Principle 7: Liquidity risk

An FMI should effectively measure, monitor, and manage its liquidity risk. An FMI should maintain sufficient liquid resources in all relevant currencies to effect same-day and, where appropriate, intraday and multiday settlement of payment obligations 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 liquidity obligation for the FMI in extreme but plausible market conditions.

Key consideration 1: An FMI should have a robust framework to manage its liquidity risks from its participants, settlement banks, nostro agents, custodian banks, liquidity providers, and other entities.

Key consideration 2: An FMI should have effective operational and analytical tools to identify, measure, and monitor its settlement and funding flows on an ongoing and timely basis, including its use of intraday liquidity.

Key consideration 3: A payment system or SSS, including one employing a DNS mechanism, should maintain sufficient liquid resources in all relevant currencies to effect same-day settlement, and where appropriate intraday or multiday settlement, of payment obligations 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 in extreme but plausible market conditions.

[Not applicable, as NSCC is not a payment system or SSS.]

Key consideration 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.

Key consideration 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.

Key consideration 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.

Key consideration 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.

Key consideration 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.

Key consideration 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.

Key consideration 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.

CCAS 17Ad-22(e)(7)

Each covered clearing agency shall establish, implement, maintain and enforce written policies and procedures reasonably designed to, as applicable:

(7) Effectively measure, monitor, and manage the liquidity risk that arises in or is borne by the covered clearing agency, including measuring, monitoring, and managing its settlement and funding flows on an ongoing and timely basis, and its use of intraday liquidity by, at a minimum, doing the following:

Maintaining sufficient liquid resources at the minimum in all relevant currencies to effect same-day and, where appropriate, intraday and multiday settlement of payment obligations with a high degree of confidence under a wide range of foreseeable stress scenarios that includes, but is not limited to, the default of the participant family that would generate the largest aggregate payment obligation for the covered clearing agency in extreme but plausible market conditions;

Holding qualifying liquid resources sufficient to meet the minimum liquidity resource requirement under paragraph (e)(7)(i) of this section in each relevant currency for which the covered clearing agency has payment obligations owed to clearing members;

Using the access to accounts and services at a Federal Reserve Bank, pursuant to Section 806(a) of the Payment, Clearing, and Settlement Supervision Act of 2010 (12 U.S.C. 5465(a)), or other relevant central bank, when available and where determined to be practical by the board of directors of the covered clearing agency, to enhance its management of liquidity risk;

Undertaking due diligence to confirm that it has a reasonable basis to believe each of its liquidity providers, whether or not such liquidity provider is a clearing member, has:

Sufficient information to understand and manage the liquidity provider's liquidity risks; and

The capacity to perform as required under its commitments to provide liquidity to the covered clearing agency;

Maintaining and testing with each liquidity provider, to the extent practicable, the covered clearing agency's procedures and operational capacity for accessing each type of relevant liquidity resource under paragraph (e)(7)(i) of this section at least annually;

Determining the amount and regularly testing the sufficiency of the liquid resources held for purposes of meeting the minimum liquid resource requirement under paragraph (e)(7)(i) of this section by, at a minimum:

Conducting stress testing of its liquidity resources at least once each day using standard and predetermined parameters and assumptions;

Conducting a comprehensive analysis on at least a monthly basis of the existing stress testing scenarios, models, and underlying parameters and assumptions used in evaluating liquidity needs and resources, and considering modifications to ensure they are appropriate for determining the clearing agency's identified liquidity needs and resources in light of current and evolving market conditions;

Conducting a comprehensive analysis of the scenarios, models, and underlying parameters and assumptions used in evaluating liquidity needs and resources more frequently than monthly when the products cleared or markets served display high volatility or become less liquid, when the size or concentration of positions held by the clearing agency's participants increases significantly, or in other appropriate circumstances described in such policies and procedures; and

Reporting the results of its analyses under paragraphs (e)(7)(vi)(B) and (C) of this section to appropriate decision makers at the covered clearing agency, including but not limited to, its risk management committee or board of directors, and using these results to evaluate the adequacy of and adjust its liquidity risk management methodology, model parameters, and any other relevant aspects of its liquidity risk management framework;

Performing a model validation of its liquidity risk models not less than annually or more frequently as may be contemplated by the covered clearing agency's risk management

framework established pursuant to paragraph (e)(3) of this section;

