

Principles for sound stress testing practices

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I. Introduction

The depth and duration of the financial crisis has led to question whether stress testing practices were sufficient prior to the crisis and whether they were adequate to cope with rapidly changing circumstances. In particular, not only was the crisis far more severe in many respects than was indicated by many stress testing results, but it was possibly compounded by weaknesses in stress testing practices in reaction to the unfolding events.

Stress testing seeks to define the impact of extreme, but plausible scenario. They aim to provide an early warning signal so that the risk management procedures can operate accordingly and informed management decisions can be made. As such stress testing has become an important risk management tool that is required by supervisory authorities and is used by UCITS as part of their risk management process.

According to the Commission Directive 2010/43/EU, as transposed by CSSF Regulation 10-4 into Luxembourg regulation, management companies and investment firms shall adopt adequate and effective arrangements, processes and techniques in order to measure and manage at any time the risks which a UCITS they manage are or might be exposed to. Those arrangements, processes and techniques shall be proportionate to the nature, scale and complexity of the business of the management companies and of the UCITS they manage and be consistent with the UCITS risk profiles (Art. 40, No.1 of 2010/43/EU). Management companies shall conduct, where appropriate, periodic stress tests and scenario analysis to address risks arising from potential changes in market conditions that might adversely impact the UCITS they manage (2010/43/EU, Art. 40, No.2(c); CSSF regulation 10-4, Art. 45, No.2 c); CSSF Circular 11/512, III.1.3, fourth paragraph). The need of a sound stress testing is explicitly emphasized again by EMSA through the explicit rules to comply with relating to the VaR approach to calculate the global exposure for UCITS (CESR/10-788 28 July 2010, Section 3.6.5).

There are several further regulatory provisions which are associated with sound risk management and related to stress testing. For example, ESMA guidelines 2012/832 as of 18 December 2012 also require that:

- A UCITS receiving collateral for at least 30% of its assets should have an appropriate stress testing policy in place to ensure regular stress tests are carried out under normal and exceptional liquidity conditions to enable the UCITS to assess the liquidity risk attached to the collateral. The liquidity stress testing policy should at least prescribe the following (ESMA/2012/832, No.45):
 - Design of stress test scenario analysis including calibration, certification & sensitivity analysis;
 - Empirical approach to impact assessment, including back-testing of liquidity risk estimates;
 - Reporting frequency and limit/loss tolerance threshold/s; and
 - Mitigation actions to reduce loss including haircut policy and gap risk protection.
- A UCITS should have in place a clear haircut policy adapted for each class of assets received as collateral. When devising the haircut policy, a UCITS should take into account the characteristics of the assets such as the credit standing or the price volatility, as well as the outcome of the stress tests performed. This policy should be documented and should justify each decision to apply a specific haircut, or to refrain from applying any haircut, to a certain class of assets (ESMA/2012/832, No.46).

The legal requirements for UCITS relating to stress testing as outlined above do not provide any further guidance as regards the practical implementation of a sound stress testing for UCITS.

Therefore, the objective of this guideline is to provide more insights into current market practices and how a management company could translate the above minimum regulatory rules into sound stress testing practice for UCITS. These guidelines benefit from ideas, recommendations and concepts from a number of other more general publications with regard to stress testing which do not specifically address the relevance and importance of stress testing for UCITS such as:

- Document relating to “Principles for sound stress testing practices and supervision” issued by the Bank for International Settlement (BIS) in May 2009 which consists of a series of principles for financial companies as well as regulators
- In July 2008, the Institute of International Finance published its Final Report of the IIF Committee on Market Best Practices: Principles of Conduct and Best Practice Recommendations. The report among other things reviewed stress testing practices and set out two principles and five specific recommendations in this area. The principles include the need for stress testing to be carried out comprehensively and integrated with the overall risk management infrastructure. They also identified the need for stress testing to have a meaningful impact on business decisions, with the board and senior management having an important role in evaluating stress test results and impact on a UCITS risk profile.
- Recommendations by the Counterparty Risk Management Policy Group (CRMPG III) in its August 2008 report (Containing Systemic Risk: The Road to Reform – The Report of the CRMPG III) include the need for firms to think creatively about how the value of stress tests can be maximised, including a so-called reverse stress test to

explore the events that could cause a significant impact on the firm.

