquid resources.

The most serious of these issues of concern relates to some CCPs' failure to include sufficient liquidity-specific scenarios in their stress testing frameworks. It is expected that CCPs with shortcomings in this area will address them with the highest priority and no later than 31 December 2016.

6.4 Margin

In general, CCPs have made important and meaningful progress towards meeting the standards of Principle 6. All of the CCPs considered in the review apply initial and variation margin to derivatives exposures, using margin systems that in their judgment reflect the particular attributes of the cleared products. All of the CCPs perform daily, and often also more detailed periodic, backtesting of their margin models to assess the adequacy of initial margin against the targeted level of coverage. Most CCPs also undertake monthly sensitivity analysis to validate key model assumptions, as well as more comprehensive annual independent model validation exercises.

The IMSG's key findings on the implementation of margin-related standards in the PFMI relate primarily to variation in the outcomes of implementation across CCPs.

- *Model choice.* The CCPs' survey responses suggest that some CCPs may not systematically take into account all relevant factors in selecting from among alternative modelling approaches, or examine potential trade-offs between these factors.
- *Key model parameters and procyclicality.* A wide range of closeout periods and lookback periods are applied across the CCPs. Some assumptions are more conservative than others, and some CCPs could do more to demonstrate they have an appropriate method for measuring credit exposure that accounts for relevant product risk factors. The CCPs have also taken different approaches to dealing with procyclicality.
- *Review, backtesting, sensitivity analysis and model validation.* The depth and sophistication of the model testing and review processes vary across the CCPs. For instance, some CCPs perform a very wide range of tests, using both actual and hypothetical portfolios and a range of lookback periods, and have backtesting and sensitivity analysis fully integrated into their model review processes. Those CCPs that conduct more sophisticated and extensive testing may be able to demonstrate more convincingly that margin coverage targets are met.

6.5 Collateral policy and investments

In general, the CCPs have made important and meaningful progress in implementing standards in the PFMI relevant to collateral policy and investments. All of the CCPs report that they have adopted collateral policies that are designed to address relevant credit, liquidity, market and legal risks. All state that their haircuts are set in a prudent manner, with VaR the most widely used methodology for calibrating haircuts. Cash collateral posted by participants is invested or held in custody. All CCPs state that they prioritise the minimisation of credit and liquidity risks over investment returns, to mitigate potential risks arising from those investments.

The IMSG has made two key findings, both of which relate primarily to the consistency of outcomes of implementation across CCPs.

- *Cash collateral investment policy.* The CCPs deposit or invest cash collateral in different combinations of central bank deposits, commercial bank deposits, government bonds, reverse repurchase agreements, and other short-term instruments. These different approaches could involve different degrees of credit, market and liquidity risks.
- *Setting haircuts; procyclical adjustments.* There is a degree of variation across the sample of CCPs in the lookback periods used to define collateral haircuts, as well as the frequency at which the sufficiency of haircuts is assessed. All of the CCPs aim to set conservative haircuts, which contribute to mitigating potential procyclical adjustments under stressed market conditions. Some CCPs also set a floor for collateral haircut levels as an additional tool to mitigate procyclicality. CCPs apply different processes for adjusting their collateral haircuts over time, and some seek to phase in changes over time to limit procyclicality.

6.6 Default management and recovery planning

In general, the CCPs have made important and meaningful progress in implementing standards in the PFMI relevant to default management. All of the CCPs have established policies and procedures to manage clearing participant defaults, which in almost all cases are regularly tested. Arrangements differ somewhat across the CCPs, reflecting the characteristics of the products cleared, participant profiles and particular features of each CCP's operating environment.

In respect of recovery planning, however, some CCPs' progress in implementation has been significantly slower and a number of serious issues of concern have been identified. While a small number of CCPs had completed their recovery plans by the effective date of the IMSG's review, for most CCPs recovery planning is a fairly new and challenging exercise and experiences continue to evolve. Even among those CCPs that had detailed plans, relatively few considered their plans to be fully consistent with the PFMI. Nearly all are planning enhancements to their recovery plans to reflect guidance in the Recovery Report.

While the additional guidance in the Recovery Report was published only eight months before the effective date of the L3 review, the specific standards related to recovery planning were already established in the PFMI. The CPMI and IOSCO reiterate the importance of developing comprehensive and effective recovery plans, consistent with standards in the PFMI and informed by associated guidance in the Recovery Report.

The report has highlighted a number of serious issues of concern in specific elements of CCPs' recovery plans. These include the following:

- *Loss allocation and restoring a matched book.* Most CCPs have at least some tools to allocate potentially uncovered credit losses to participants, most commonly assessments on surviving participants, in some cases supplemented with some form of variation margin gains (or other payments) haircutting. Most CCPs also employ either a form of service tear-up or forced allocation as their final tool for restoring a matched book at least one of their clearing services. For the CCPs that do not have an uncapped loss allocation tool (whether through assessments, gains-based haircutting or service tear-up) in place, however, it is unclear whether their plans would comprehensively address uncovered credit losses. Similarly, for CCPs that do not have a mandatory tool for liquidating the positions of the defaulter, such as tear-up or forced allocation measures, it is unclear whether their plans would restore a matched book.
- *Replenishment.* Most CCPs have arrangements in place to replenish prefunded financial resources in the event of a drawdown following a participant default. There is a wide variation in the details of such arrangements, however, including in the timing of replenishment and the setting of caps on replenishment obligations. In some cases there is also no clear distinction between assessments on participants for the purposes of loss allocation and assessments to

replenish resources. Some CCPs have established delayed, phased or discretionary replenishment deadlines. While some of these CCPs have put in place interim measures to ensure that they can nevertheless continue to meet coverage standards, others have not; for these latter CCPs, it is unclear how they would ensure a timely return to full coverage following a depletion of resources. Such interim measures include calls for additional initial margin until replenishment of mutualised prefunded resources is complete.

- *Liquidity shortfalls.* Relatively few CCPs have arrangements in place to cover liquidity shortfalls with specific liquid resources, liquidity arrangements or liquidity generated by credit loss allocation tools. Some CCPs refer in their responses to the tools in place to avoid unforeseen and potentially uncovered liquidity shortfalls, but do not appear to have arrangements to deal with liquidity shortfalls should they actually arise. Even where arrangements are in place, some of these do not appear to meet the criteria set out in the Recovery Report.
- *Tools to address losses not caused by clearing participant default (ie non-default losses).* Most CCPs would rely on capital injections from holding companies, shareholders or insurance policies to address uncovered non-default losses. Some have also developed arrangements to allocate certain general business risk losses – principally, investment losses – to participants beyond some threshold. A number of CCPs plan to develop their recovery plans further to more comprehensively address non-default losses.

The CPMI and IOSCO expect CCPs with shortcomings in their recovery plans to accord the highest priority to developing and completing their plans. It is expected that these CCPs will have done so by 31 December 2016.

Annex A: Summary information for ASX Clear (Futures)

Overview and Product Scope

ASX Clear (Futures) Pty Limited (ASX Clear (Futures)) provides central counterparty (CCP) services for futures and options on Australian dollar- and New Zealand dollar-denominated interest rate, equity, energy and commodity products traded on the ASX 24 market, as well as Australian dollar-denominated over-the-counter (OTC) interest rate derivatives (IRD).⁸⁵

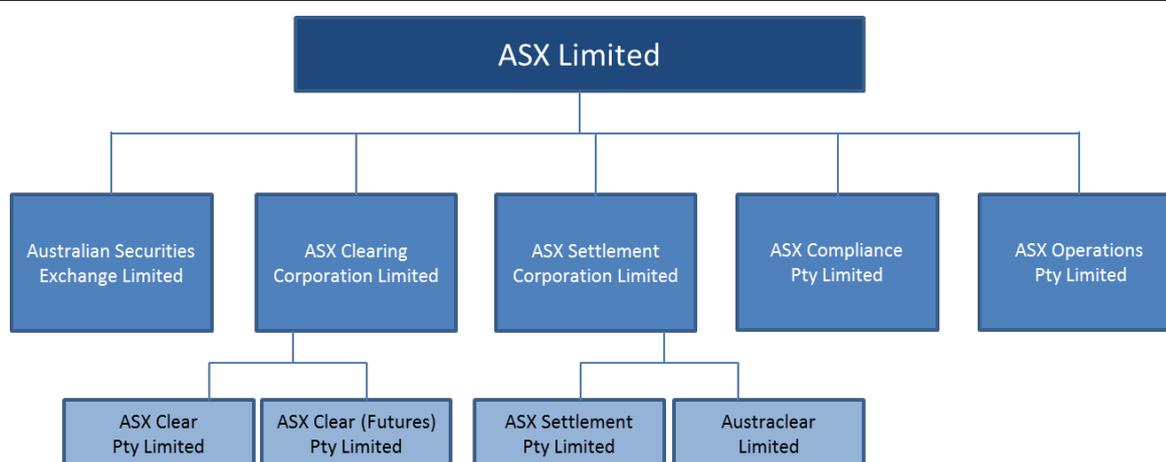
The review undertaken by CPMI-IOSCO considered risk management arrangements in respect of the full scope of derivatives products cleared by ASX Clear (Futures).

Structure and Governance

ASX Clear (Futures) is part of the broader ASX Group. In the ASX corporate structure, ASX Clear (Futures) and one other CCP (ASX Clear Pty Limited) are subsidiaries of ASX Clearing Corporation Limited (ASXCC) (Figure A1). ASXCC is in turn a wholly owned subsidiary of the ASX Group's parent entity, ASX Limited. ASX Limited is the licensed operator of the ASX market, while another subsidiary, Australian Securities Exchange Limited, is the licensed operator of the ASX 24 market. ASX 24 is an exchange for futures products cleared by ASX Clear (Futures), while the ASX market provides a trading platform for ASX-exchange-traded securities and equity derivatives that are cleared by ASX Clear. The group also includes two securities settlement systems/central securities depositories (SSS/CSDs) – ASX Settlement Pty Limited and Austraclear Limited.

ASX Group Structure

Figure A1



ASX Limited is a publicly listed company. The ASX Limited Board is responsible for overseeing the processes for identifying significant risks to ASX and ensuring that appropriate policies, as well as adequate control, monitoring and reporting mechanisms, are in place. In addition, ASX Limited's Board assigns certain responsibilities to subsidiaries within the ASX Group, including to the board of ASX Clear

⁸⁵ ASX Clear (Futures) primarily clears Australian dollar products; futures and options on New Zealand dollar-denominated interest rate and energy products represent a relatively small proportion of ASX Clear (Futures)' overall exposures.

(Futures) and the boards of the other CCP and SSS/CSDs. These boards are responsible for managing the particular clearing and settlement risks faced by each respective entity and for ensuring that they meet relevant regulatory obligations (see 'Regulatory Framework' below).

ASXCC is the holding company for, and manages the financial resources of, the two CCPs. It invests these resources according to a treasury investment policy and investment mandate approved by the boards of ASXCC and the CCPs.

To deliver its services, ASX Clear (Futures) relies on group-wide operational and compliance resources that reside in ASX Operations Pty Limited and ASX Compliance Pty Limited.

Regulatory Framework

Part 7.3 of the *Corporations Act 2001* establishes a licensing regime for clearing and settlement (CS) facilities in Australia. CCPs and Securities Settlement Facilities (SSFs) are the two types of CS facilities that operate in Australia; the term SSF includes both CSDs and SSSs. Licensing authority rests ultimately with the responsible Minister, with licence obligations specified in the Corporations Act – and in any supplementary licence conditions – administered by the Australian Securities and Investments Commission (ASIC). Compliance is overseen jointly by ASIC and the Reserve Bank of Australia (RBA).

- Under s 827D of the Corporations Act, the RBA may determine Financial Stability Standards (FSS) 'for the purposes of ensuring that CS facility licensees conduct their affairs in a way that causes or promotes overall stability in the Australian financial system'. The RBA's FSS for CCPs (and FSS for SSFs) were revised in December 2012 to align with the standards in the PFMI that address matters relevant to financial stability.⁸⁶ The RBA also has responsibility to ensure that licensees take any other necessary steps to reduce systemic risk. The RBA carries out continuous supervision of ASX Clear (Futures) against the FSS, conducting formal assessments of its compliance annually and reporting findings to the Minister. These formal assessments are published on the RBA's website.
- Under the Corporations Act, ASIC is responsible for ensuring that ASX Clear (Futures) complies with all other obligations, including the fair and effective provision of services. Together, the Corporations Act and the *Australian Securities and Investment Commission Act 2001* give ASIC a range of inspection, investigation and enforcement powers. These enable ASIC to carry out its regulatory functions, including for licensed CS facilities.⁸⁷

ASX Clear (Futures) is also recognised as a third-country CCP by the European Securities and Markets Authority (ESMA), under the *Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories* (EMIR) and has been granted an exemption from registration as a Derivatives Clearing Organization (DCO) by the US Commodity Futures Trading Commission (CFTC). ASIC and the RBA have agreed information sharing and cooperation arrangements with both ESMA and the CFTC in respect of the regulation of ASX Clear (Futures).

