

Second assessment of KRONOS
in relation to the
Core Principles for Systemically
Important Payment Systems

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1. The system in general

1.1. Background

This report is the second assessment of Danmarks Nationalbank's RTGS¹ system, KRONOS, in relation to the Core Principles For Systemically Important Payment Systems (CPSIPS). KRONOS was launched on 19 November 2001. This second assessment is based on the changes made to the system until 13 May 2002 together with experience from the operation of the system since the implementation.

KRONOS replaced the existing RTGS systems, the DN Inquiry and Transfer System and DEBES, that handled real-time gross settlement in respectively DKK and EUR. KRONOS is thus a dual currency system, and is also considered part of the joint European RTGS system, TARGET², handling EUR transactions between the EU member states, which is also an instrument to support the single monetary policy of the EU member states that participate in the Economic and Monetary Union (EMU). The interconnection between KRONOS and the other national RTGS system that are part of TARGET is handled via a module, Interlinking, that is continued by and large unchanged. Interlinking was previously connected to DEBES.

1.2. Description

In popular terms, KRONOS is Danmarks Nationalbank's home-banking system for the banks, etc. (participants) that hold accounts at Danmarks Nationalbank. The participants will thus be able to use KRONOS to exchange payments in both DKK and EUR. KRONOS is primarily to be used for wholesale payments. An overview of the volume in the DN Inquiry and Transfer System and DEBES, whose functions are taken over by KRONOS, is presented in Table 1. The figures are taken from Danmarks Nationalbank's annual reports.

Table 1. DN-F and DEBES. KRONOS as of 19 November 2001.

	1997	1998	1999	2000	2001
DN Inquiry and Transfer					
Transactions, thousands	369	384	368	388	398
Amount per transaction, DKK million	49.10	56.39	57.03	66.17	90.30
DEBES					
Transactions, thousands			61	80	106
Amount per transaction, million euro			20.05	18.20	13.46

¹ RTGS stands for Real Time Gross Settlement.

² TARGET stands for Trans-european Automated Realtime Gross settlement Express Transfer System.

All of Danmarks Nationalbank's current-account holders have access to the system via the KRONOS terminal. Via the terminal it is possible to transact payments and keep up-to-date with movements and the account balance. For those participants who so require, payments can also be sent in SWIFT³ format via the Poseidon module, which ensures the opportunity for STP⁴. KRONOS is built up to translate automatically between the SWIFT format and the format used in the terminal. Banks that have chosen the Poseidon module pay separately for this function and for "translation" of payment messages to/from the SWIFT format.

Finally, via KRONOS cross-border payments can be sent to and received from other banks within the EU area that participate in TARGET. The structure of KRONOS is described in detail in the system description, cf. also Section 7. Chart 1 below presents the structure of KRONOS.

1.3. Responsibility

The responsibility for day-to-day operation of KRONOS is taken over by the Accounts department of Danmarks Nationalbank (RA) when KRONOS goes live on 19 November 2001. The responsibility for initiating troubleshooting to correct acute faults, as well as user support for external participants, will be handled by RA. Design and testing of planned changes to KRONOS is handled by the KRONOS section of the Payment Systems department of Danmarks Nationalbank (BFK), in cooperation with RA. Design and implementation, as well as system documentation, are handled by Bankernes EDB Central (BEC).

The technical operation of the system is outsourced to BEC. This means that BEC is the operator of the system including responsibility for the daily operation of the hardware and the software developed for KRONOS. All major systems, owned by Danmarks Nationalbank, are operated by BEC. This setup has been the prevailing practice for a number of years. The responsibilities, commitments and rights of respectively Danmarks Nationalbank and BEC are set up in a contract between the two parties. The contract entails a number of appendices, each representing a system which are operated by BEC on behalf of Danmarks Nationalbank including KRONOS.