- EBA (formerly CEBS) has published revised guidelines on stress testing for financial institutions on 26 August 2010. These guidelines should assist in understanding supervisory expectations of appropriate stress testing governance and infrastructure, and also cover the use of stress testing as a risk management tool. The guidelines are designed to assist financial entities and supervisors in achieving robust, methodologically sound outputs that are effective in identifying risks and their potential mitigants during stressed conditions and their overall impact on an institution. They are designed to be as practical as possible and aim to identify the relevant “building blocks” in an effective stress testing program. The topics covered are ranging from stress testing governance structures and their use, to possible methodologies, including choosing the appropriate severity of scenarios, multi-layered approach to stress testing programs, from simple portfolio-level to comprehensive firm-wide scenario analyses to outputs of stress testing programs, including the interaction between the outcomes of stress tests and management intervention/mitigating actions.

The revised guidelines are supplemented by a number of annexes that provide examples of stress testing specific risks (market risk, securitisation, credit risk, operational risk, interest rate risk from non-trading activities and concentration risk), which illustrate some practices in relation to stress testing these risk types, but are not exhaustive lists of such practices.

Following the various market and regulatory developments, the objective of this paper is to provide high level principles for stress testing applicable for UCITS. These principles should be used as a baseline for developing comprehensive stress testing programs and their integration into the risk governance framework of a management company. They should become part of an informed decision making process.

The recommendations are aimed at strengthening UCITS stress testing practices and supervisory assessment of these practices. By itself, stress testing cannot address all risk management weaknesses, but as part of a comprehensive approach, it has a leading role to play in a robust UCITS governance framework.

Following this paper, ALFI will publish further technical papers with regard to more specific guidance for specific risk types, asset classes and how to consider them in a common framework.

II. Background and context

Stress testing alerts management companies to adverse unexpected outcomes related to a variety of risks and provide an indication of how much losses can be endured should large shocks occur. Stress testing is a tool that supplements other risk management approaches and measures. It plays a particularly important role in:

- Providing forward-looking assessments of risk;
- Overcoming limitations of models and historical data;
- Supporting internal and external communication;
- Feeding into liquidity planning procedures;
- Informing the setting of a management company's risk tolerance; and
- Facilitating the development of risk mitigation or contingency plans across a range of stressed conditions.

Stress testing is especially important after long periods of benign economic and financial conditions, when fading memory of negative conditions can lead to complacency and the underpricing of risk. It is also a key risk management tool during periods of expansion, when innovation leads to new products that grow rapidly and for which limited or no loss data is available.

Circular CSSF 11/512 states that *"management companies shall, where appropriate, conduct periodic stress tests and scenario analyses to address risks arising from potential changes in market conditions that might have an adverse impact upon the managed UCITS"* and *"A description of how the stress testing program works shall be made and its compliance with Boxes 19 to 21 of ESMA Guidelines 10-788 shall be demonstrated. The risks which are subject to stress testing as well as simulated scenarios shall be described and justified. The taking into account of the stress testing results in the risk management, reporting and investment decision processes shall be specified"*. There are also clear references to stress tests for market and liquidity risk.

A stress test is commonly described as the evaluation of a financial position under a severe but plausible scenario to assist in decision making. The term "stress testing" is also used to refer not only to the mechanics of applying specific individual tests, but also to the wider environment within which the tests are developed, evaluated and used within the decision-making process. In this paper, we use the term "stress testing" in this wider sense.

The financial crisis has highlighted weaknesses in stress testing practices employed prior to the start of the crisis in four broad areas:

- Use of stress testing and integration in risk governance;
- Stress testing methodologies;
- Scenario selection;
- Stress testing of specific risks and products.
- Reporting
- Management actions

In addition, these areas of shortfalls led to a lack of credibility and confidence in stress tests results, putting further emphasis on the necessity to get a strong buy-in from senior management in basing decisions on stress test results.

1. Use of stress testing and integration in risk governance

Board and senior management involvement is critical in ensuring the appropriate use of stress testing in UCITS risk governance. Boards and senior management are already involved in defining the risk appetite of the UCITS they managed, i.e. the level and type of risk they are willing to accept in line with the risk profile of the UCITS. They now face the challenge of embedding the risk appetite in decision-making by becoming more engaged in stress testing exercises: this includes setting stress testing objectives, defining scenarios and internal limits or thresholds, discussing the results of stress tests, assessing potential actions and decision making. In particular, stress tests can help to identify major contributors to the firm's overall exposure and display sources of risks that otherwise would not be apparent, to allocate capital and to manage funding problems.