⁸⁶ A policy statement setting out how the Principles have been implemented in Australia is available at: <http://www.rba.gov.au/payments-and-infrastructure/financial-market-infrastructure/principles/implementation-of-principles.html>. The Australian authorities' implementation of the Principles was also recently independently assessed by CPMI and IOSCO. A report on the findings of this assessment may be found at: <http://www.bis.org/cpmi/publ/d140.pdf>.

⁸⁷ ASIC's regulatory guidance for CS facilities is available at: <http://www.asic.gov.au/regulatory-resources/find-a-document/regulatory-guides/rq-211-clearing-and-settlement-facilities-australian-and-overseas-operators>.

Risk Management Framework

ASX's high-level framework for risk management divides risks identified by ASX into two broad categories: strategic risks and operational risks. Operational risks are further categorised into financial risks, legal and regulatory risks, and technological and operational risks. Within financial risks, ASX Clear (Futures) has further identified that it bears counterparty credit, market and liquidity risks arising from its activities as a CCP.

ASX Clear (Futures) manages its exposures to participants in a number of ways, including through:

- *Participation requirements.* ASX Clear (Futures) requires participants to hold at least \$5 million in net tangible assets (NTA). Participants using the OTC derivatives clearing service must meet a higher minimum NTA (or Tier 1 Capital) requirement of \$50 million.
- *Risk monitoring and compliance.* ASX Clear (Futures) actively monitors its exposure to financial risk. This includes monitoring and validation of information regarding, among other things, financial requirements, risk profiles and open positions of its clearing participants. ASX Clear (Futures) also has wide-ranging powers to sanction participants if needed, including to suspend or terminate a participant's authority to clear some or all market transactions in the event of a default.
- *Margin collection.* ASX Clear (Futures) utilises various forms of margin to cover exposures to its participants.
 - Variation margin is collected at least daily from participants with mark-to-market losses and paid out to participants with mark-to-market gains.
 - Initial margin is called from each participant to cover the credit risk arising from potential changes in the market value of a defaulting participant's open positions between the last settlement of variation margin and the close out of its positions by the CCP. ASX Clear (Futures) uses a SPAN model to calculate initial margin on exchange-traded products, and a historical value at risk model to calculate initial margin on OTC derivatives.
 - ASX Clear (Futures) re-calculates margin requirements on an intraday basis, both at scheduled times or following significant market movements, calling for additional collateral where there is significant erosion in the margin cover provided by individual participants.
 - ASX Clear (Futures) may also make calls for additional initial margin when exceptionally large or concentrated exposures are identified through stress testing, or when predefined limits on the ratio of positions to capital are exceeded.
- *Prefunded pooled financial resources.* ASX Clear (Futures)' prefunded pooled financial resources total \$650 million, sized to cover the potential loss on the default of two participants and their affiliates. This includes \$360 million of ASX capital, \$200 million of contributions from participants and a \$90 million subordinated loan from ASXCC.
- *Recovery tools.* ASX Clear (Futures) has developed recovery arrangements designed to address situations in which prefunded pooled financial resources, or prefunded liquid resources, could be insufficient to fully absorb default-related losses. These include powers to call additional cash from participants, to haircut outgoing payments to participants or, in the most extreme cases, to terminate contracts. Other recovery tools are available to address threats to ASX Clear (Futures)' viability from sources other than a participant default. Some of these powers, while agreed prior to the effective date of the review, were implemented in the ASX Clear (Futures) rulebook on 1 October 2015. Some further enhancements to replenishment arrangements were implemented in 2016.

Published Information on ASX Clear (Futures)

- CCP overview web page: <http://www.asx.com.au/services/clearing/asx-clear-futures.htm>
- OTC IRD clearing web page: <http://www.asx.com.au/services/otc-clearing.htm>
- PFMI Disclosure Framework: <http://www.asx.com.au/documents/asx-compliance/pfmi-disclosure-framework.pdf>
- PFMI Quantitative Disclosure Framework: <http://www.asx.com.au/regulation/regulatory-compliance/asx-clear-futures.htm>
- Rulebook: <http://www.asx.com.au/regulation/rules/asx-clear-futures-operating-rules.htm>
- Summary of risk management policies: <http://www.asx.com.au/documents/about/summary-of-risk-management-policies.pdf>
- The RBA's 2014/15 Assessment of ASX Clear (Futures) and other ASX CS facilities against the FSS: <http://www.rba.gov.au/payments-and-infrastructure/financial-market-infrastructure/clearing-and-settlement-facilities/assessments/2014-2015/>
- ASIC and RBA's September 2014 Assessment of ASX Clear (Futures) and other ASX CS facilities against the PFMI: <http://www.rba.gov.au/payments-and-infrastructure/financial-market-infrastructure/principles/assessments/asx/2014/index.html>

Annex B: Summary information for BM&FBOVESPA Clearinghouse

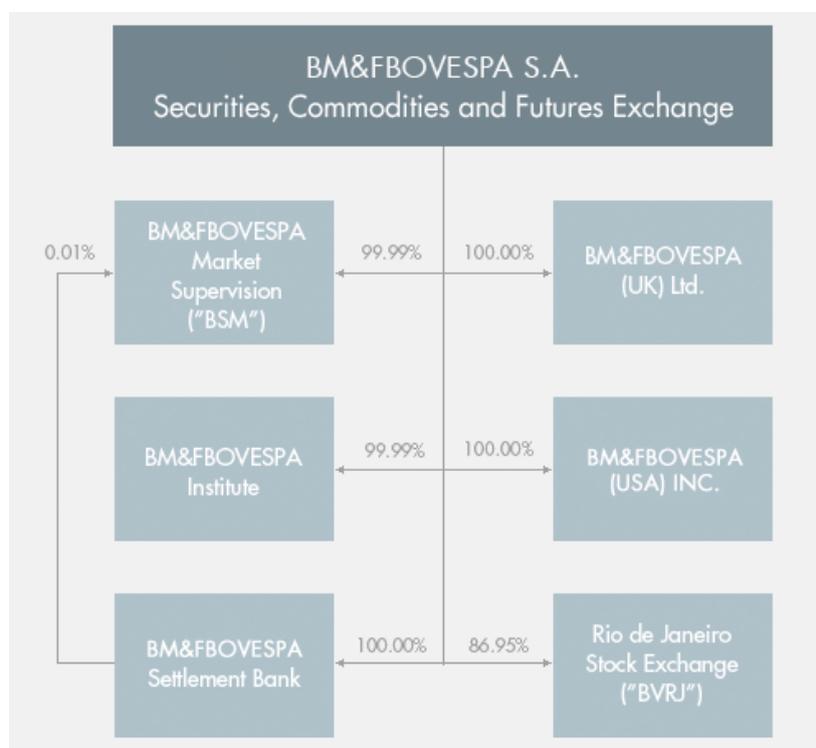
Overview and Product Scope

BM&FBOVESPA S.A. — Securities, Commodities & Futures Exchange (BM&FBOVESPA) is a vertically integrated multi-asset exchange that operates both exchange-traded and over-the-counter markets, also acting as a central securities depository, clearinghouse and central counterparty (CCP), offering a comprehensive array of products and services. BM&FBOVESPA provides clearing services through four clearinghouses, namely BM&FBOVESPA Clearinghouse (financial and commodities derivatives and gold), Equities Clearinghouse (equities cash, derivatives and lending markets, corporate fixed income market), Foreign Exchange Clearinghouse (US dollar spot market) and Government Bonds Clearinghouse (Brazilian government bonds market).

BM&FBOVESPA is developing a post-trading integration project, which first stage was completed in 2014, consisting of the establishment of BM&FBOVESPA Clearinghouse, which featured a new clearing platform and a new risk management system, and replaced the former Derivatives Clearinghouse. The second stage of the project, currently under development and scheduled for completion in the second half of 2016, consists of the extension of CCP services by the BM&FBOVESPA Clearinghouse to equities and fixed income markets, thus ceasing the functioning of the Equities Clearinghouse. Finally, the US dollar spot market and the Brazilian government bonds market will be served by the BM&FBOVESPA Clearinghouse and the Foreign Exchange Clearinghouse and Government Bonds Clearinghouse will be closed down. Only BM&FBOVESPA Clearinghouse is in the scope of the Level 3 Assessment.

Structure and Governance

The main objectives of BM&FBOVESPA are to manage organized markets for bonds, securities and derivatives contracts, and to provide registration, clearing and settlement services, acting mainly as a CCP for the financial settlement of transactions carried out in the markets it manages. Created in 2008 with the integration between BM&F and BOVESPA, with headquarters in the city of São Paulo, BM&FBOVESPA is a public company and trades under the ticker symbol BVMF3 on the “Novo Mercado” special listing segment for companies committed to best practice in corporate governance. It is also part of the Ibovespa, IBrX-50, IBrX and ITAG indices, among others.



- BM&FBOVESPA Settlement Bank is a wholly-owned subsidiary organized with the purpose of facilitating the clearing and settlement of transactions carried out in the markets managed by BM&FBOVESPA, and acting as an important mechanism for risk mitigation and operational support.
- BM&FBOVESPA Institute is a civil society organization created in 2007 for the purpose of integrating and coordinating BM&FBOVESPA's social investment projects.
- BM&F Market Supervision is a not-for-profit association organized as a self-regulatory and market surveillance organization which, consistent with the Securities and Exchange Commission of Brazil (CVM) Ruling 461/07, is responsible for regulatory and oversight activities relative to the markets managed by BM&FBOVESPA.
- BM&F USA Inc. is a wholly-owned subsidiary based in New York, which also operates a representative office in Shanghai, China. It operates as a cross-border representative office, establishing professional relationships with other exchanges and market regulators, prospects customers for the markets managed by BM&FBOVESPA and disseminates information about the Brazilian market.
- BM&FBOVESPA (UK) Ltd. is a wholly-owned subsidiary based in London, which promotes BM&FBOVESPA's markets, products and services to institutional investors in Europe, the Middle East and Africa, establishes professional relationships with market regulators, governmental entities, and the exchanges of the region, and assists in prospecting new customers for BM&FBOVESPA markets.
- Rio de Janeiro Stock Exchange is an inactive stock exchange. Since 2004, it has been renting space in its headquarters building where interested parties can hold a variety of events.

Regulatory Framework

The Brazilian financial and capital markets are regulated and supervised by National Monetary Council (CMN), Central Bank of Brazil (BCB) and Securities and Exchange Commission of Brazil (CVM). The regulatory framework is based on the Law 4,595/64 (National Financial System Law), Law 4,728/65 (Financial & Capital Markets Law), Law 6,385/76 (Securities Law), Law 10,214/01 (Clearinghouses Law) and Law 12,810/13 (Central Securities Depository Law), CMN Resolution 2882/01 (provisions about payment system and clearing and settlement systems), BCB Circular 3057/01 (the functioning of clearinghouses) and CVM Instruction 461/07 (governs the regulated security markets).

According to the Brazilian regulatory framework, the creation and management of regulated securities markets and settlement and custody systems, as well as the activities of trade repositories, require prior authorization by CVM and/or BCB, depending on the market and respective sphere of legal and regulatory competence.

Risk Management Framework

BM&FBOVESPA is exposed to strategic risks (possibility of implementing an unsuccessful or ineffectual strategy or a strategy that fails to achieve the expected returns), financial risks (including credit, market and liquidity risks), operational risk, legal risk and reputational risk, maintaining a governance structure for risk management designed to assure the identification, measurement, control and mitigation of the material risks inherent in its business and activities. BM&FBOVESPA's Board of Directors has established two risk management frameworks: a) the corporate risk management framework which comprises activities based on the responsibilities established by BM&FBOVESPA's Corporate Risk Management Policy, Operational Risk Policy and Internal Controls Policy; and b) the CCP risk management framework which is based on the following structure of responsibilities and accountability.

- Financial and Risk Committee (advises the Board of Directors): defines the risk appetite;
- Executive Board: carries out all corporate business managerial actions;
- Credit Risk Technical Committee (an advisory committee to the CEO): approves risk limits assigned to participants in BM&FBOVESPA Clearinghouse;
- Market Risk Technical Committee (an advisory committee to the CEO): defines the criteria and parameters to be used in calculating margin requirements and the value of collateral;
- Risk Analysis Advisory Committee (where market participants are members): analyses BM&FBOVESPA's risk methodologies; and
- Risk Management Department: implements and controls guidelines and policies in accordance with the strategy defined.