1.4. Process

This assessment of KRONOS in relation to the Core Principles For Systemically Important Payment Systems⁵ (CPSIPS) is based on the

³ SWIFT is the Society for Worldwide Interbank Financial Telecommunication.

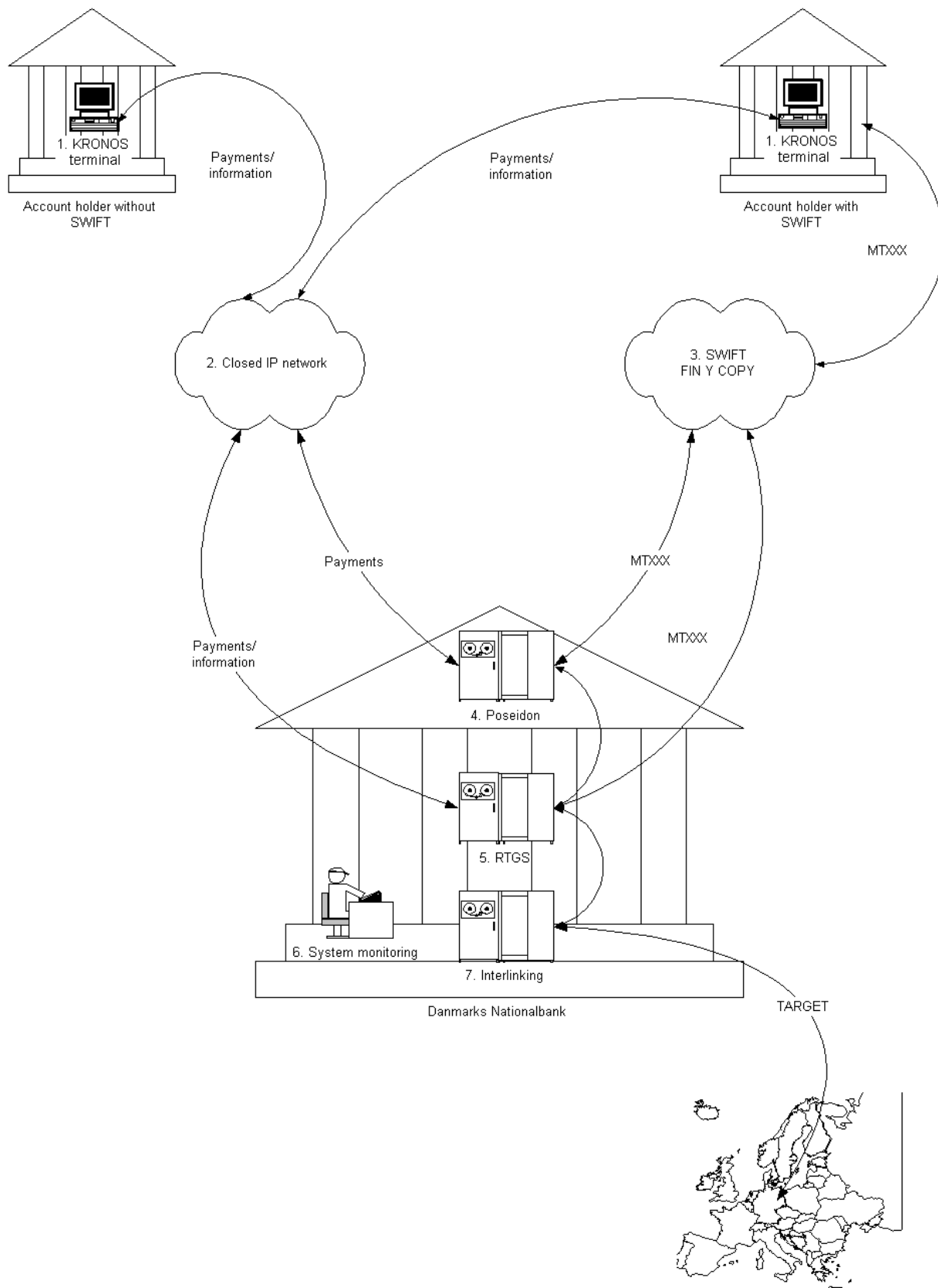
⁴ STP stands for Straight Through Processing. This provides for automatic handling of payments without manual processes.