At UCITS that were highly exposed to the financial crisis and fared comparatively well, management companies as a whole took an active role in the development and operation of stress testing, with the results of stress tests serving as an input into strategic decision making and aligning investment strategy with risk management.

The financial crisis has also revealed weaknesses in organisational aspects of stress testing programs. Prior to the crisis, stress testing at some UCITS was performed mainly as an isolated exercise by the risk function with little interaction with business areas. This meant that, amongst other things, business areas often believed that the analysis was not credible. Moreover, at some UCITS, the stress testing program was a mechanical exercise. While there is room for routinely operated stress tests within a comprehensive stress testing program (e.g. for background monitoring), they do not provide a complete picture because mechanical approaches can neither fully take account of changing business conditions nor incorporate qualitative judgments from across the different areas of a UCITS. Furthermore, in many UCITS, stress tests were carried out by separate units focusing on particular business lines or risk types. This led to organisational barriers when aiming to integrate quantitative and qualitative stress testing results.

Prior to the crisis, many UCITS did not have an overarching stress testing program in place but ran separate stress tests for particular risks or portfolios with limited integration. While stress testing for market and interest rate risk had been practiced for several years, stress testing for credit risk has only emerged more recently. Other types of stress tests are still in their infancy. As a result, there was insufficient ability to identify correlated tail exposures and risk concentrations across the UCITS.

One of the challenges to implement a flexible stress testing framework is the need for data and system integration (e.g. to aggregate exposures quickly, apply new scenarios or modify models).

Further investments in IT infrastructure are often necessary to enhance legacy

systems (lack of open interfaces or architectures) and the aggregation of data, to get the required availability and granularity of risk information that will enable timely analysis and assessment of the impact of new stress scenarios designed to address a rapidly changing environment.

No less important is to mention that stress testing can also help firms to check on modeling assumptions and help design system to protect/cover against stress events and build contingency plans/programs.

Stress testing should be used to define a stress profile of the UCITS and further refine limits or thresholds internally accepted. As such, the risk appetite of the UCITS is central and needs to be fully aligned with the stress tests definition, the stress testing validation and the stress testing reporting processes. These processes should be designed and implemented to allow for iterative and on-going stress testing execution and revision, to respond to evolving UCITS and market evolutions.

2. Stress testing methodologies

Stress tests cover a range of methodologies. Complexity can vary, ranging from simple sensitivity tests- which assess the effect of a large move in one risk factor or a set of closely related risk factors, leaving others unchanged- to multi factor/scenario analysis -which aim to assess the impact of a severe macroeconomic historical or hypothetical stress events and capture dependencies among risk factors - or reverse stress tests scenario – that would made a fund unviable for instance.

Stress tests may be performed at varying degrees of aggregation, from the level of an individual instrument up to the UCITS level. Stress tests are performed for different risk types including market, credit, operational and liquidity risk.

Notwithstanding this wide range of methodologies, the crisis has highlighted several methodological weaknesses. At the most fundamental level, weaknesses in infrastructure limited the ability of UCITS to identify and aggregate exposures. This weakness also limited the effectiveness of risk management tools – including stress testing.

Most risk management models, including stress tests, use historical statistical relationships to assess risk. They assume that risk is driven by a known and constant statistical process, i.e. they assume that historical relationships constitute a good basis for forecasting the development of future risks. The crisis has revealed that historical scenario may be less suited to actual risk profile of the funds and may not adequately reflect the risk taking appetite of the UCITS.

First, given a long period of stability, backward-looking historical information indicated benign conditions so that these models did not pick up the possibility of severe shocks nor the build-up of vulnerabilities within the system. Historical statistical relationships, such as correlations, proved to be unreliable once actual events started to unfold. Second, the financial crisis has again shown that, especially in stressed conditions, risk characteristics can change rapidly as reactions by market participants within the system can induce feedback effects and lead to system-wide interactions. These effects can dramatically amplify initial shocks as recent events have illustrated.

Extreme reactions (by definition) occur rarely and may carry little weight in models that rely on historical data. It also means that they are hard to model quantitatively. The management of most UCITS did not sufficiently question these limitations of more traditional risk management models used to derive stress testing outcomes nor did they sufficiently take account of qualitative expert judgment to develop innovative ad-hoc stress scenarios.