Besides pre-trading risk limits, price limits, and daily mark to market, it is important to highlight the following within BM&FBOVESPA Clearinghouse's framework for managing risk exposures to participants:

- *Admission criteria*: rules and minimum operational and financial requirements for acceptance of clearing participants and intermediaries;
- *Co-responsibility structure*: defining credit relationships and hence responsibilities in the event of default, between customers and intermediaries, intermediaries and clearing participants, and clearing participants and BM&FBOVESPA;
- *Safeguard structure*: establishes a tiered structure of collateral and resources designed to absorb potential losses associated with default by one or more participants. The safeguards are aimed

at covering market risk and liquidity risk. The safeguards aimed at covering liquidity risk consist of (i) both collateralized and uncollateralized liquidity assistance facilities based on contracts between BM&FBOVESPA and financial institutions (banks); and (ii) a portion of the BM&FBOVESPA own capital. The safeguards aimed at covering market risk are arranged in two layers:

- Layer 1 is constituted by (i) collateral posted by customers to cover losses associated with their positions in the event of failure to perform their obligations; (ii) collateral posted by intermediaries (full trading participants, settlement participants) and clearing participants to cover the intraday risk arising out of transactions registered under their responsibility; and (iii) minimum non-operating collateral deposited by full trading participants and clearing participants.
 - Layer 2 is the default fund, made up of (i) contribution by clearing participants and (ii) a contribution by BM&FBOVESPA, which consists of a portion of its capital allocated to the fund. The default fund has never been used, even taking into consideration Derivatives Clearinghouse existence period. The adequacy of the default fund size is assessed according to a stress test methodology with 99.99% severity level (a crisis every 40 years).
- *Intraday and daily margin calls*: assurance of adequate amounts available in each component of the safeguard structure.
 - *Position concentration limits*: upper limits for long and short positions per instrument, applicable to the customer or group of customers acting jointly (conglomerate), considering the customer's (conglomerate's) aggregated positions under all intermediaries and clearing participants. Breaches of position limits may result in additional margin calls (concentration add-on) and/or compulsory position closeout.
 - *Collateral limits*: upper limits for concentration per asset class and for the total amount of illiquid assets posted as collateral by the customer (or conglomerate), considering its aggregated positions under all intermediaries and clearing participants.
 - *Intraday risk limit*: assigned to each intermediary, it corresponds to the highest collateral shortfall allowed during the day for the concerned intermediary. The adequacy of the intermediary to the limit is monitored by the Risk Management Department on an intraday basis every 10 minutes by updating positions and collateral.

The Risk Management Department monitors the adequacy of margin parameters on a daily basis, reporting any instances of violation of such parameters to the Market Risk Technical Committee, which reviews all key methodology parameters (such as stress scenarios and time horizons) on a fortnightly basis, and reviews the most stable/less important parameters at least once a month.

Published Information

- BM&FBOVESPA investor relations website: <http://ir.bmfbovespa.com.br/?idioma=enu>
- BM&FBOVESPA Bylaws, Codes and Policies: <http://ir.bmfbovespa.com.br/static/enu/estatutos-codigos-politicas.asp?idioma=enu>
- BM&FBOVESPA – Securities, Commodities and Futures Exchange website: <http://www.bmfbovespa.com.br/en-us/home.aspx?idioma=en-us>

- BM&FBOVESPA Rules/Regulations/Derivatives: <http://www.bmfbovespa.com.br/en-us/rules/regulations/operational-regulations/derivatives.aspx?Idioma=en-us>
- BM&FBOVESPA Rules/Operational Procedures/Derivatives: <http://www.bmfbovespa.com.br/en-us/rules/regulations/operational-procedures/derivatives.aspx?Idioma=en-us>

Annex C: Summary information for Clearing Corporation of India limited (CCIL)

Overview and Product Scope

The Clearing Corporation of India Ltd. (CCIL), set up in April 2001, has been authorised to operate various payment system under the Payment and Settlement Systems Act, 2007. It provides clearing and settlement to the wholesale market players which are also regulated entities.

The review undertaken by CPMI-IOSCO considered risk management arrangements in respect of the full scope of derivatives products cleared by CCIL (currently, Forex Forwards).

Structure and Governance

CCIL is incorporated as a Public Limited Company under the Companies Act, 1956. It is a user owned company, shares in which are held by various public and private sector banks and financial institutions. CCIL has a wholly owned subsidiary Clearcorp Dealing Systems (India) Limited (Clearcorp), set up to provide electronic dealing systems and platforms in Collateralised Borrowing and Lending Obligations (CBLO), Repos, foreign exchange, derivatives, etc. There is interdependency, integration of operations carried out between CCIL and Clearcorp with respect to Straight Through Processing of trades. CCIL also functions as a Trade Repository and through its wholly owned subsidiary Legal Entity Identifier India Limited (LEIL) issues Legal Entity Identifiers (LEI) as well.

As part of the structure of Corporate Governance put in place by CCIL, all the activities of CCIL are overseen by the Board of Directors of the Company. The Board is represented by the nominees of the shareholders and independent directors. The Board undertakes review of the activities through the committees of directors entrusted with specific functions and oversees the same by close monitoring through periodic meetings.

Regulatory Framework

The regulatory framework under which CCIL operates as a Central Counterparty comprises of the Payment and Settlement Systems Act, 2007 (PSS Act), the Payment and Settlement Systems Regulations, 2008 (PSS Regulations) and directives thereunder. The PSS Act confers upon the Reserve Bank of India (RBI) the power to authorize, regulate and supervise payment systems. CCIL has been authorized as a "System Provider" under Section 7 of the PSS Act to operate payment systems viz., (i) Securities Segment – Outright & Repo trades in Government Securities, (ii) Collateralised Borrowing and Lending Obligations (CBLO), (iii) Forex Settlement Segment comprising of sub segments:- USD-INR Segment, CLS Segment and Forex Forward Segment and (iv) Rupee Derivatives Segment – Rupee Denominated IRS trades in IRS & FRA. CCIL is also the designated trade repository under the PSS Act.

The PSS Act provides for the regulation and supervision of payment systems as also empowers RBI to determine and prescribe the standards for payment systems and issue guidelines which it may consider necessary for the proper and efficient management of the payment systems. The Bye-Laws, Rules and Regulations of CCIL have been approved by RBI under the PSS Act and are also included

under the Schedule to Regulation 5 of the PSS Regulations, making them subordinate legislation. The FMI, including the CCIL, are regulated and supervised as per the PFMI.⁸⁸

Risk Management Framework

CCIL offers central counterparty (CCP) clearing services for trades in Indian government Securities, Forex (including Forward trades), CBLO segments and Rupee OTC derivative trades. At an enterprise level, its activities as a CCP expose CCIL to Credit (including Settlement Bank Risk), Market, Liquidity, Operational, Legal and Reputation Risks. For cash products the risks arise mainly on account of settlement failures due to default by counterparties. In case of Derivative trades with longer maturities, apart from risk of participant default, inability to meet day to day margin requirements by the members may also pose considerable risk.

CCIL manages its exposures to participants in the following ways:

- *Membership requirements:* Membership and access criteria are different for different segments. It depends on the conditions required to be fulfilled for trading/dealing in the respective market and /or the minimum requirement to settle such trades (for instance, in Forex Settlement only authorised dealers can be participants). Participation requirements are adequately tailored to ensure participation of all eligible entities and any restriction imposed is only on risk ground or due to regulatory prescriptions. Participation requirements are reviewed on a periodic basis.
- *Member Exposure monitoring:* CCIL actively monitors its exposures arising out of CCP clearing on an online real time basis. CCIL's Bye-laws, Rules and Regulations give it wide-ranging powers for suspension of a participant and its orderly exit in the event of a default. For any existing participant which does not fulfil eligibility criteria, already accepted positions are frozen and no new positions are accepted.
- *Settlement Risk:* CCIL eliminates settlement risk through a process of multilateral netting and DVP or PVP modes of settlement, while settling transactions in the cash market.
- *Margin collection:* Current and potential future exposures to each participant are covered through margins collected from the members. Margins are in the form of Government of India securities and cash. Haircut is also accounted for in case securities are provided as collaterals.
 - Potential Future Exposures are covered using VaR based Initial Margins in all segments. In derivative products like Forex Forwards and Rupee Derivatives, replenishment level and rejection levels are prescribed to cover sudden increase in potential future exposure (PFE) due to jump in market volatility. On reaching replenishment level (90% utilization of available margin) members are required to replenish. However on reaching rejection level (95% utilization of available margin), CCIL would not accept any new trade for guaranteed settlement.
 - Mark to Market margin is charged daily at the end of the day. Intra day MTM losses if any, are assessed at scheduled times and if the losses are higher than the pre defined threshold⁸⁹, such losses are recovered from participants in the form of intra day MTM margin.
 - CCIL has provision for collection of volatility margin when there is a sudden increase in volatility in the market.

⁸⁸ Policy for "Regulation and Supervision of Financial Market Infrastructures regulated by RBI" https://www.rbi.org.in/scripts/bs_viewcontent.aspx?Id=2705.

⁸⁹ Significant erosion of the cover provided by the VaR based Initial Margin.

- Margins are back tested on a daily basis.
- *Prefunded risk resources:* CCIL has Settlement Reserve Fund (SRF) created out of its own profits. The balance in this Reserve as on 31st March 2016 was slightly in excess of INR10,000 Million. This reserve is available to meet residual losses arising out of events such as defaults by clearing participants, settlement bank failures, operational events, etc. Apart from this, it has committed lines of credit in both funds and securities to take care of immediate liquidity shortfall while meeting an event of a settlement shortage.

The liquid net asset available is higher than six months' current operating expenses. Resources designated to cover business risks and losses are separated from resources designated to cover the default of a member. These balances are kept separately in liquid instruments such as bank deposits and Treasury Bills.

Stress testing is carried out on a daily basis from both solvency and liquidity perspectives. Reverse stress tests are also carried out periodically.
- *Recovery tools:* CCIL has provided for its insolvency in its Bye-laws and this will guide the requirements. CCIL is in the process of development of a detailed recovery plan [https://www.ccilindia.com/Documents/whats_new/2015/Consultation%20Paper_%20CCP%20Recovery%20And%20Resolution_310715\(final\).pdf](https://www.ccilindia.com/Documents/whats_new/2015/Consultation%20Paper_%20CCP%20Recovery%20And%20Resolution_310715(final).pdf).

Published Information on CCIL

Overview web page: <https://www.ccilindia.com/Pages/default.aspx>

CCIL's response to the PFMI Disclosure Framework:
<https://www.ccilindia.com/RiskManagement/Pages/PFMIDisclosures.aspx>

Other publications of public interest by CCIL:
<https://www.ccilindia.com/Research/CCILPublications/Pages/Default.aspx>

Annex D: Summary information for CME Clearing

Overview and Product Scope

CME Clearing provides central counterparty (“CCP”) services for a broad range of exchange-traded and over-the-counter (“OTC”) derivatives across all major asset classes, including interest rates; equity indexes; foreign exchange; energy, metals, agricultural commodities; and alternative investment products; and OTC IRS, OTC CDS, OTC FX, and OTC agriculture and metal products.

The review undertaken by CPMI-IOSCO considered CME Clearing’s risk management arrangements in respect of the following derivatives products: exchange-traded interest rate, equity, and commodity derivatives and OTC interest rate, OTC credit and OTC FX derivatives.

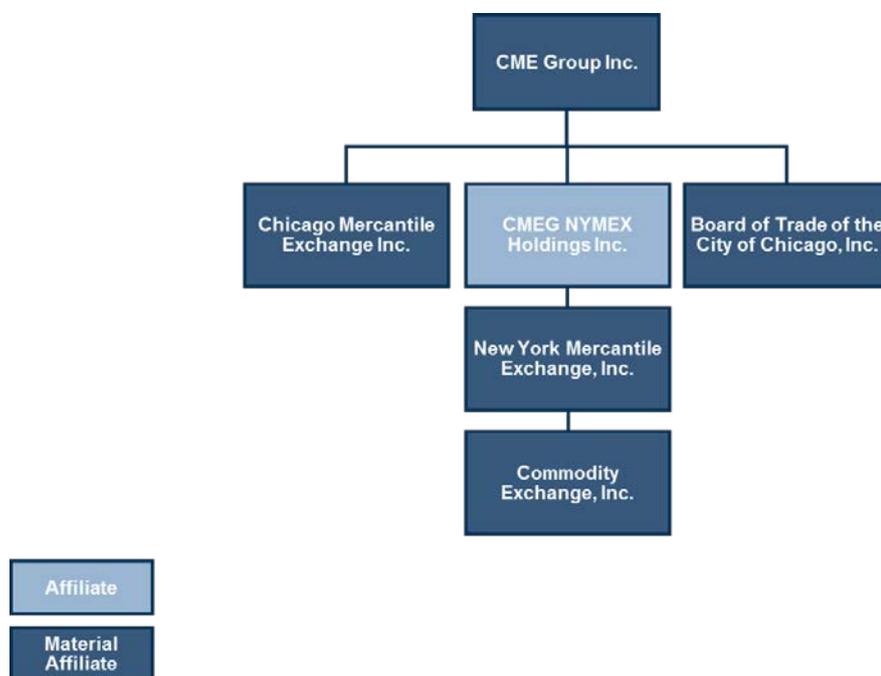
Structure and Governance

CME Clearing is part of the broader CME Group Inc. (“CME Group”). CME Group is the holding company for four U.S. exchanges: CME Inc., the Board of Trade of the City of Chicago Inc., the New York Mercantile Exchange, Inc., and the Commodity Exchange, Inc. All four exchanges are wholly owned subsidiaries of CME Group. (Figure D1)

CME Clearing is a division of CME Inc.

CME Group Structure Relevant to CME Inc.

Figure D1



The governance arrangements of the Clearing division of CME Inc. are driven primarily by:

- Its registration as a derivatives clearing organization (“DCO”) with the U.S. Commodity Futures Trading Commission (“CFTC”), its primary regulator;

- Its designation as a systemically important under Title VIII of the Dodd-Frank Wall Street Reform and Consumer Protection Act (“Dodd-Frank”) by the Financial Stability Oversight Council (“FSOC”);
- Delaware corporate law (Delaware is the U.S. state in which CME Group is incorporated);
- Listing standards of CME Group as a publicly listed and traded company.