⁵ The report is published by BIS (CPSS) and can be found on BIS' Web site at www.bis.org.

documents and facts that are known or are expected to be introduced within the foreseeable future.

This second assessment gives rise to a number of comments and recommendations that compared to the first assessment are reduced considerably. The identified outstanding issues are not considered to be of a magnitude that affect the systems stability and efficiency in a negative way.

Chart 1. KRONOS structure



2. Overall conclusion

The table below shows the overall conclusions for KRONOS in relation to the individual core principles. The conclusion can be one of five categories: observed, broadly observed, partly observed, non-observed and not applicable.

- Observed – used whenever all assessment criteria are generally met without any significant deficiencies.
- Broadly observed – used whenever only minor shortcomings are found, which do not raise major concerns and when corrective actions to achieve full observance with the CP are scheduled and realistically achievable within a prescribed period of time.
- Partly observed – used whenever the shortcomings are sufficient to raise doubts about the ability to achieve observance within a reasonable time frame.
- Non-observed – used whenever major shortcomings are found in adhering with the assessment criteria.
- Not applicable – used whenever it does not apply given the structural, legal and institutional conditions.

Core principle no.	Conclusion
I – legal basis	Observed
II – clear rules	Observed
III – management of risks	Observed
IV – final settlement	Observed
V – completion of settlement (multilateral netting)	Not applicable
VI – central-bank claim	Observed
VII – operational reliability	Observed
VIII – efficient for the economy	Observed
IX – access criteria	Observed
X – responsibility and governance rules	Observed

3. Performance of oversight

3.1. Danmarks Nationalbank's role

The role of Danmarks Nationalbank is to oversee payment systems. This is in line with the definition of the central bank's role in CPSIPS⁶. Moreover, CPSIPS⁷ defines that a central bank is responsible for compliance with CPSIPS by the systems it operates.

3.2. Purpose of oversight

The primary objective of Danmarks Nationalbank's oversight function is to contribute to efficiency and stability in payment and clearing systems and on the financial markets⁸.

The greater international focus on this area has e.g. led to review by the IMF and the World Bank of the systemically important payment systems of the member states in the FSAP (Financial Sector Assessment Programme) consultations. A natural task is to ensure that Danmarks Nationalbank fulfils the international requirements on Danmarks Nationalbank as overseer (in particular of Danmarks Nationalbank's assessment of the systemically important payment systems in Denmark) and on Danmarks Nationalbank's own systems.

3.3. Cooperation with other authorities⁹

Danmarks Nationalbank has entered into a Memorandum of Understanding with the Danish Financial Supervisory Authority, which determines the framework for cooperation in relation to oversight between the Authority and Danmarks Nationalbank. This e.g. entails exchange of information and coordination between the Authority and Danmarks Nationalbank in order to avoid duplication for both the system owners whose systems are assessed in relation to the oversight, and for the Danish Supervisory Authority and Danmarks Nationalbank. This agreement is published in Danmarks Nationalbank's Monetary Review, 2nd Quarter 2001, and is also published on Danmarks Nationalbank's Web site.

Besides the domestic Memorandum of Understanding with the Danish Financial Supervisory Authority, a Memorandum of Understanding has been signed on the European level between supervisory authorities and oversight authorities in the EU. The Memorandum includes exchange of information and cooperation between the authorities. The Memorandum has been signed by the Danish Financial Supervisory Authority and Danmarks Nationalbank.

⁶ See Responsibility C, p. 11 (part I) and amplification p. 51 (part II).

⁷ See Responsibility B, p. 11 (part I) and amplification p. 50 (part II).