Therefore, UCITS generally underestimated the strong interdependencies between, for example, the lack of market liquidity and funding liquidity pressures. The reliance on historical relationships and ignoring reactions within the system implied that firms underestimated the interaction between risks and the firm-wide impact of severe stress scenarios.

Prior to the crisis, most management companies did not perform comprehensive stress tests that took a firm-wide perspective across risks. Even if they did, the stress tests were insufficient in identifying and aggregating risks. As a result, management companies did not had a comprehensive view across credit, market and liquidity risks of their various businesses. An appropriately conducted stress test would have beneficially drawn together experts from across the organisation.

Therefore it is important to build a methodology that evolves over time, through a series of changes in assumptions that encompass the definition of scenarios, risk factors and risk hierarchies for instance. Also, stress tests based on historical correlations need to be complemented by dynamic hypothetical scenarios.

The specific advantage of reverse stress-testing is to be pointed out. It is often argued, and rightly so, that stress-testing is very calibration sensitive. Results are indeed very dependent on the nature of the assumptions taken, such as the amplitude of market shocks, the assumptions of stress period,

As stress-testing does not assume any given probability threshold, the very likelihood of the event used and the foundation for assuming one specific calibration can be discussed. This alleviates the impact of stress-testing and jeopardies its usefulness in matters of possible escalations or use of results.

Reverse stress-testing on the contrary focuses on identifying the scenarios, as opposed to postulating them a priori, which would generate a deterioration of the NAV of the fund for a given predetermined loss. In that respect, reverse stress-testing adds a sensitive information and complements a direct stress-testing program by at least partially correcting the biases coming along the arbitrary calibration and limited use of results obtained via direct stress-testing.

3. Adequacy of scenario selection

Most UCITS stress tests were not designed to capture the extreme market events that were experienced. Most management companies discovered that one or several aspects of their stress tests did not even broadly match actual developments. In particular, scenarios tended to reflect mild shocks, assume shorter durations and underestimate the correlations between different positions, risk types and markets due to system-wide interactions and feedback effects.

A range of techniques has been used to develop scenarios. Sensitivity tests, which are at the most basic level, generally shock individual parameters or a set of closely related risk factors without relating those shocks to an underlying event or real-world outcomes. These include interest rates tests, parallel shift of yield curve, changes of yield curve slope, shock to equity market or volatility (...). Given that these scenarios ignore multiple risk factors or feedback effects, their main benefit is that they are easily understood, simple to apply and can provide a fast initial assessment of portfolio sensitivity to a given risk factor or exposure to certain risk concentrations. By failing to capture dependencies, they do not offer an integrated view on the risk exposure of the fund.

More sophisticated approaches apply shocks to many parameters simultaneously.

Approaches are typically either historically based or hypothetical.

Historical scenarios were frequently implemented based on a significant market event experienced in the past. They tend to be more fully articulated and involve less judgment as they capture historical dependencies among risk factors. Samples might refer to the European Sovereign crisis (2010/2011), the subprime and US credit crisis (2008/2009), September 11 (2001), the Russian credit crisis (1998), The Asian currency crisis (1997). However, such stress tests were not able to capture risks in new products that have been at the centre of the crisis. Furthermore, the severity levels and duration of stress indicated by previous episodes proved to be inadequate. The length of the stress period was viewed as unprecedented and so historically based stress tests underestimated the level of risk and interaction between risks. One advantage of historical scenario is that historical data can however be used to identify relationships, to be further refined with hypothetical assumptions of correlation when implementing hypothetical stress tests.

UCITS also implemented hypothetical stress tests, aiming to capture events that had not yet been experienced. The building of these scenarios is usually labor intensive and require judgment and specialist expertise: usually macroeconomic scenarios are linked with hypothetical events and risk models, to derive correlation for different asset classes. Prior to the crisis, however, UCITS generally applied only moderate scenarios, either in terms of severity or the degree of interaction across portfolios or risk types. At many UCITS, it was difficult for risk managers to obtain senior management buy-in for more severe scenarios. Scenarios that are considered extreme or innovative might often be regarded as implausible and therefore might lack support from the Board and senior management.

Quantitative reverse stress test is another technique that might be considered. It consists of defining a target loss situation and identify scenarios or circumstances that might led to this situation.