To oversee risks relating specific to its clearing services, the Board of Directors of CME Group (the “Board”), which is comprised of the same individuals as the Board of CME, Inc., has established key committees chaired by members of the Board and comprised of other Board members and market participants. These committees include: the Clearing House Risk Committee, the IRS Risk Committee, and the CDS Risk Committee (collectively referred to as the “CME Clearing Risk Committees”). The CME Clearing Risk Committees are responsible for the oversight of risk management policy issues and the financial safeguards systems relevant to the asset class in which they have primary oversight of (ie futures and options on futures, IRS, CDS, etc.).

Regulatory Framework

Section 5b of the Commodity Exchange Act (“CEA”)⁹⁰ requires an entity acting as a DCO to register as a derivatives clearing organization with the CFTC, and sets forth the Core Principles with which the DCO must comply in order to obtain and maintain its registration. There are 18 Core Principles for DCOs.⁹¹ The Core Principles address compliance, financial resources, participant and product eligibility, risk management, settlement procedures, treatment of funds, default rules and procedures, rule enforcement, system safeguards, reporting, recordkeeping, public information, information sharing, antitrust considerations, governance fitness standards, conflicts of interest, composition of governing boards, and legal risk.⁹²

Part 39 of the CFTC’s Regulations,⁹³ implements Section 5b of the CEA by establishing specific requirements for compliance with the Core Principles, as well as procedures for registration. In particular, Subpart C of Part 39,⁹⁴ is intended to cover, for systemically important DCOs (“SIDCOs”)⁹⁵ and other DCOs that have elected to be held to such standards, gaps between Subparts A and B of Part 39 and the standards of the Principles for Financial Market Infrastructures (“PFMIs”).⁹⁶

The CFTC’s Division of Clearing and Risk (“DCR”) is responsible for all aspects of supervision of DCOs, including SIDCOs.

On at least an annual basis, the CFTC conducts an examination of CME Clearing in consultation with the Board of Governors of the Federal Reserve System. In this examination, the CFTC reviews and evaluates CME Clearing’s compliance with applicable CFTC Regulations and other relevant regulations.

⁹⁰ 7 U.S.C. §7a-1.

⁹¹ See CEA §5b(c)(2)(A)-(R), 7 U.S.C. §7a-1(c)(2)(A)-(R).

⁹² *Id.*

⁹³ 17 C.F.R. Part 39.

⁹⁴ 17 C.F.R. §39.30-39.41.

⁹⁵ A SIDCO is a DCO which has been designated by the Council as systemically important, and for which the CFTC is the Supervisory Agency. See Dodd-Frank §803(8), 12 U.S.C. §5462(8)).

⁹⁶ See 17 C.F.R. §39.40.

Risk Management Framework

CME Clearing maintains a Risk Management Framework ("RMF"), which encompasses the risk management policies and methodologies used to meet its standards for prudent risk management. These policies and procedures conform to CME Clearing's regulatory requirements, including CFTC Regulation 39.13(b), which requires each DCO to maintain a written risk management framework. Additionally, other policies and procedures supplement the RMF and more granularly address the risks to which CME Clearing is exposed through its activities.

The RMF in conjunction with its supplementary policies and procedures describes CME Clearing's approach for managing the risks facing the Clearing House, which include, but are not limited to: credit risk, market risk, liquidity risk, concentration risk, default risk, investment risk, legal risk, model risk, operational risk, reputational risk, sovereign risk, and wrong-way risk.

With respect to managing its exposures to market participants, CME Clearing utilizes a number of measures, including the following:

- Participation requirements. Clearing participants are required to, in relevant part, deposit an amount determined by the exchange memberships for which it holds and hold a minimum of 5 million USD to clear exchange traded futures and options and 50 million USD to clear any OTC product.
- Risk monitoring. Clearing participants are subject to daily, monthly, quarterly, and annual financial reporting requirements. In addition, CME Clearing monitors and validates information regarding risk profiles and open positions. Further, CME Clearing requires all clearing participants to have written risk management policies and procedures that ensure clearing participants are able to perform certain risk and operational functions at all times. All clearing participants are subject to onsite examinations and ongoing oversight by the appropriate CME Clearing Risk Committee. CME Clearing requires notification of any clearing participant failure to comply with CME's participation requirements. CME Clearing has broad powers to sanction clearing participants, including suspension or termination of a clearing participant's authority to clear some or all market transactions in the event of a default.
- Margin Collection. CME Clearing utilizes variation margin to eliminate current exposures and initial margin to cover potential future exposures between its clearing participants. At least daily, variation margin is collected from participants with mark-to-market losses and paid to participants with mark-to-market gains. CME Clearing also reserves the right to perform additional ad hoc intra-day settlement cycles as market conditions warrant or to call for additional performance bonds as necessary. Initial margin is called (twice a day for certain products) from participants to cover credit risk arising from potential changes in the market value of a defaulting participant's open positions between the last settlement of variation margin and the close out of these positions by the CCP. CME Clearing employs the following portfolio risk assessment models: SPAN (exchange traded derivatives and a small number of OTC instruments), HVaR (OTC Interest Rate Swaps and OTC Foreign Exchange), and Multi-Factor Algorithm (OTC-CDS).
- Prefunded guaranty fund resources (pooled risk resources). CME Clearing's prefunded financial resources total over 6 billion USD and are sized to cover at least the losses associated with the default of the two largest participants in extreme but plausible market conditions. This includes over 6 billion USD of contributions by participants and over 300 million USD of CME Inc.'s own dedicated capital.
- Recovery. CME Clearing's recovery plan sets forth CME Clearing's tools for addressing uncovered losses and/or liquidity shortfalls with respect to member default(s) and non-default losses. The plan documents the information and procedures CME can use to effect recovery

and continue to provide critical operations and services when its viability is threatened. These procedures include, but are not limited to, powers to call for additional cash from participants, haircutting outgoing payments to participants, and voluntarily termination of contracts.

Published Information on CME Clearing:

- Overview web page: <http://www.cmegroup.com/>
- OTC clearing page:
http://www.cmegroup.com/trading/otc/?utm_source=trading_flyout&utm_medium=otc&utm_campaign=flyout
- OTC IRS clearing web page: <http://www.cmegroup.com/trading/interest-rates/cleared-otc/>
- CDS clearing page: <http://www.cmegroup.com/trading/cds/>
- CME Clearing's response to the PFMI Disclosure Framework: <http://www.cmegroup.com/clearing/risk-management/files/cme-clearing-principles-for-financial-market-infrastructures-disclosure.pdf>
- CME Clearing's Response to the PFMI Quantitative Discourse Framework: <https://www.cmegroup.com/clearing/cpmi-iosco-reporting.html>
- Summary of CME risk management policies: <http://www.cmegroup.com/clearing/files/financialsafeguards.pdf>
- Summary of Clearing Membership Requirements: <https://www.cmegroup.com/company/membership/files/Summary-of-CMEG-Clearing-Membership-Requirements.pdf>
- Clearing Membership Handbook:
<http://www.cmegroup.com/company/membership/files/cme-group-clearing-membership-handbook.pdf>

Annex E: Summary information for Eurex Clearing AG

Overview and Product Scope

Eurex Clearing AG (Eurex Clearing) is a central counterparty (CCP) authorised under the European Market Infrastructure Regulation (EMIR)⁹⁷ and a credit institution under the German Banking Act (KWG). Furthermore Eurex Clearing was registered as a Derivative Clearing Organisation (DCO) by the Commodities Futures Trading Commission (CFTC) in accordance with the Commodity Exchange Act (CEA). In addition, Eurex Clearing is also subject to the German Recovery and Resolution Act (SAG).

Eurex Clearing performs the duties of a CCP and clears transactions concluded on Eurex Frankfurt AG and Eurex Zürich AG (Eurex exchanges); the Frankfurter Wertpapierbörse (the Frankfurt Stock Exchange), the Irish Stock Exchange; Eurex Repo GmbH; and Eurex Bonds GmbH as well as for OTC Interest Rate Swaps and Securities Lending transactions.

The review undertaken by CPMI-IOSCO considered risk management arrangements for all products cleared by Eurex Clearing, as of end-June 2015.

Structure and Governance

Eurex Clearing is a wholly owned subsidiary of Eurex Frankfurt AG (Eurex Frankfurt), a German stock corporation which is wholly owned by Deutsche Börse AG, a German stock corporation listed at the Frankfurt Stock Exchange (Figure E1).

Deutsche Börse Group Structure (with focus on Eurex)

Figure E1

⁹⁷ Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories (EMIR).



Eurex Clearing has a two-tier board structure in place: Executive Board and Supervisory Board. The responsibilities of the “Board” are allocated as below:

- As part of conducting the business of Eurex Clearing in accordance with § 76 Stock Corporation Act (AktG) the Executive Board establishes the objectives and strategies for Eurex Clearing. The Supervisory Board approves the company strategy and planning as well as important corporate decisions;
- Consistent with § 111 AktG, the most important function of the Supervisory Board is to oversee the work of the Executive Board. Furthermore, the Supervisory Board appoints the members of the Executive Board;
- The Executive Board establishes and oversees the risk management and the daily operation of the CCP.

Regulatory Framework

CCPs located in Germany fall within the scope of the German Banking Act (KWG) and are supervised in accordance with the European Market Infrastructure Regulation (EMIR) and the German Banking Act. The distribution of tasks between the responsible authorities is carried out according to the German Banking Act. Furthermore, CCPs located in Germany are subject to Central Bank Oversight.

As Eurex Clearing is authorised as CRR credit institution, it falls within the scope of the German Recovery and Resolution Act (SAG). The requirements of the German Recovery and Resolution Act are further specified by EBA Regulatory Technical Standards and Guidelines based on the BRRD. The German Recovery and Resolution Act transposes the EU Bank Recovery and Resolution Directive (Directive 2014/59/EU, BRRD) into German national law. Competent authorities are the Federal Financial Supervisory Authority (BaFin), the German Central Bank (Deutsche Bundesbank) and the Federal Agency for Financial Market Stabilisation (FMSA) as competent authority for resolution, respectively.

Eurex Clearing is operating on the basis of a (re)authorization as a CCP since 10.04.2014, which was granted on the basis of compliance with EMIR. In this respect, BaFin is chairing an EMIR college on the basis of written agreements between members of CCP colleges⁹⁸. The European Securities Markets Authority (ESMA) has a coordinating role within the supervisory college ('EMIR college') for Eurex Clearing and is assuming certain direct competences namely with respect to coordination and supervisory convergence.

In addition, Eurex Clearing as a credit institution is considered a "Less Significant Credit Institution" pursuant to the Single Supervisory Mechanism (SSM) and in this respect is subject to indirect prudential supervision by the European Central Bank (ECB).

On 01.02.2016, Eurex Clearing was registered as DCO by the CFTC in accordance with the CEA. The Order of Registration is subject to certain conditions. One of these conditions is that Eurex Clearing needs to comply with the CFTC's "straight-through processing" (STP) requirements⁹⁹ in order to be allowed to clear swaps for U.S. clearing participants and their U.S. customers. Since Eurex Clearing does not yet comply with this requirement, CFTC issued a no action letter, which allows Eurex Clearing to offer services to U.S. clearing participants for clearing OTC IRS proprietary transactions, without complying with the STP requirement. Clearing for U.S. customers, however, will not be permitted before compliance with the STP requirement is achieved.

Eurex Clearing performed an assessment of its compliance with the "Principles for financial market infrastructures" (PFMI) published by CPSS-IOSCO in April 2012. As a CCP compliant with the CPSS-IOSCO PFMI, Eurex Clearing also publishes a comprehensive set of quantitative data. The public quantitative disclosure complements the PFMIs. Quarterly updates of the quantitative disclosure are being provided in accordance with the frequencies set out by CPMI-IOSCO.

Risk Management Framework

Eurex Clearing has established documented policies, procedures and systems to identify, monitor and manage all material risks. The risk types are defined as below:

- *Financial risk.* This comprises credit risk, market risk, liquidity risk as well as risk associated with regulatory parameters. Resulting from its business model as a central counterparty, Eurex Clearing is exposed to the risk that a clearing participant cannot fulfil its contractual obligations resulting from any of its transactions until final settlement or any time thereafter (credit risk), or that clearing participants will settle obligations late (liquidity risk). In extraordinary market environments, a number of key clearing participants may default at the same time (systemic risk).
- *Operational risk.* This is defined as the risk of loss resulting from inadequate or defective systems and internal processes, from human or technical failure, from inadequate or defective external processes and from legal risks.
- *Project risk* arises from the change of the current risk profile once the project will go live in the future.

⁹⁸ <http://www.esma.europa.eu/content/Guidelines-and-Recommendations-regarding-written-agreements-between-members-CCP-colleges>

⁹⁹ Those requirements have not been issued in Europe yet, due to the delay in the implementation of the European Markets in Financial Instruments Directive II (MiFID II) and Regulation (MiFIR). Eurex Clearing will comply with those requirements once the respective provisions of MiFIR and the corresponding Regulatory Technical Standards of ESMA entered into force.