⁸ See policy statement in Monetary Review, 2nd Quarter 2001.

⁹ See responsibility D in CPSIPS (p. 11 part I) and amplification (p. 55, part II).

Representatives from Danmarks Nationalbank participates in a number of committees and working groups in the ECB, i.e. Payment and Settlement Systems Committee (PSSC).

Finally information about the work with oversight is exchanged between the Nordic central banks. The exchange of information is concentrated around the practical implementation of oversight.

3.4. Definition and publication of Danmarks Nationalbank's objectives and roles

In accordance with responsibility A¹⁰ Danmarks Nationalbank has published its objectives and roles for the oversight of systemically important payment systems in Denmark¹¹. These documents are published in Danish and English, and can also be found on Danmarks Nationalbank's Web site.

3.5. Organisation of assessment of KRONOS

The assessment is handled by a section of BFK, which is organisationally segregated from the section that has developed KRONOS, and from the section of RA that handles day-to-day operational matters. The section comprises individuals with broadbased professional expertise (lawyers, economists and banking professionals).

The practical implementation of the review of KRONOS is based on CPSIPS, but also involves experience gained from other central banks, while the general guidelines of the IMF and the World Bank¹² are used as a template.

Finally, the methods for assessment of KRONOS and this report are subject to assessment by Danmarks Nationalbank's Audit department (Rev.kt.) in order to ensure that the assessment adheres to CPSIPS and that assessment of the system and the responsibility for operation and development of the system are not handled by the same individuals.

3.6. Assessment of KRONOS

The assessment of KRONOS in relation to CPSIPS is based on self-assessment. This self-assessment is performed by the project manager for KRONOS, as well as the head of the section of RA that took over responsibility for the operation of KRONOS when the system was launched.

The self-assessment is based on these individuals' assessment of the principles in CPSIPS, which by the oversight section of BFK are amplified

¹⁰ Responsibility A in CPSIPS (p. 11 part I) and amplification (p. 48, part II).

¹¹ See Monetary Review, 2nd Quarter 2001.

¹² Guidance Note for Assessing Observance of Core Principles for Systemically Important Payment Systems (CPSIPS) and The Structure and Scope of the Assessment Report. August 2001. The report is an internal working document used for FSAP.

and systemised via a number of questions related to the individual core principles.

The self-assessment received is part of the basis for this report. Aspects which have been unclear, or required amplification, have been handled by the people behind the preparation of the self-assessment. The ongoing work has consisted of evaluating the responses, as well as a review by the oversight section of relevant material concerning KRONOS¹³. The outstanding issues from the first assessment have been revisited during the second assessment. The responsible staff has been fully cooperative during the second assessment.

4. Detailed assessment of KRONOS in relation to the core principles

4.1. Structure

Each core principle is assessed separately. An oversight is given in Section 2 "Overall conclusion".

The assessment of the individual core principles starts with a brief description reproduced directly from CPCIPS. Then follows a description of issues related to the core principle, as well as a description of the assessment of KRONOS in relation to each core principle. This is followed by an assessment of KRONOS in relation to the core principle. The assessment is allocated to one of the five categories explained in Section 2 "Overall conclusion".

When a system is allocated to one of the categories Broadly-, Partly- or non-observed in relation to a core principle, proposals for compliance with the core principle will be found under Comments.

There can also be a number of comments related to each core principle. These can be of varying nature, e.g. special factors, assessments or proposals for improvements.

Finally, under each core principle a table refers to the documentation used. The numbers in the first column refer to the general list of documentation set out under Section 7 "Documentation". The second column refers to any specific sections of the relevant documentation.

¹³ See Section 7 "Documentation" for amplification.

4.2. Core principle I

The system should have a well-founded legal basis under all relevant jurisdictions.