It is often viewed as a separate and complementary exercise to traditional stress testing exercises. The idea is to further explore tail risks and identify the risk factors that had the most impact on the portfolio tail region. These factors need then to be mapped to macroeconomics factors to further refine dependencies and isolate potential overlapping effects. In practice, putting in place such a framework at UCITS funds level is complex and involve discretionary judgment as well as expertise as regards risk parameters, correlations and the implementation of scenarios. Despite the objective and conclusions of reverse stress testing being easily understood, the implementation of reverse stress tests currently represents a challenge to risk management and its practical advantages in the UCITS world are yet to be tested.

4. Stress testing of specific risks and products

Particular risks that were not covered in sufficient detail in most stress tests include:

- The behaviour of complex structured products under stressed liquidity conditions;
- Market risk;
- Basis risk in relation to hedging strategies;
- Counterparty credit risk;
- Contingent risks; and
- Liquidity risk.

Scenarios were not sufficiently severe when stress testing structured products and leveraged lending prior to the crisis. This may, to some degree, be attributed to reliance on historical data. In general, stress tests of structured products suffered from the same problems as other risk management models in this area in that they failed to recognize that risk dynamics for structured instruments are different from those of similarly-rated cash instruments such as bonds. These differences were particularly pronounced during the crisis, further degrading the performance of the stress tests. In particular, stress tests should specifically consider the credit quality of the underlying exposures, as well as the unique characteristics of structured products.

Furthermore, stress tests also assumed that markets in structured products would remain liquid or, if market liquidity would be impaired, that this would not be the case for a prolonged period. This also meant that UCITS underestimated the pipeline risk related to issuing new structured products.

In many cases stress tests dealt only with directional risk and did not capture basis risk, thereby reducing the effectiveness of hedges.

In addition, stress tests for counterparty credit risk typically only stressed a single risk factor for a counterparty, were insufficiently severe and usually omitted the interaction between credit risk and market risk. Stress testing for counterparty credit risk should be improved by utilising stresses applied across counterparties and to multiple risk factors, as well as those that incorporate current valuation adjustments.

Another weakness of the models was that they did not adequately capture contingent risks that arose either from legally binding credit and liquidity issues or from reputational concerns.

With regard to liquidity stress tests did not capture the systemic nature of the crisis or the magnitude and duration of the disruption to interbank markets. For a more in-depth discussion of the shortcomings of liquidity stress tests, see the Basel Committee's *Principles for Sound Liquidity Risk Management and Supervision* (September 2008).

5. Reporting

The reporting capability should support the needs of on-going monitoring made by the risk management function of the UCITS as well as the periodic reporting due to the Board or senior management. Whereas the frequency of monitoring stress-tests should be in line with at least the valuation frequency of the fund, the reporting frequency may be defined on periodic basis in accordance with the fund profile and at least each time the fund NAV is calculated or when significant portfolio movements or market events are recorded, complemented by an ad-hoc approach each time warning levels are reached.

Therefore it is important to define warning signals up front with a management consensus and acceptance of these theoretical limits or thresholds.

Critical to the implementation of a stress test reporting is the ability to maintain linkage among risk model data, the assumption made, the methodology used and to store the results of the quantitative analyses so as to support reporting highlight disruptions in historical stress testing trends (to be kept in perspective with the risk profile and investment policy of the fund).

The risk reporting should also allow for the aggregation of risk at multiple levels, to report stress tests results in different ways to support management actions.

6. Management actions

Stress tests should enable the Board and senior management to compare the risk exposure and vulnerabilities of the UCITS with its risk appetite. In this context, stress testing is used to see how the fund responds to adverse market conditions in terms of risk sensitivity and risk management effectiveness.

While the participation of Board to the definition of stress tests scenarios remains a challenge, they should be closely involved in the setup, amendment or validation of internal risk limits, thresholds and concentrations. Thus, when limits reached or thresholds exceeded the prior acceptance and validation of the stress testing framework and reporting format should trigger an informed discussion with the asset manager, and foster an informed decision making process that should be documented.

Escalation procedures: as stress-testing is not regulatory framed in an equivalent way to VaR or global exposure for instance (i.e., there is no upper limit for the result of stress-testing which is stipulated), the actions undertaken on the basis of its results are to be conceptualized and defined beforehand, and ultimately validated by the Board. As static calculation of stress-testing is by nature likely to give rise to losses of high amplitude, it is not entirely straightforward and highly subjective to

define thresholds above which there should be some action taken. An alternative might be to consider the dynamics of the stress-testing results. For a given predetermined scenario, changes in stress-testing results will reveal either a change of economic condition, or a change of portfolio composition. More than the absolute value therefore, the relative variation over time of stress-testing results is likely to be an appropriate risk monitoring tool.