- *Business risk* reflects the sensitivity to macroeconomic evolution and vulnerability to event risk arising from other threats and weaknesses.

Eurex Clearing manages its exposures to participants in a number of ways, including through:

- *Participation requirements.* Eurex Clearing requires participants to hold certain level of creditworthiness, including capital requirements.
- *Risk monitoring and compliance.* Eurex Clearing actively monitors its exposure to financial risk. This includes monitoring and validation of information regarding, among other things, financial requirements, risk profiles and open positions, Eurex Clearing also has wide-ranging powers to sanction participants if needed, including to suspend or terminate a participant's authority to clear some or all market transactions.
- *Margin collection.* Eurex Clearing utilises various forms of margin to cover exposures to its participants.
 - Variation margin is collected at least daily from participants with mark-to market losses and paid out to the participants with mark-to market gains, but Eurex Clearing has the authority and capability to request and to pay-out variation margin as well as to conduct intraday margin calls. In compliance with EMIR Eurex Clearing performs a real time risk monitoring.
 - Initial margin is called from participants to cover credit risk arising from potential changes in the market value of a defaulting participant's open position between the last settlement of variation margin and the close out of these positions by the CCP. Eurex Clearing uses two models to calculate initial margin: RBM and PRISMA. RBM is a risk based model to estimate future losses. The PRISMA margin methodology is based on a complete view of each clearing participant's portfolio that takes into account hedging, and as a result, risk offsetting effects.
- *Prefunded pooled risk resources.* Eurex Clearing maintains a pre-funded Clearing Fund that is calibrated to cover the losses resulting from the default of the two clearing participants with the largest exposures including all their customers in extreme but plausible scenarios. In addition, Eurex Clearing has access to further financial resources, namely dedicated own reserves of Eurex Clearing which are utilised after the defaulting clearing participant's contribution but before the mutual Clearing Fund, parental guaranty and the remaining capital of Eurex Clearing.
- *Recovery tools.* Eurex Clearing prepared a recovery plan in accordance with the Banking Recovery and Resolution Directive and its transposition into German law, the German Recovery and Resolution Act (SAG), in coordination with the German Supervisory Authorities. The most essential part is the application of several recovery tools, which shall protect the soundness of Eurex Clearing in stressed situations. These include powers to call additional cash from participants, or, in the most extreme cases, to tear-up contracts. In addition, Eurex Clearing determined and documented the potential procedure and time period necessary to wind-down or restructure its business including a description of the underlying assumptions.

Published Information on Eurex Clearing:

- Overview web page: <http://www.Eurex Clearingclearing.com/clearing-en/about-us>
- ESMA web page: <http://www.esma.europa.eu/page/Central-Counterparties>
- Eurex Clearing exchange derivatives web page: <http://www.Eurex Clearingclearing.com/clearing-en/cleared-markets/Eurex Clearing-exchange>
- Eurex Clearing OTC derivatives web page: <http://www.Eurex Clearingclearing.com/clearing-en/cleared-markets/Eurex Clearing-otc-clear>

- Eurex Clearing response to the PFMI Disclosure Framework: <http://www.eurexclearing.com/clearing-en/about-us/regulatory-standards>; [http://www.eurexclearing.com/blob/148684/58e6fe89e3f54ebe169e530ac2235b43/data/cpss-iosco-pfmi assessment 2014 en.pdf](http://www.eurexclearing.com/blob/148684/58e6fe89e3f54ebe169e530ac2235b43/data/cpss-iosco-pfmi%20assessment%202014%20en.pdf)
- Eurex Clearing response to the PFMI Quantitative Disclosure Framework: <http://www.eurexclearing.com/clearing-en/about-us/regulatory-standards>; [www.eurexclearing.com/blob/2476606/1faf64390b39b4f5032789bb62d83848/data/CPMI-IOSCO Q4 2015.xlsx](http://www.eurexclearing.com/blob/2476606/1faf64390b39b4f5032789bb62d83848/data/CPMI-IOSCO%20Q4%202015.xlsx)

Annex F: Summary information for ICE Clear Credit

Overview and Product Scope

ICE Clear Credit LLC. ("ICC") provides central counterparty ("CCP") services for a range of over-the-counter ("OTC") single name and index Credit Default Swaps ("CDS") derivatives.

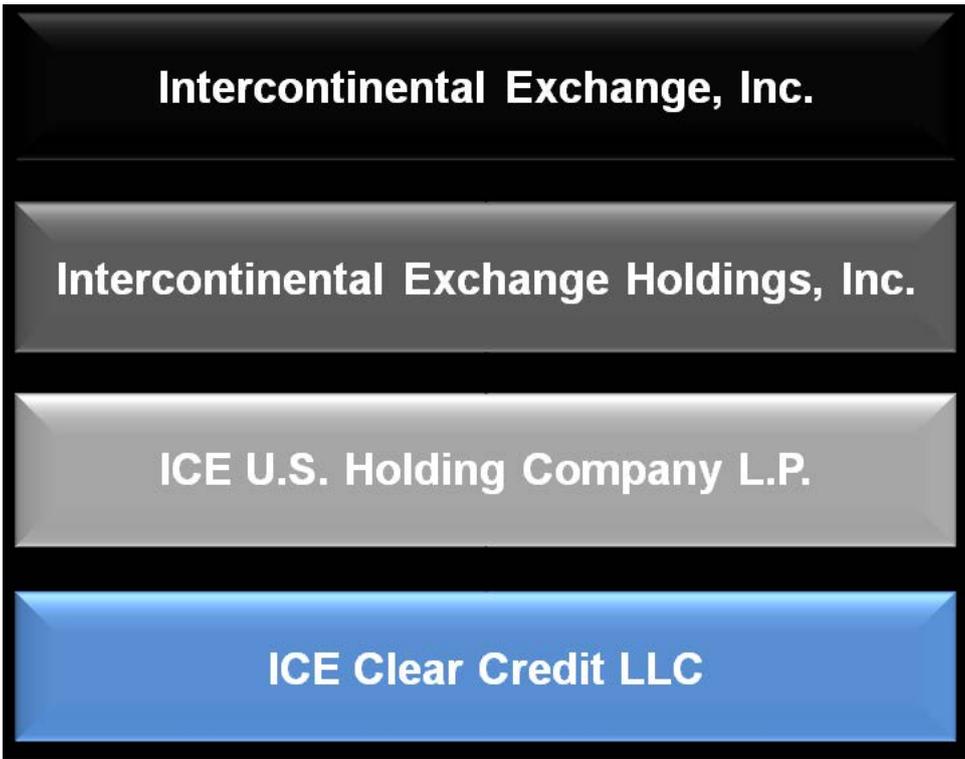
The review undertaken by CPMI-IOSCO considered ICC's risk management arrangements in respect of the following derivatives products: OTC credit derivatives.

Structure and Governance

ICC is a limited liability company. Its operating agreement and the ICC Rules set forth the ICC governance structure and provide for the ICC Board and its various committees. ICC is a wholly-owned subsidiary of ICE U.S. Holding Company L.P. ("ICC Parent") which is owned in turn by Intercontinental Exchange Holdings, Inc. and ultimately by Intercontinental Exchange, Inc. ("ICE, Inc."). ICC's ownership structure is summarized below in Figure F1.

ICC

Figure F1



ICE Clear Credit is governed by an 11-member Board of Managers. Four of the Managers are independent members of ICE, Inc.'s Board of Directors. Three are members of ICE, Inc. management. Finally, the Risk Committee designates four nominees for election by ICE, Inc., two of whom must be independent and two may be non-independent.

The ICC Board has full responsibility for ICC's operations and can approve initiatives without any requirement for approval from the ICC Parent or ICE, Inc. In addition to the ICC Board, ICC's committees are actively involved in the ICC governance process. The primary ICC governance committees are the Risk Committee, Risk Management Subcommittee, Advisory Committee, Audit Committee, and Business Conduct Committee.

ICC's officers, including the Chief Operating Officer, Chief Risk Officer, Chief Compliance Officer, and General Counsel and Corporate Secretary, report to the ICC President. The ICC Chief Compliance Officer has an additional reporting line to the ICC Board. The ICC Chief Risk Officer has an additional reporting line to the Chairperson of the ICC Risk Committee, who is also a non-executive manager on the ICC Board.

Regulatory Framework

ICC is registered as a Derivatives Clearing Organization ("DCO") with the U.S. Commodity Futures Trading Commission ("CFTC"), its primary regulator. Additionally, ICC has been designated as systemically important under Title VIII of the Dodd-Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank") by the Financial Stability Oversight Council ("FSOC"); and thus, is a "SIDCO" under the CFTC regulatory framework¹⁰⁰;

Section 5b of the Commodity Exchange Act ("CEA")¹⁰¹ requires an entity acting as a DCO to register as a derivatives clearing organization with the CFTC, and sets forth the Core Principles with which the DCO must comply in order to obtain and maintain its registration. There are 18 Core Principles for DCOs.¹⁰² The Core Principles address compliance, financial resources, participant and product eligibility, risk management, settlement procedures, treatment of funds, default rules and procedures, rule enforcement, system safeguards, reporting, recordkeeping, public information, information sharing, antitrust considerations, governance fitness standards, conflicts of interest, composition of governing boards, and legal risk.¹⁰³

Part 39 of the CFTC's Regulations,¹⁰⁴ implements Section 5b of the CEA by establishing specific requirements for compliance with the Core Principles as well as procedures for registration and for implementing DCO rules and clearing new products. In particular, Subpart C of Part 39,¹⁰⁵ is intended to cover, for SIDCOs and other DCOs that have elected to be held to such standards, gaps between Subparts A and B of Part 39 and the standards of the Principles for Financial Market Infrastructures ("PFMIs").¹⁰⁶

The CFTC's Division of Clearing and Risk ("DCR") is responsible for all aspects of supervision of DCOs, including SIDCOs.

On at least an annual basis, as a SIDCO, ICC is subject to a Title VIII DCO Examination, which is conducted by the CFTC with the support of the Board of Governors of the Federal Reserve System.

¹⁰⁰ A SIDCO is a DCO which has been designated by the Council as systemically important, and for which the CFTC is the Supervisory Agency. See Dodd-Frank §803(8), 12 U.S.C. §5462(8)).

¹⁰¹ 7 U.S.C. §7a-1.

¹⁰² See CEA §5b(c)(2)(A)-(R), 7 U.S.C. §7a-1(c)(2)(A)-(R).

¹⁰³ *Id.*

¹⁰⁴ 17 C.F.R. Part 39.

¹⁰⁵ 17 C.F.R. §§39.30-39.41

¹⁰⁶ See 17 C.F.R. §39.40:

Through this process, ICC's risk management tools are reviewed and evaluated for consistency with the CEA, CFTC Regulations, and other relevant regulations.

Risk Management Framework

ICC's risk management program addresses how ICC manages various types of risks, including legal, credit, liquidity, operational risks, investment, wrong-way risk, and default risk.

ICC sets certain membership requirements for its clearing participants, which include fitness criteria, financial standards, operational standards, and appropriate registration requirements with applicable statutory regulatory authorities. Set forth below are some of the measures ICC utilizes to manage its exposures to participants:

- *Participation requirements* - ICC requires all clearing participants to have (on an ongoing basis) a minimum of 50 million USD of capital.
- *Risk monitoring and compliance* - ICC Participant Review Committee ("PRC") is a multi-disciplinary committee comprised of ICC management formed for the purpose of conducting due diligence on a clearing participant applicant and monitoring clearing participant good standing on an ongoing basis. The PRC meets at least monthly to execute these responsibilities. The PRC's recommendations are referred to the ICC Risk Management Subcommittee and ICC Risk Committee for review and all recommendations are then proposed to the ICC Board for their approval. ICC Rules authorize the ICC Board to suspend or revoke a clearing participant's clearing privileges or to terminate a clearing participant's membership under specified conditions.

Pursuant to CFTC Regulations, ICC requires all clearing participants to have written risk management policies and procedures in place to ensure they are able to perform certain basic risk and operational functions at all times.

- *Margin collection* - ICC utilizes various forms of margin to cover exposures to its clearing participants.
 - variation margin is collected daily from clearing participants with mark-to-market losses and paid out to clearing participants with mark-to-market gains.
 - initial margin is called from clearing participants on a daily basis to cover credit risk arising from potential changes in the market value of a member's open positions between the last settlement of variation margin and the potential close out of these positions by the CCP in the event of default. ICC actively monitors the adequacy of initial margin collected to determine if ICC's intraday exposure to each clearing participant is sufficiently covered by the margin on deposit. If necessary, ICC will issue intraday margin calls to cover its exposure.
- *Prefunded guaranty fund resources* (pooled or mutualized risk resources) - ICC has prefunded financial resources total over 1.9 billion USD, sized to cover at least the losses associated with the default of the two largest clearing participants in plausible but extreme circumstances. This includes 1.9 billion USD of contributions by members and 50 million USD of ICE's own dedicated capital.
- *Recovery* - ICC, as a SIDCO, is required, pursuant to CFTC Regulations, to maintain a viable plan for recovery or orderly wind-down necessitated by uncovered credit losses or liquidity shortfalls; and, separately, general business risk, operational risk, or any other risk that threatens its viability as a going concern. This plan includes rules and procedures to address recovery and wind-down scenarios. These procedures include, but are not limited to, raising additional capital and voluntarily terminating contracts.