Addressing foreseeable liquidity shortfalls that would not be covered by the covered clearing agency's liquid resources and seek to avoid unwinding, revoking, or delaying the same day settlement of payment obligations;

Describing the covered clearing agency's process to replenish any liquid resources that the clearing agency may employ during a stress event; and

Undertaking an analysis at least once a year that evaluates the feasibility of maintaining sufficient liquid resources at a minimum in all relevant currencies to effect same- day and, where appropriate, intraday and multiday settlement of payment obligations with a high degree of confidence under a wide range of foreseeable stress scenarios that includes, but is not limited to, the default of the two participant families that would potentially cause the largest aggregate payment obligation for the covered clearing agency in extreme but plausible market conditions if the covered clearing agency provides central counterparty services and is either systemically important in multiple jurisdictions or a clearing agency involved in activities with a more complex risk profile.

Liquidity risk management framework

NSCC, and its affiliates, DTC and FICC, have adopted a Clearing Agency Liquidity Risk Management Framework ("Liquidity Risk Framework"), which sets forth the manner in which NSCC measures, monitors and manages the liquidity risks that arise in or are borne by it, including the manner in which NSCC deploys its liquidity tools to meet its settlement obligations on an ongoing and timely basis and NSCC's use of intraday liquidity, in accordance with applicable legal requirements, including CCAS 17Ad- 22(e)(7) and addresses related matters. The Liquidity Risk Framework has been filed with and approved by the SEC, and is reviewed and approved by the BRC on an annual basis.

NSCC's liquidity risk management strategy and objectives are designed to ensure that NSCC maintains sufficient liquid resources to meet the potential amount of funding required to settle outstanding transactions of a defaulting Member or affiliated family of defaulting Members in a timely manner. Liquidity risk is the risk that NSCC would not have sufficient funding resources to complete settlement obligations of a defaulting Member's unsettled transactions. NSCC's liquidity risk is managed by the Liquidity Risk Management ("LRM") team within FRM, and subject to oversight by the MRC and the BRC.

As a central counterparty, NSCC's liquidity needs are driven by the requirement to complete end-of day money settlement, on an ongoing basis, in the event of a failure of a Member. As a cash market CCP, if a Member defaults, NSCC will need to complete settlement of guaranteed transactions on the failing Member's behalf from the date of insolvency (referred to as "DOI") through the remainder of the two-day settlement cycle. As such, NSCC measures the sufficiency of its qualifying liquid resources through daily liquidity studies across a range of scenarios, including amounts needed over the settlement cycle in the event that the Member or Member's affiliated family with the largest aggregate liquidity exposure becomes insolvent (that is, on a Cover One standard). NSCC settles only in U.S. dollars.

NSCC then seeks to maintain qualifying liquid resources (as defined in Rule 17Ad-22(a)(14)) in an amount sufficient to cover this risk. NSCC's liquidity resources include, for example: the cash in the Clearing Fund; the cash that would be obtained from NSCC's committed 364-day credit facility with a consortium of lenders; cash proceeds from NSCC's commercial paper and extendable note program ("CP Program"); cash proceeds from NSCC's Senior Unsecured Notes (and together with the CP Program, "Prefunded Liquidity"), and as discussed more fully below, additional cash deposits ("Supplemental Liquidity Deposits" or "SLD") designed to cover the heightened liquidity exposure presented by those Members whose activity would pose the largest liquidity exposure to NSCC.

As all securities cleared and settled through NSCC settle in U.S. dollars, NSCC has no cross-currency exposure. As noted above under the discussion of Credit Risk (Principle 4), NSCC is not systemically important in multiple jurisdictions, and as a U.S. cash market equity

CCP, its activities do not have a complex risk profile. NSCC does not have access to routine credit at the central bank for liquidity; as such, it does not account for this option in its liquidity planning.

Measurement and monitoring of liquidity risk and needs

On a daily basis, FRM and NSCC's Settlement Operations groups monitor settlement flows and projected debit obligations. Each Member's incoming credits and debits are reviewed to estimate the size of cash outflow required to satisfy settlement needs. In addition, automated risk systems are utilized to measure and monitor potential liquidity demands.

In the event an NSCC Member defaults on its open obligations, NSCC's liquidity needs are driven by whether the defaulted Member has satisfied its unsettled obligations on DOI, plus the settlement amount of the defaulted Member's net long (buy) positions for each remaining day of the settlement cycle.