III. Changes in stress testing practices since the Circular CSSF 11/512

Given the unexpected severity of events during the last crisis, stress testing has gained greater prominence and credibility within UCITS as a complementary risk management process to provide a different risk perspective. It is important that this process continues so that stress testing programs become embedded in UCITS' governance structures. Moreover, this process needs to be led by the board and senior management.

UCITS recognize that current stress testing frameworks must be enhanced both in terms of granularity of risk representation and the range of risks considered. Some UCITS have started to address these issues and other weaknesses of stress tests for the specific risks identified above. More general areas in which UCITS are considering future improvement include:

- Setting most appropriate stress testing methods (single or multifactor sensitivity, scenario, reverse stress testing) and methodologies.
- Identification and adequacy of scenarios/ sensitivities versus investment policy;
- Reviewing scenarios and looking for new ones;
- Examining new products prior to launch them to identify potential risks;
- Improving the identification and aggregation of correlated risks as well as the interactions between market, credit and liquidity risk; and
- Considering concentration risk in time of stress (and when historical correlation structures change)
- Evaluating appropriate time horizons.

Generally, stress testing is an area that many management companies recognize they will need to improve to ensure appropriate risk capture and to aggregate risk more effectively across business lines.

The principles set forth in this paper are intended to support and reinforce efforts made by management companies to improve their practices, but management companies should not restrict themselves to a checklist approach to improvement. After the onset of the crisis, ad hoc "hot-spot" stress testing has been used by some UCITS as an important tool to inform senior management's crisis management decisions. The ability to conduct stress tests at very short notice has proven to be valuable during a period of rapidly changing market conditions.

The need for improvement in stress testing has also been recognised by the financial industry. In July 2008 the Institute of International Finance published its *Final Report of the IIF Committee on Market Best Practices: Principles of Conduct and Best Practice Recommendations*. The report among other things reviewed stress testing practices and set out two principles and five specific recommendations in this area. The principles include the need for stress testing to be carried out comprehensively and integrated with the overall risk management infrastructure. They also identified the need for stress testing to have a meaningful impact on business decisions, with the board and senior management having an important role in evaluating stress test results and impact on a bank's risk profile. Recommendations by the Counterparty Risk Management Policy Group (CRMPG III) in its August 2008 report (*Containing Systemic Risk: The Road to Reform – The Report of the CRMPG III*) include the need for firms to think creatively about how the value of stress tests can be maximised, including a so-called reverse stress test to explore the events that could cause a significant impact on the firm.

Stress testing should be communicated to the Board in an understandable way.

IV. Key Principles

Use of stress testing and integration in risk governance:

- a) Stress testing should form an integral part of the overall governance and risk management culture of a management company/ investment firm. Stress testing should be actionable, with the results from stress testing analyses impacting decision making at the appropriate management level, including strategic investment decisions of the board and senior management. Board and senior management involvement in the stress testing program is essential for its effective operation.
- b) A management company should operate a stress testing program for its managed UCITS that promotes risk identification and control; provides a complementary risk perspective to other risk management tools and enhances internal and external communication.
- c) Stress testing programs should be specific and relevant to the various different risk profiles of the UCITS portfolios under management.
- d) Stress testing programs should take account of views from across the organisation and should cover a range of perspectives and techniques.
- e) A management company should have written policies and procedures governing the stress testing program. The operation of the program should be appropriately documented.
- f) A management company should have a suitably robust infrastructure in place, which is sufficiently flexible to accommodate different and possibly changing stress tests at an appropriate level of granularity.
- g) A management company should regularly maintain and update its stress testing framework for the various UCITS portfolios under management. The effectiveness of the stress testing program, as well as the robustness of major individual components, should be assessed regularly and independently.