Published Information on ICC Clearing:

- Overview web page: <https://www.theice.com/clear-credit>
- OTC clearing page: <https://www.theice.com/clearing>
- CDS clearing page: <https://www.theice.com/clear-credit/cds-client-clearing>
- ICC's response to the PFMI Disclosure Framework: https://www.theice.com/publicdocs/clear_credit/ICEClearCredit_DisclosureFramework.pdf
- ICC's clearing resources: <https://www.theice.com/clear-credit/clearing-resources>

Annex G: Summary information for JSCC (ETD, CDS, and IRS)

Overview and Product Scope

Japan Securities Clearing Corporation (JSCC) is the primary clearing house in Japan, providing clearing services for cash products on Tokyo Stock Exchange (TSE) and other exchanges/proprietary trading systems (PTS) in Japan, exchange-traded derivatives on Osaka Exchange (OSE), over-the-counter (OTC) credit default swaps (CDS), OTC interest rate swaps (IRS), and OTC Japanese Government Bond (JGB) transactions. With respect to derivatives products, JSCC provides central counterparty (CCP) services for futures and options on derivatives on OSE, as well as OTC CDS and OTC IRS.

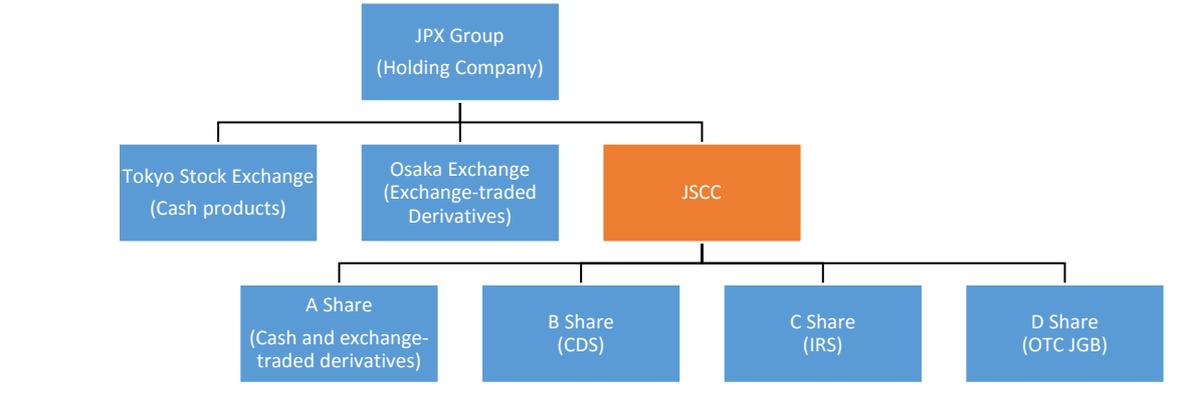
The review undertaken by CPMI-IOSCO considered risk management arrangements in respect of the full scope of derivatives products cleared by JSCC, as of end-June 2015.

Structure and Governance

JSCC is a majority-owned subsidiary of Japan Exchange Group, Inc. (JPX Group). JPX Group’s other subsidiaries include TSE, OSE, and Japan Exchange Regulation (Figure G1).

JPX Group Structure

Figure G1



The board of JSCC is responsible for approving high-level policies and budgets, and assessing the controls and rules of JSCC business. It is required to comply with relevant laws and regulations, and is subject to review by statutory auditors and at the annual general shareholders meeting.

All of JSCC’s clearing activities take place within four Clearing Business units: Exchange-traded Products, CDS, IRS, and OTC JGB.¹⁰⁷ Each Clearing Business maintains its own capital and share class, with business decisions made according to resolutions by the general shareholders meeting and class-shareholders meeting.

¹⁰⁷ All Clearing Business units other than OTC JGB clear derivative products.

Regulatory Framework

JSCC holds a license for “financial instruments obligation assumption service” (ie financial instruments clearing) under the *Financial Instruments and Exchange Act* (FIEA) and are directly regulated by the Japanese Financial Services Agency (JFSA). JSCC is obligated by the FIEA to conduct its business and operations according to its Business Rules, thus making these rules legally binding and enforceable. In December 2013, the JFSA released Comprehensive Guidelines for Supervision of FMIs (JFSA’s Guidelines), which incorporates CPMI-IOSCO “the Principles for Financial Market Infrastructures” (PFMIs), into Japanese regulations.

JSCC is also subject to oversight by the Bank of Japan (BOJ) of financial market infrastructures, as provided in the Bank of Japan Act.

- Chapter 5-3 of the FIEA establishes a licensing regime for CCPs in Japan. Licensing authority rests ultimately with the Prime Minister, with licence obligations specified in the FIEA administered by the JFSA. JFSA’s Guidelines sets out the requirements for business and operations for all FMIs. JFSA oversees FMI’s compliance with FIEA and JFSA’s Guidelines.
- In March 2013, BOJ formulated the “The Bank of Japan Policy on Oversight of Financial Market Infrastructures,” clarifying the adopting of the PFMIs as criteria to be used for evaluating the safety and efficiency of systemically important financial market infrastructures.

JSCC is also recognised as a third-country CCP by the European Securities and Markets Authority (ESMA), and is granted an exemption from registration as a Derivatives Clearing Organization (DCO) by the US Commodity Futures Trading Commission (CFTC). Furthermore, JSCC is designated as Prescribed CCP by the Australian Securities and Investments Commission (ASIC). JFSA has agreed on information sharing and cooperation arrangements with both ESMA and the CFTC in respect of the regulation of JSCC.

Risk Management Framework

JSCC’s risk management policy consists of a number of categories, including categories as below:

- *Clearing participant credit risk.* JSCC has defined risk management frameworks, including Clearing Participant rules, margin rules, a Clearing Fund and Loss Compensation Scheme, and default management procedures in its Business Rules and subordinate rules. These frameworks are established separately for each Clearing Business unit to reflect the nature of the products cleared;
- *Operational risk.* JSCC has established number of plans, including “BCP Basic Plan” to minimize the impact of interruptions to operations and lay out business continuity measures in case of the realization of various risk factors.;
- *Settlement and custody risks.* JSCC has defined the “Policies for Designation of Japanese Yen Fund Settlement Banks,” “Policies for Designation of Foreign Currency Fund Settlement Banks” and “Policies for Designation of Custodians of Posted Collateral,” which provide for criteria and procedures for designating commercial banks as Fund Settlement Banks and/or collateral custodians; and
- *Investment risk.* JSCC has defined the “Policies for Fund Management of Own Assets” and “Policies for Management of Posted Collateral,” which provide for the scope and methods of such management.

JSCC manages its exposures to participants in a number of ways, including through:

- *Participation requirements.* JSCC requires participants to hold certain level of creditworthiness, including capital requirement.
- *Risk monitoring and compliance.* JSCC actively monitors its exposure to financial risk. This includes monitoring and validation of information regarding, among other things, financial requirements, risk profiles and open positions. JSCC also has wide-ranging powers to sanction participants if needed, including to suspend or terminate a participant's authority to clear some or all market transactions.
- *Margin collection.* JSCC utilises various forms of margin to cover exposures to its participants. The core components of the margins are variation margin and initial margin.
 - Variation margin is collected at least daily from participants with mark-to-market losses and paid out to the participants with mark-to-market gains.
 - Initial margin is called from participants to cover credit risk arising from potential changes in the market value of a defaulting participant's open positions between the last settlement of variation margin and the close out of these positions by the CCP. JSCC uses a SPAN model to calculate initial margin on exchange-traded derivatives, and an expected shortfall to calculate initial margin on OTC derivatives.
- *Prefunded pooled risk resources.* JSCC's prefunded pooled financial resources is sized to cover the largest potential loss on the default of one participant and their affiliates for exchange-traded derivatives and IRS, and two participants and their affiliates for CDS. This includes contribution by the JSCC and exchanges and contributions from participants in the form of default fund. The amount of each contribution varies across Clearing Business units.
- *Recovery tools.* JSCC has developed recovery arrangements designed to address very extreme cases in which prefunded pooled financial resources, or prefunded liquid resources, could be insufficient to fully absorb default-related losses. These include powers to call additional cash from participants, to haircut outgoing payments such as variation margins gains to participants or, in the most extreme cases, to terminate contracts.

Published Information on JSCC

- Overview web page: <http://www.jsccl.co.jp/en/cash.html>
- JSCC's response to the PFMI Disclosure Framework: <http://www.jsccl.co.jp/en/fmi-pdf.html>
- JSCC's response to the PFMI Quantitative Disclosure Framework: <http://www.jsccl.co.jp/en/fmi-pdf2.html>

Annex H: Summary information for LCH.Clearnet Ltd (SwapClear)

Overview and Product Scope

LCH.Clearnet Limited provides central counterparty (CCP) services for a broad range of asset classes, including securities, exchange-traded derivatives, commodities, energy, freight, interest rate swaps, non-deliverable FX forwards, bonds and repurchase transactions.

The review undertaken by CPMI-IOSCO considered risk management arrangements only in respect of LCH.Clearnet Limited's SwapClear clearing service. This clearing service clears products including interest rate swaps, inflation rate swaps, forward rate agreements, overnight index swaps and variable notional swaps products in up to 17 currencies.

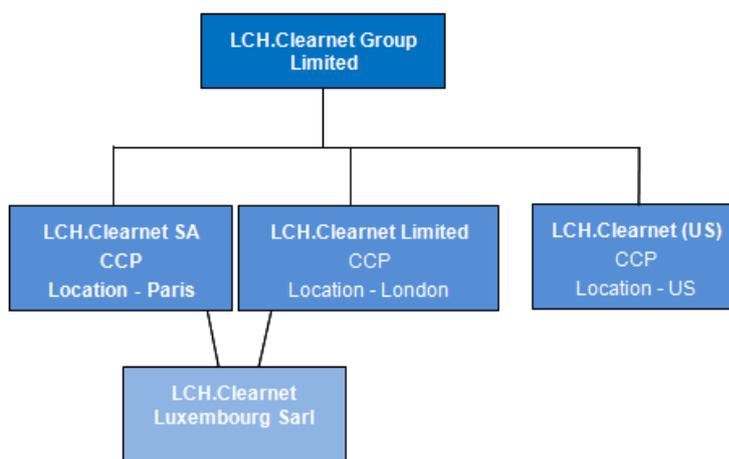
Structure and Governance

LCH.Clearnet Limited is part of the broader LCH.Clearnet Group Limited. In this corporate structure, LCH.Clearnet Limited and two other CCPs (LCH.Clearnet SA and LCH.Clearnet LLC) are direct subsidiaries of LCH.Clearnet Group Limited (Figure H1 (together the "Group"). LCH.Clearnet Limited and LCH.Clearnet SA jointly own LCH.Clearnet Luxembourg, which holds intellectual property licenses used by CCPs in the LCH.Clearnet Group.

There are operational interdependencies within the LCH.Clearnet Group; for instance certain staff are shared between entities, and certain technological and operational support is provided by LCH.Clearnet Limited to the other CCPs in the Group. LCH.Clearnet Limited also outsources specific technology functions to a London Stock Exchange (LSE) Group subsidiary. All of these arrangements are governed by legal agreements and are subject to EMIR requirements and supervisory overview.

LCH.Clearnet Group structure

Figure H1



The LCH.Clearnet Group Limited is majority-owned by the London Stock Exchange (LSE) Group Limited which is an international exchange that operates a range of international equity, bond and derivatives markets. The LSE Group also operates another CCP (CC&G) and two central securities

depositories (CSDs) (Monte Titoli and globeSettle).¹⁰⁸ Minority shareholders of LCH.Clearnet Group Limited include clearing participants and exchanges.

The LCH.Clearnet Board is responsible for establishing clear objectives and strategies, monitoring LCH.Clearnet's senior management, establishing appropriate remuneration policies, establishing and overseeing the risk management function, overseeing the compliance and internal control function, overseeing outsourcing arrangements and providing accountability to shareholders, employees, clearing participants, customers and other stakeholders.

Regulatory Framework

The Bank of England ('the Bank') is the authority responsible for regulation, supervision, oversight and resolution of CCPs in the United Kingdom. The Bank's financial stability objective is to protect and enhance the stability of the financial system of the United Kingdom.

The CPSS-IOSCO *Principles for Financial Market Infrastructure* (PFMI) form the basis for the Bank's oversight and supervision of CCPs. The Financial Services and Markets Act 2000 ('FSMA'), [including secondary legislation made under FSMA, as well as] EMIR¹⁰⁹ and accompanying binding technical standards provide the legal framework.

LCH.Clearnet Limited is a recognised central counterparty under FSMA and is authorised for the purposes of providing clearing services as a central counterparty in accordance with Article 14 of EMIR. [It is also the operator of an inter-bank payment system recognised under Part 5 of the Banking Act 2009 with regard to its embedded payment system].