To the extent that a Member's open portfolio to be closed out is "net-long," NSCC is responsible for the receipt of securities from, and payment of cash to, the contra side Members. As such, long (receive) positions drive the potential liquidity risk that is posed to NSCC, since NSCC would be responsible for the payment of cash required to settle those purchases.

Accordingly, NSCC calculates its liquidity needs per individual Member at a legal entity-level and further aggregates amounts at the family-level (that is, including all affiliated entities that are also NSCC Members, under the assumption that all such affiliates fail simultaneously). Members' total liquidity needs are calculated by netting the sum of contract values for all securities on a per CUSIP per service (CNS and SFT) basis per Member (that is, to determine the Member's net long or short position per CUSIP per service) for each day of the cycle, and summing the total of the debit (long) positions only. These positions represent the securities that NSCC would have an obligation to receive and pay for in the event of a Member default. The liquidity need calculations also capture potential liquidity needs for cleared SFTs.

Based on the results of the calculation, NSCC determines its aggregate financial resources that would be available to satisfy the largest peak aggregate settlement obligation of a Member or Member family on the day of the simulated default.

In order to assess its liquidity obligations under a wide array of scenarios, NSCC performs daily liquidity sufficiency testing with respect to normal market scenarios, as a baseline reference point to assess other stress assumptions, and two types of stress scenarios:

- Regulatory stress scenarios, which are designed to meet the requirements set forth in Rule 17Ad- 22(e)(7)(i) and (7)(vi)(A), and a wide range of stress scenarios that include, but are not limited to, extreme but plausible scenarios, including the default of the Affiliated Family that would generate the largest aggregate payment obligation for NSCC in extreme but plausible market conditions.
- Informational stress scenarios, which are executed as part of internal analysis. These stress scenarios are not designed to meet the requirements of Rules

17Ad-22(e)(4)(vi)(A) and (7)(vi)(A) and, as such, are utilized for informational, analytical and/or monitoring purposes only.

Regulatory stress scenarios are subject to review on at least a monthly basis and approval by the ESTC. On a monthly basis, liquidity risk metrics are escalated, and these results are used to evaluate the adequacy of NSCC's liquidity resources.

Size and composition of qualifying liquid resources; reporting

NSCC's Rules specifically permit borrowing from the Clearing Fund to facilitate end-of-day money settlement. Additionally, Clearing Fund collateral may be pledged for the purpose of securing loans to facilitate settlement. The investment of Clearing Fund cash is managed in accordance with the Investment Policy (as described under Principle 16 Custody and investment risks), as are cash proceeds from the Prefunded Liquidity. These amounts are available, as needed, for NSCC to draw upon to complete settlement.

NSCC may access its committed credit facility up to the amount of the resources eligible to secure a borrowing. These resources are also available on a same-day basis. If drawn upon, the credit facility is collateralized with Eligible Clearing Fund Securities and the securities in the process of settlement which, as a result of the defaulting Member's failure-to-settle, are received and paid for by NSCC (i.e., unpaid long allocations owned by NSCC), or collateral supporting those long allocations.

Members may also be required to provide additional liquidity in the form of Supplemental Liquidity Deposits ("SLD") to the Clearing Fund to cover the liquidity exposures presented by those Members' activity. This requirement is stipulated in NSCC Rule 4A and requires Members (whether individually, or as part of an affiliated Member family) whose activity generates liquidity needs in excess of NSCC's then available qualifying liquid resources, to fund such additional amounts. SLD must be in cash and are held and maintained in the same manner as other Clearing Fund deposits. They are thus available to fund settlement as needed.

All of these liquidity resources constitute "qualifying liquid resources" under Rule 17Ad-22(a)(14).

With respect to Member SLD requirements, NSCC provides reporting that includes daily liquidity reports to Members to facilitate their understanding of the risks that their activity presents to NSCC. This reporting is consistent with NSCC's outreach to affected Members concerning its potential SLD requirements, and enhances Members' ability to make decisions regarding potential or future liquidity obligations and incorporate that impact into its capital planning process (or modify its behavior to minimize the liquidity risk presented to NSCC).

Reliability of liquidity providers and others

As described below, NSCC undertakes due diligence with respect to its liquidity providers and conducts testing with those providers. NSCC conducts formal reviews of the reliability of its qualified liquid resources providers in extreme but plausible market conditions.