Stress testing methodology and scenario selection:

- h) Stress tests should cover a range of risks on a position and portfolio level. All significant risk contributors (including the various parameters of a model) should be considered.
 - i) Stress testing programs should cover a range of circumstances, including forward-looking scenarios, and aim to take into account system-wide interactions and feedback effects. Scenarios should not be limited to historical events.
 - j) Stress testing programs should be aligned with a UCITS risk profile
 - k) Stress testing programs should generally consist of sensitivity (single and simple multi-factor) and scenario analysis addressing all material risks at various levels as well as reverse stress tests where relevant.
 - l) Stress tests should feature a range of severities, including exceptional events capable of generating the most damage whether through size of loss or through loss of reputation. A stress testing program should also determine what scenarios could challenge the viability of an UCITS portfolio and a management company, where relevant, (reverse stress tests) and thereby uncover hidden risks and interactions among risks. Stress test scenarios should reflect severe economic downturns.
 - m) As part of an overall stress testing program, a UCITS should aim to take account of simultaneous pressures in funding and asset markets, and the impact of a reduction in market liquidity on exposure valuation.
- Specific areas of focus:**
- n) The effectiveness of risk mitigation techniques (including hedging strategies) should be systematically challenged.
 - o) Observable or unobservable parameters (e.g. correlations, dividends, volatilities, etc.) involved in the valuation of

complex financial products should be systematically challenged.

- p) Risks arising from off balance sheet commitments and exposure (e.g. OTC derivatives and efficient portfolio management techniques) should be specifically stressed (e.g. liquidity risk, default risk, operational risk, etc.).
- q) UCITS involve in non-linear or complex investment strategies should test the convexity of their risk profile, i.e. their elasticity to changes in market movements amplitude.
- r) The stress testing program should particularly respond to the risk profile of a UCITS. It should be articulated consistent to the UCITS risk profile. For example, it may not necessarily sufficient to use current time series methodologies to perform stress tests as such time series methodologies do not capture significant and severe downturn risks of a UCITS.

s) As stress testing programs are often operationalised through financial models, the respective model risks should be carefully assessed and monitored.

t) The stress testing program should explicitly cover complex and bespoke products such as securitised exposures. Stress tests for securitised assets should consider the underlying assets, their exposure to systematic market factors, relevant contractual arrangements and embedded triggers, and the impact of leverage, particularly as it relates to the subordination level in the issue structure.

A UCITS should enhance its stress testing approaches to consider its vulnerability to specific asset categories or market movements and to assess potential wrong-way risk related to risk mitigating techniques.

About ALFI

The Association of the Luxembourg Fund Industry (ALFI), the representative body for the Luxembourg investment fund community, was founded in 1988. Today it represents more than 1 300 Luxembourg-domiciled investment funds, asset management companies and a wide variety of service providers including depository banks, fund administrators, transfer agents, distributors, law firms, consultants, tax advisers, auditors and accountants, specialist IT providers and communications agencies.

Luxembourg is the largest fund domicile in Europe and its investment fund industry is a worldwide leader in cross-border fund distribution. Luxembourg-domiciled investment structures are distributed in more than 50 countries around the globe, with a particular focus on Europe, Asia, Latin America and the Middle East.

ALFI defines its mission as to “**Lead industry efforts to make Luxembourg the most attractive international centre**”.

Its main objectives are to:

Help members capitalise on industry trends

ALFI’s many technical committees and working groups constantly review and analyse developments worldwide, as well as legal and regulatory changes in Luxembourg, the EU and beyond, to identify threats and opportunities for the Luxembourg fund industry.

Shape regulation

An up-to-date, innovative legal and fiscal environment is critical to defend and improve Luxembourg’s competitive position as a centre for the domiciliation, administration and distribution of investment funds. Strong relationships with regulatory authorities, the government and the legislative body enable ALFI to make an effective contribution to decision-making through relevant input for changes to the regulatory framework, implementation of European directives and regulation of new products or services.

Foster dedication to professional standards, integrity and quality

Investor trust is essential for success in collective investment services and ALFI thus does all it can to promote high professional standards, quality products and services, and integrity. Action in this area includes organising training at all levels, defining codes of conduct, transparency and good corporate governance, and supporting initiatives to combat money laundering.

Promote the Luxembourg investment fund industry

ALFI actively promotes the Luxembourg investment fund industry, its products and its services. It represents the sector in financial and in economic missions organised by the Luxembourg government around the world and takes an active part in meetings of the global fund industry.

ALFI is an active member of the European Fund and Asset Management Association, of the European Federation for Retirement and of the International Investment Funds Association.

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This text has been copied and adapted from the BIS Principles for sound stress testing practices and supervision, May 2009 (www.bis.org/publ/bcbs155.htm). It refers to UCITS context.

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**Principles for sound stress testing
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