LCH.Clearnet Limited is also recognised, registered or licensed by authorities in other jurisdictions:

- Registered as a Derivatives Clearing Organization with the Commodity Futures Trading Commission (CFTC) in the United States of America.
- Licensed by the Swiss Financial Market Supervisory Authority (FINMA) to operate a securities settlement system in the role of CCP to SIX Swiss Exchange Switzerland.
- Recognised as a Clearing Agency by the Ontario Securities Commission (OSC) in Canada to offer its SwapClear, ForexClear, RepoClear and EnClear clearing services to Ontario-resident clearing participants. The SwapClear service is designated as systemically important by the Bank of Canada.
- Recognised as a Clearing House by Autorité des marchés financiers (AMF Québec) to offer SwapClear, RepoClear and ForexClear clearing services to Québec-resident clearing participants.
- Holds an Australian Clearing and Settlement Facility Licence granted by the Minister under the Corporations Act 2001 to provide the SwapClear service in Australia and to clear for the financial market operated by FEX Global Pty Ltd.
- Recognised as a Recognised Clearing House by the Monetary Authority of Singapore to provide the SwapClear, ForexClear and EnClear (Freight Division) services in Singapore.
- Licensed by the Japanese government to provide the SwapClear service in Japan, for currencies other than Japanese Yen.

¹⁰⁸ See <http://www.lseg.com/about-london-stock-exchange-group/what-we-do> for more information on the LSE Group.

¹⁰⁹ Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories (EMIR).

- Granted an infrastructure licence to conduct clearing operations in Norway.

In line with Responsibility E of the PFMI, the Bank cooperates with relevant domestic and international authorities to promote the safety and efficiency of UK CCPs, including LCH.Clearnet Limited. For international cooperation, the Bank chairs both an EMIR supervisory college and a 'global' supervisory college for LCH.Clearnet Limited and has a number of MoUs in place with supervisory authorities in jurisdictions around the world to facilitate effective and efficient co-ordination.

Risk Management Framework

The LCH.Clearnet Risk Governance Framework identifies 22 specific risk classifications: latent market risk; sovereign risk; wrong way risk; concentration risk; counterparty credit risk; liquidity risk; procyclicality risk; settlement, payment and custody risk; FX risk; investment risk; default management; model risk; business risk; legal risk; regulatory and compliance risk; pension risk; project risk; business continuity risk; information security and cyber risk; strategic risk; reputational risk and operational risk.¹¹⁰

LCH.Clearnet Limited manages its exposures to participants in a number of ways, including, but not limited to the following:

- *Participation requirements.* LCH.Clearnet Limited defines 'minimum acceptance criteria' for clearing membership in its rulebooks. This includes requirements for members to have a minimum level of net capital, appropriate banking arrangements and staff and systems in place that are sufficient to manage their clearing activities.¹¹¹
- *Risk monitoring and compliance.* LCH.Clearnet Limited actively monitors its exposure to financial risk. This includes monitoring information regarding, among other things financial requirements, risk profiles and open positions. It also has an internal credit scoring framework in place to continuously assess participants' credit ratings, and depending on the credit score, LCH.Clearnet Limited may increase margins, reduce participant credit tolerances and/or force participants to reduce their exposures.
- *Margin collection.* LCH.Clearnet Limited collects various forms of margin to cover exposures to its participants in SwapClear.
 - Variation margin is called at least daily from participants to cover market price movements on each clearing participant's positions.
 - Initial margin is called at least daily from participants and is calibrated to a 99.7% confidence level. LCH.Clearnet Limited uses a VaR/Expected Shortfall model to calculate initial margin, using a look-back period of ten years and a holding period of five (seven) days for house (client) accounts.
 - LCH.Clearnet Limited re-calculates margin requirements on an intraday basis and will call for additional margin if there is significant erosion in the margin cover provided by individual participants.
 - LCH.Clearnet Limited may also call additional initial margin to account for the anticipated higher exit cost of large or concentrated exposures.
- *Prefunded pooled risk resources.* LCH.Clearnet Limited sizes its SwapClear default fund to cover potential future exposures that would arise from the default of the two clearing participants

¹¹⁰ Based on <http://www.lchclearnet.com/risk-collateral-management/risk-management-overview#>

¹¹¹ Based on <http://www.lchclearnet.com/members-clients/members>

that would have the largest stress loss above margins (including customers and affiliates) in 'extreme but plausible' scenarios in SwapClear. It then multiplies the requirement by 1.1 to ensure that there is a ten percent buffer above the 'Cover 2' standard. A further £400 million is then added as a Trade Registration Fund (TRF). As at 30 June 2015 the SwapClear default fund was sized at £2.5 billion. LCH.Clearnet Limited also provides a specific amount of CCP 'skin-in-the-game' for SwapClear that is used before the default fund contributions of non-defaulting members. As at 30 June 2015 the skin-in-the-game was approximately £35 million.¹¹²

- *Recovery tools.* LCH.Clearnet Limited has developed recovery arrangements designed to address situations in which prefunded pooled financial resources, or prefunded liquid resources, could be insufficient to fully absorb default-related losses. These include powers to call additional cash from participants, to haircut outgoing payments to participants or, in the most extreme cases, to terminate contracts. Other recovery tools are available to address threats to LCH.Clearnet Limited's viability from sources other than a participant default.

Published Information on LCH.Clearnet Limited:

- CCP overview web page: <http://www.lchclearnet.com/about-us>
- SwapClear webpage: <http://www.swapclear.com/>
- PFMI qualitative disclosure: http://www.lch.com/documents/731485/762522/lch.ltd-cpmi-iosco-self-assessment-2015-for-publication-180416_1.pdf/c282e7f2-245e-4199-848e-0cd716580cea
- PFMI quantitative disclosures: <http://www.lchclearnet.com/rules-regulations/regulatory-responses#>
- Rulebook: <http://www.lchclearnet.com/rules-regulations/rulebooks/ltd>
- Summary of risk management policies: <http://www.lchclearnet.com/risk-collateral-management/risk-management-overview>
- The Bank of England's approach to the supervision of financial market infrastructures <http://www.bankofengland.co.uk/publications/Documents/news/2012/nr161.pdf>
- The Bank of England's supervision of financial market infrastructures – Annual report <http://www.bankofengland.co.uk/publications/Documents/fmi/annualreport2015.pdf>

¹¹² <http://www.lchclearnet.com/risk-collateral-management/risk-management-overview> - Updated quarterly

Annex I: Summary information for LCH.Clearnet SA

Overview and Product Scope

LCH.Clearnet SA (incorporated as "Banque centrale de compensation SA") provides central counterparty services for:

- equity securities and equity and commodity derivatives listed on Euronext trading venues in Paris, Brussels, Amsterdam and Lisbon (mostly euro-denominated),
- fixed income securities and repo transactions on euro-denominated French, Italian and Spanish sovereign bonds,
- tri-party repo transactions on ECB-eligible collateral baskets with Euroclear France acting as tri-party agent and
- OTC credit derivatives (indices and single names).

Structure and Governance

LCH.Clearnet SA is a wholly owned subsidiary of the LCH.Clearnet Group Ltd, incorporated in the United Kingdom. The LCH.Clearnet Group Ltd owns two other CCPs, LCH.Clearnet Ltd, incorporated in the United Kingdom, and LCH.Clearnet LLC, incorporated in the United States. The LCH.Clearnet Group Ltd is owned with a 58% share by the London Stock Exchange Group PLC.

The LCH.Clearnet SA Board is comprised of LCH.Clearnet Group and SA executives, representatives of trading venues, clearing participants and customers, and independent members. It determines the business strategies of LCH.Clearnet SA and oversees their implementation in particular regarding business management, annual budget, capital management; compensation of employees, financial reporting and controls including LCH.Clearnet SA's annual accounts and the proposal of dividend payment; risk management and compliance and internal controls.

The LCH.Clearnet SA Risk Committee is comprised of 3 independent Board members, 3 representatives of clearing participants and 1 representative of customers. Clearing participant risk experts also attend in a non-voting capacity. It is in charge of reviewing and approving changes to risk management policies.

It should be noted that although the LCH.Clearnet Group has common policies, especially regarding risk management, all Group policies are approved by the Group Board and the Executive Risk Committee (ERCo) of the Group as well as the Board and risk committees of each Group CCP. LCH.Clearnet SA is solely responsible for its risk management and the implementation of these policies.

Regulatory Framework

LCH.Clearnet SA is authorised to provide clearing services as a CCP in accordance with Article 14 of EMIR. Authorisation was granted by the Prudential Supervision and Resolution Authority (ACPR) in May 2014. In addition, LCH.Clearnet SA is authorised as a credit institution in accordance with Article 440-1 of the French Monetary and Financial Code and supervised as such by the ACPR.

As provided under Article 22 of EMIR, the French Monetary and Financial Code designates the Banque de France, the ACPR and the Financial Markets Authority (AMF) as national competent authorities responsible for the supervision and oversight of LCH.Clearnet SA. In accordance with Article

621-7 of the French Monetary and Financial Code, the AMF is tasked with approving any change to the CCP's rulebook.

In addition, as provided under Article 18 of EMIR, a college of supervisors was established in January 2014 to involve all relevant EU supervisors in the cooperative oversight of LCH.Clearnet SA. This college is chaired by the Banque de France and is comprised of 18 authorities from 9 EU member states. It granted LCH.Clearnet SA a unanimously favourable opinion ahead of authorisation pursuant to Article 19 of EMIR. In accordance with Articles 15 and 49, the college is tasked with providing joint opinions on any extension of services or significant change to risk models and parameters. In addition, the European Securities and Markets Authority is responsible for validating any significant change to risk models and parameters, to ensure consistent implementation of the prudential requirements of EMIR across the European Union.

Moreover, LCH.Clearnet SA is a Recognised Overseas Clearing House ("ROCH") in the United Kingdom under the UK's Financial Services and Markets Act and as such is approved to conduct any regulated activity in the UK for the purposes of providing clearing services. In December 2013, LCH.Clearnet SA obtained from the US Commodity and Futures Trading Commission ("CFTC") the licence as a Derivatives Clearing Organisation ("DCO") for clearing indices on Credit Default Swap ("CDS") for US persons.

Risk Management Framework

The LCH.Clearnet Risk Governance Framework identifies and establishes the Board's appetite/tolerance for 22 types of risk (latent market risk, sovereign risk, wrong way risk, concentration, counterparty credit risk, liquidity risk, settlement, payment and custody risk, FX risk, investment risk, default management, model risk, business risk and operational risk).

The main risks related to clearing activities are credit and liquidity risks, which are managed by LCH.Clearnet SA:

- *Margins*: Initial margin for all services is calibrated to be sufficient to offset any losses under normal market conditions incurred during the close-out period of a clearing participant default, to a 99.7% confidence level. Margin models are SPAN on equity and exchange-traded derivatives services, and VaR/Expected Shortfall on the OTC credit derivatives service. Additional margins are levied to cover position concentrations, wrong way risk, illiquid positions and clearing participants with lower credit standing or capital support. Margins are backtested daily for each clearing participant and sub account against this confidence level, and reported monthly at clearing service level to regulators and at least quarterly to the Risk Committee.
- *Default fund and "skin-in-the-game"*: Mutualised Default Funds are calibrated monthly and tested daily to be sufficient to withstand the default of the two clearing participants and their affiliates giving rise to the largest losses calculated under scenarios of extreme but plausible market conditions. Default Funds have a floor and a cap to ensure minimum levels of protection and avoid over-mutualisation. Clearing participant contributions are subject to a minimum amount and re-calibrated monthly in proportion to the risk they introduce. A proportion of CCP capital is placed ahead of non-defaulting clearing participant contributions in the waterfall.
- *Collateral*: Cash and securities eligible to cover margin liabilities are restricted to those with low credit, liquidity, and market risks. Securities are limited to US and EU (some member states only) sovereign bonds and Eurostoxx 50 equity stocks. Default Fund contributions can only be made in cash in the primary currencies (ie Euro) designated by each clearing service, or, for certain markets, Central Bank guarantees. Haircuts are applied to securities to cover market, credit, concentration/liquidity, wrong way and foreign exchange risks, calculated to a 99.7% confidence level over a 3 day horizon based on a 10 year look-back period.

- *Participation requirements:* LCH.Clearnet SA reviews the counterparty risk of clearing participants and other counterparties including sovereigns by continually monitoring market indicators and financial information. An Internal Credit Scoring (ICS) framework assesses the entity's financial profile, including asset quality, capital adequacy, funding and liquidity and profitability; operational capability, including external support, operating environment and operational profile and risk management policies and procedures; and support and sovereign ceiling considerations. A minimum credit score is set for joining a clearing service and the same entry requirement is applied to existing clearing participants wishing to join another service within LCH.Clearnet SA. Increased margins are applied when the credit score deteriorates below the entry level. Other actions may include reduced credit tolerances and forced reduction of exposures.
- *Liquid resources:* liquidity requirements are calibrated to be sufficient to withstand the default of the two clearing participants to which it has the largest exposure calculated under scenarios of extreme but plausible market conditions. LCH.Clearnet SA holds sufficient liquid resources in the form of cash and ECB-eligible securities, which it can convert into cash thanks to routine access to the ECB standing credit facility at the Banque de France.