4.2.1. Description

The legal basis for KRONOS can be divided into 4 categories:

- A. Ordinary Danish law of property
- B. Special Danish rules of law directed at payment systems and collateral arrangements
- C. The general basis of agreement for KRONOS (the Danish RTGS rules)
- D. The terms of the European System of Central Banks (ESCB) for the participation of the "non-euro-area" central banks in TARGET.

Re A

Danish law of property recognises, and to a very great degree, protects agreements and other legal acts between parties (freedom of agreement, informal contracts, free right of evidence and access to immediate enforced realisation).

Payments via electronic transfers are recognised as valid legal acts, while the bookkeeping of electronic payments and claims as account balances (e.g. money and securities) are accepted as evidence before Danish courts.

Under Danish insolvency law the effects of insolvency are counted from the time of pronouncement of the decree, and do not have mandatory retroactive effect (i.e. no "zero-hour" rule in Danish insolvency law).

Re B

KRONOS is designated in accordance with the rules of the EU directive on settlement finality in payment and securities settlement systems (the Finality directive). All payments via KRONOS are thus final and irrevocable, even in the event of a participant's insolvency. In the same way, the establishment and realisation of collateral for credit in KRONOS can take place immediately and without consideration of the general procedures of Danish insolvency law for the realisation of securities provided as collateral. This applies to any type of collateral, including via pledging or repo transactions.

Re C

The basis of agreement for KRONOS comprises bilateral connection agreements between the participants and Danmarks Nationalbank, as well as the terms and conditions for accounts at Danmarks Nationalbank. The connection agreement and the terms and conditions for accounts at Danmarks Nationalbank are generally available, and e.g. published on Danmarks Nationalbank's Web site. Via connection agreements all KRONOS participants have accepted a Danish legal venue and Danish

governing law. Foreign participants must document their legal capacity and the recognition by the home country's legal system of the finality and irrevocability of payments transacted via KRONOS, even in the event of insolvency proceedings against the participant in accordance with the insolvency law of the home country.

Moreover, as system owner, Danmarks Nationalbank has entered into an agreement with an external computer centre to provide service and IT services, as well as a number of normal licence agreements, etc. These agreements are not publicly available.

Re D

As part of the European RTGS system, TARGET, KRONOS is subject to the rules of the TARGET agreement. This agreement sets out the detailed terms for TARGET participation by the "non-euro-area" central banks. In 2001, after thorough verification of the Danish RTGS rules, the ECB has found that the terms of the TARGET Agreement are correctly incorporated in the Danish RTGS rules.

Danmarks Nationalbank assesses the legal basis for KRONOS to be complete and well documented.

4.2.2. Assessment

KRONOS is assessed to comply with core principle I.

4.2.3. Comments

There are no comments in relation to this standard.

4.2.4. Reference

Documentation	Section
1	All

4.3. Core principle II

The system's rules and procedures should enable participants to have a clear understanding of the system's impact on each of the financial risks they incur through participation in it.

4.3.1. Description

The system's rules and procedures are found in the documentation basis, including general descriptions of responsibility, granting of power of attorney, emergency procedures, prices and governing law. An article describing the structure of the general set-up was attached with the last issue of the documentation basis to the participants.

Since user access to test the system was given, all users have been able to download information regarding the system from Danmarks Nationalbank's Web site. On the implementation of the system in the production environment, thorough guidelines were issued to all participants.

Below the instruments used to ensure that participants have a clear understanding of the system's impact on the risks to which participation in the system exposes them are presented.

4.3.1.1. Manuals

In connection with KRONOS new terms and conditions for holders of accounts at Danmarks Nationalbank have been prepared. All account holders have been required to subscribe to the system in writing, hereby accepting the rules applying to use of the system.

At the same time, a guide for participants has been prepared. It is also available in an electronic version on Danmarks Nationalbank's Web site.

Situations with *credit risks* cannot arise because the system always checks for cover on the participant's account before a payment is transacted. A payment is final when it has been transacted, even if the participant becomes insolvent, cf. core principle I. The participants can choose to provide collateral for overdrafts on the account. The type of collateral is defined in more detail, just as haircuts according to the classification of the asset are applied to the calculation of the size of the collateral. See also the description under core principle III.