NSCC's committed line of credit is maintained with a diversified consortium of lenders, all of which are regulated financial institutions in the business of extending credit on a committed basis as provided in the credit agreement governing the facility. The line of credit is renewed annually. During the renewal period, NSCC, in coordination with the lead facility arranger, provides potential liquidity providers with information to enable them to understand the liquidity obligations and risks they may face as potential lenders under the facility, which include the need to be able to provide funding within a short time window on a same-day basis. The lead facility arranger also conducts standard due diligence on all potential counterparties to determine their suitability, and NSCC conducts its own credit analysis of the potential lenders. These reviews, together with discussions and meetings conducted in connection with the annual renewal, are designed to provide NSCC with confidence that the lenders have sufficient information and the capacity to perform their obligations should NSCC need to draw on the facility.

Test drawdowns for the line of credit are performed periodically to demonstrate that the agents and the lenders are operationally capable to perform their obligations under the facility and are familiar with the drawdown process.

The Prefunded Liquidity is an additional qualifying liquid resource. It represents the cash proceeds from issuance and private placement of debt represented by unsecured notes, including commercial paper. In order to provide for the ongoing resource reliability of the Prefunded Liquidity, NSCC seeks to maintain strong credit worthiness, which supports its access to the relevant markets, continuously monitor the state and resiliency of the relevant markets, and limit the potential impact of rollover risk of maturing commercial paper on NSCC's liquidity resources.

NSCC also seeks to manage its liquidity and operational risks arising from settling banks and investment counterparties. With respect to settling banks, minimum requirements are effectuated through the membership application and ongoing review process, and with respect to investment counterparties, the Investment Policy includes counterparty credit and concentration standards. NSCC has established strict eligibility requirements for entities seeking to act as settling banks, which include minimum financial, credit and operational standards. Entities that act as such and are not otherwise Members (and thus subject to ongoing financial reporting requirements and surveillance review in their capacity as Members) are required to be

“Settling Bank Only Members” and agree to abide by the requirements applicable to that class of membership; this includes timely adherence to daily settlement protocols.

Stress scenarios, review and validation

LRM conducts a daily liquidity test, which includes a number of stress scenarios and assumptions used to evaluate NSCC’s liquidity needs on a conservative basis and to ensure the maintenance of sufficient qualifying liquid resources to timely meet NSCC’s settlement obligations with a high degree of confidence. In addition, LRM may perform daily liquidity studies for informational and monitoring purposes using stress scenarios that exceed regulatory minimums.

Scenarios stress test results are reviewed by the MRC on at least a monthly basis and escalated to the BRC as necessary. These results are used to evaluate the adequacy of NSCC’s qualifying liquid resources, for example, the impact of extreme market moves and the potential changes in resource availability that may follow. To the extent that stress tests indicate a potential impact on the sufficiency of NSCC’s liquidity resources, management may consider options available to supplement resources.

The results of these analyses are reviewed by the ESTC at its monthly meeting as well as NSCC’s MRC and the BRC. The ESTC uses such results to evaluate the adequacy of the stress testing methodology for the purpose of achieving compliance with the minimum prefunded financial resource requirements set forth in the Liquidity Risk Management Framework.

NSCC also performs an annual liquidity assessment to calibrate its default liquidity resources, including sizing of its credit line, to assure the maintenance of sufficient liquid resources under a wide range of foreseeable stress scenarios that includes both historical and hypothetical market scenarios selected from an inventory of risk factors. This assessment is presented to the MRC and the BRC.

NSCC’s liquidity stress-testing methodology is reviewed and validated in accordance with the Model Risk Framework, including validation on an annual basis and monthly model performance monitoring.

Replenishment of liquidity resources; uncovered liquidity shortfalls

As the liquidation of a defaulting Member’s portfolio completes (including the sale of collateral used to secure a borrowing), the proceeds from the closeout are used to repay liquidity borrowings, thus replenishing NSCC’s liquidity resources.

If closeout proceeds are insufficient to fully repay such liquidity usage/borrowings, then the amount of any such shortfall would constitute a loss that would first be satisfied by recourse to the defaulting Member’s available resources pursuant to the provisions of NSCC Rule 4 (Clearing Fund) and the applicable terms of any cross-guaranty agreements. Any loss remaining thereafter would be addressed by the loss allocation waterfall, which is described in Principle 13 (Participant-default rules and procedures).