Published Information on LCH.Clearnet SA:

- Home web page: <http://www.lchclearnet.com/home>
- CDSClear service web page: <http://www.lchclearnet.com/asset-classes/otc-credit-default-swaps>
- Rulebook: <http://www.lchclearnet.com/rules-regulations/rulebooks/sa>
- CPMI-IOSCO Public quantitative disclosure: <http://www.lchclearnet.com/rules-regulations/regulatory-responses>
- Summary of risk management policies: <http://www.lchclearnet.com/risk-collateral-management/risk-management-overview>
- 2014 Banque de France report on the oversight of payment instruments and financial market infrastructures: https://www.banque-france.fr/uploads/tx_bdfgrandesdates/rapport-surveillance-des-moyens-de-paiement-et-des-systemes-d-echange-2014-EN.pdf

Annex J: Summary information for Singapore Exchange Derivatives Clearing (SGX-DC)

Overview and Product Scope

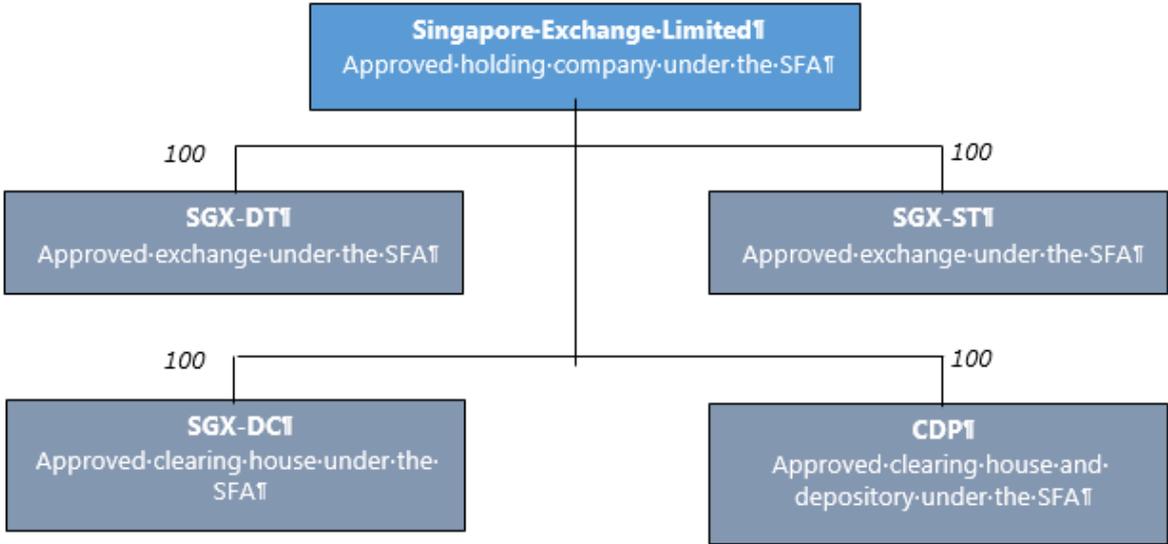
SGX-DC provides central counterparty (CCP) services for products listed on Singapore Exchange Derivatives Trading (SGX-DT), commodity trades registered via the SGX OTC Trade Registration Platform and OTC financial derivatives (OTCF) trades registered via (an) industry-used trade registration system(s).

Structure and Governance

SGX-DC is a wholly-owned subsidiary of Singapore Exchange Limited (SGX) (Figure J1), which is regulated as an approved holding company under the Securities and Futures Act (SFA). Both SGX-DC and The Central Depository (Pte) Limited (CDP) are wholly owned subsidiaries of SGX and are regulated as approved clearing houses under the SFA. CDP is also regulated as a depository under the SFA. Other key wholly owned subsidiaries in the SGX group are SGX-DT and Singapore Exchange Securities Trading Limited (SGX-ST), which are both regulated as approved exchanges under the SFA.

SGX Group Structure

Figure J1



SGX is a publicly listed company. The SGX Board oversees SGX’s affairs and its main duties include:

- Approving the appointment of the Chief Executive Officer, directors, key personnel and the succession planning process;
- Approving broad policies, strategies and objectives of SGX;
- Approving the adequacy of internal controls, risk management, financial reporting and compliance;
- Considering the sustainability of SGX’s policies and proposals; and

- Responsibility for corporate governance.

To assist the SGX Board in the discharge of its oversight functions, various Board Committees such as the Audit Committee (AC), Risk Management Committee (RMC) and Nominating Committee (NC) have been constituted. The Chief Risk Officer reports to the Chief Executive Officer, and has direct access to the RMC.

Regulatory Framework

The Monetary Authority of Singapore (MAS) regulates and supervises systemically important CCPs and securities settlement systems as approved clearing houses under Part III of the SFA and relevant subsidiary legislations¹¹³. MAS' objectives in regulating approved clearing houses are to promote the safety and efficiency of clearing facilities that support systemically-important markets or form an integral part of the financial infrastructure, and to reduce systemic risk. The SFA provides MAS with the powers to supervise approved clearing houses on an ongoing basis to ensure that they comply with the statutory obligations under the SFA. SGX-DC, as an approved clearing house, is required under the SFA to operate safe and efficient clearing facilities, manage its risks prudently, have sufficient financial, human and system resources, and not act against the public interest. MAS' supervisory framework includes regular monitoring, meetings with senior management, self-assessment and inspections. MAS adopts the CPMI-IOSCO Principles for Financial Market Infrastructures (PFMI) in its supervision of financial market infrastructures in Singapore¹¹⁴ and approved clearing houses are required to comply with the PFMI under the Notice on Financial Market Infrastructure Standards.¹¹⁵

SGX-DC is also regulated or recognised in two other jurisdictions.

- SGX-DC is regulated as a derivatives clearing organisation by the U.S. Commodity Futures Trading Commission (CFTC) under the U.S. Commodity Exchange Act.
- SGX-DC is recognised as a third-country CCP by the European Securities and Markets Authority (ESMA), under the *European Regulation on OTC derivatives, central counterparties and trade repositories*.

MAS has information sharing and cooperation arrangements with both CFTC and ESMA in respect of the regulation of SGX-DC.

Risk Management Framework

SGX-DC complies with an overall risk management framework approved by the SGX RMC which identifies, measures and monitors the key risks that SGX-DC faces, including credit risk, liquidity risk, custody and investment risks, operational risk, legal risk and general business risk.

SGX-DC manages its exposures to participants in a number of ways, including through:

¹¹³ MAS regulates approved exchanges, approved clearing houses, approved holding companies and central depository systems under Parts II, III, IIIA and IIIAA of the SFA respectively. Relevant subsidiary legislations include the Securities and Futures (Clearing Facilities) Regulations 2013 and the Securities and Futures (Central Depository System) Regulations 2015.

¹¹⁴ MAS's Monograph on Supervision of Financial Market Infrastructures in Singapore is published at <http://www.mas.gov.sg/News-and-Publications/Monographs-and-Information-Papers/2013/Supervision-of-Financial-Market-Infrastructures-in-Singapore.aspx>. SGX-DC was also independently assessed by IMF for observance of the CPMI-IOSCO PFMI in 2013. A link to the detailed assessment report is provided under 'Published Information on SGX-DC'.

¹¹⁵ MAS's Notice on Financial Market Infrastructure Standards is published at <http://www.mas.gov.sg/Regulations-and-Financial-Stability/Regulations-Guidance-and-Licensing/Securities-Futures-and-Funds-Management/Notices/2015/Notice-on-Financial-Market-Infrastructure-Standards-Notice-No-SFA02A03N01.aspx>

- *Participation requirements.* SGX-DC admits only financially sound companies that meet minimum financial requirements as clearing participants¹¹⁶. On an ongoing basis, clearing participants must comply with rules on capital adequacy, risk management and reporting requirements.
- *Risk monitoring and management.* SGX-DC manages risks through monitoring of the exposures from clearing participants, trading members and their customers and the monitoring of market developments that may have a negative impact on SGX-DC's products or participants. SGX-DC takes risk mitigating actions where necessary, such as requiring participants to deposit more collateral with SGX-DC to manage concentration in a product, counterparty or portfolio.
- *Margin collection.* SGX-DC manages credit risk from clearing participants by requiring initial margins (to address potential price movement) and variation margins (to address actual price movements during the day).
 - SGX-DC operates four clearing cycles daily. SGX-DC will mark trades and positions to a price that is representative of the market. Margin calls are made to clearing participants whose collateral is insufficient to cover variation losses and the initial margin requirement. Margin calls must be met within an hour of SGX-DC's call. SGX-DC is also able to run more cycles when necessary.
 - Initial margin for products is set at a single-tail confidence level of at least 99%. SGX uses the Standard Portfolio Analysis of Risk (SPAN) margin system to determine the margin requirement for each marginable portfolio in exchange traded and OTC derivatives contracts. For OTC derivatives contracts, SGX-DC uses the Historical Value-at-Risk (HSVaR) methodology. In addition, SGX-DC applies risk-based add-ons to reflect the increased risk due to concentration or credit or any other risk consideration.
- *Prefunded clearing fund.* SGX-DC maintains a clearing fund to cover its credit exposure to clearing participants in conditions of extreme market stress. SGX-DC's prefunded clearing fund amounts to S\$715 million¹¹⁷, sized to cover the default of the clearing participant and its affiliates that are responsible for SGX-DC's largest credit exposure, and the two financially weakest clearing participants. Inclusion of the two financially weakest clearing participants acknowledges the risk of contagion in the market under a stressed condition. The pre-funded clearing fund includes S\$150 million of SGX-DC's own capital contribution.
- *Recovery and resolution plan.* SGX-DC has developed a recovery and resolution plan to allow the continued provision of critical operations and services in the event of a recovery or an orderly wind-down of operations.

Published Information on SGX-DC

- Overview web page:
http://sgx.com/wps/portal/sgxweb/home/clearing/derivatives/derivatives_clearing
- SGX's PFMI disclosure documents:
http://sgx.com/wps/portal/sgxweb/home/clearing/derivatives/pfmi_disclosure
- Summary of SGX's risk management framework: http://sgx.com/wps/portal/sgxweb/home/regulation/risk_management/risk_control_safeguard#.VnJrR8Kwpy0

¹¹⁶ SGX's admission criteria can be found at http://sgx.com/wps/portal/sgxweb/home/regulation/members/members_admission.

¹¹⁷ This figure is as of 30 September 2015, published at http://sgx.com/wps/portal/sgxweb/home/regulation/risk_management/risk_control_safeguard.

- The IMF's detailed assessment of observance of the CPSS-IOSCO PFMI: <https://www.imf.org/external/pubs/ft/scr/2013/cr13345.pdf>

Annex K: Members of the CPMI-IOSCO Implementation Monitoring Standing Group (IMSG) and assessment teams

Members who led an assessment team have an asterisk next to their name and those that led a topic sub-team have two asterisks next to their name.

IMSG co-chairs

Reserve Bank of Australia	Mark Manning
Bundesanstalt für Finanzdienstleistungsaufsicht (Bafin), Germany	Thomas Eufinger (from September 2015)
Securities and Exchange Commission, US	Haimera Workie (until September 2015)

Members

Australian Securities and Investments Commission	Andrew McPherson
Reserve Bank of Australia	Peter Wallis** Sarah Harris (from November 2015)**
Brazilian Securities and Exchange Commission (CVM)	Sergio Ricardo Silva Schreiner
Autorité des marchés financiers, Québec	Claude Gatien (until January 2016) Anna Tyniec (from January 2016)
Bank of Canada	Carol Brigham* Sophie Lefebvre**
European Central Bank	Tom Kokkola Pierre Marmara
European Securities and Markets Authority	Maud Timon
Bank of France	Audrey Metzger (until March 2016) Maud Abdeli (from March 2016)
Bundesanstalt für Finanzdienstleistungsaufsicht (Bafin), Germany	Edip Acat
Hong Kong Monetary Authority	Stephen Pang
Securities and Exchange Board of India	Kumar, Shashi (until October 2015) Maninder Cheema (from October to December 2015) Sanjay C Puroo (from December 2015)
Bank of Italy	Veronica Fucile
Bank of Japan	Tomohiro Usui Yuriko Watanabe**
Financial Services Agency, Japan	Kazunari Mochizuki* Takahide Habuchi
Bank of Korea	Young-Seok Kim
National Banking and Securities Commission (CNBV), Mexico	Felipe Ortuno
Central Bank of the Russian Federation	Mikhail Myznikov
Monetary Authority of Singapore	Ken Nagatsuka Tze Hon Lau (from March 2016)

Sveriges Riksbank, Sweden	Johanna Stenkula von Rosen
Capital Markets Board of Turkey	Nalan Sahin Urkan
Bank of England	Andrew Powell**
Board of Governors of the Federal Reserve System	Jennifer Lucier (until September 2015)
	Emily Caron (from September 2015)
	Kathy Wilson**
Commodity Futures Trading Commission, US	Robert Wasserman
Securities and Exchange Commission, US	Natasha Greiner
	Stephanie Kim Park (from September 2015)
IOSCO assessment committee	Steven Bardy
IOSCO Secretariat	Manabu Kishimoto
	Tajinder Singh
CPMI Secretariat	Philippe Troussard
	Umar Faruqui
	Tze Hon Lau (until January 2016)
	Paul Wong (from April 2016)