The material issued to participants gives a full description of the circumstances for handling situations with a *liquidity shortfall*. These include a description of the queue functions in which the participants themselves can opt for priority according to the size of the payments or the time of receipt. In addition, the participants themselves can sort the payments as they choose. There is also a general function (bypass) whereby the system settles subsequent payments if the payment, which is first in the queue, cannot be settled due to lack of cover. In situations where the

payments of several participants each await the others' execution, the system can execute these transactions simultaneously via a gridlock buster. The gridlock buster takes into account the priority the participants give to the payments. The gridlock buster and underlying algorithms are described in detail in the material received by participants.

The financial risks thus appear to be well documented and are described exhaustively in the material issued to all participants, which can also be seen on Danmarks Nationalbank's Web site.

4.3.1.2. Training

During summer 2001 training days have been held for all KRONOS participants. The training material is also available on Danmarks Nationalbank's Web site. In addition to these training days, all participants have undergone mandatory tests of the system and have also had the opportunity for "free test" of the system before it went into production.

Before new participants are accepted, they must undergo a series of tests to ensure that they live up to the technical requirements and that they have the required operational capacity and expertise. New procedures for this area are designed and compiled for KRONOS on the basis of the existing procedures for the work in the euro and krone groups respectively at RA.

Internally, RA's personnel have been trained. The training was based on a training plan targeted at each RA user. In addition, staffs at RA have had the opportunity to get to know the system during the test period and in the period up to its implementation, since Phase 1 of implementation required participants to load information. During this period RA was required to provide user support to participants.

4.3.1.3. Emergency procedures

Emergency procedures for the participants are described in the documentation basis, while templates for completion are attached should it be necessary to use the emergency procedures. These emergency procedures cover situations where the system is out of order, and in the event of communication breakdowns between the system and the participants, or breakdown of the systems of the participants themselves. The emergency procedures are updated when they are amended.

Participants are also obliged to take part in testing the emergency procedures, cf. the documentation basis.

4.3.2. Assessment

KRONOS is assessed to comply with core principle II.

4.3.3. Comments

In connection with assessment of the documentation basis, in a number of cases wordings and sentence structures that may be unclear have been found (cf. item 1c of the Terms and Conditions for a Current Account in Danish Kroner). It is recommended that those responsible in due time review the documentation basis in order to ensure optimum clarity without compromising the legal framework with which the documentation basis is required to comply.

In future, Danmarks Nationalbank should investigate whether the issued material gives the participants sufficient insight into the structure and functionality of the system and the risks to which the participants can be exposed.

4.3.4. Reference

Documentation	Sections
1	All
8	All
9	All
10	3

4.4. Core principle III

The system should have clearly defined procedures for the management of credit risks and liquidity risks, which specify the respective responsibilities of the system operator and the participants and which provide appropriate incentives to manage and contain those risks.

4.4.1. Description

4.4.1.1. Managing credit risks

Since KRONOS is an RTGS system, no credit risks can arise between the participants, since all payments are final and irrevocable when the recipient's account at Danmarks Nationalbank is credited.

Participants must pledge a safekeeping account in favour of Danmarks Nationalbank in order to gain access to overdrafts on their current accounts. A list of securities that are acceptable for access to overdrafts has been drawn up. The list of accepted securities is drawn up on the basis of a credit assessment of the issuer, possibly supported by a rating from a recognised rating agency, if available. If a participant does not cover its overdraft, Danmarks Nationalbank may invoke its claims on the safekeeping account without warning.

It is assessed that the procedure for listing the accepted securities handles the credit risk in a manner, which is satisfactory for Danmarks Nationalbank, and there are not assessed to be any credit risks for the participants in KRONOS.

4.4.2. Managing liquidity risks

KRONOS presents a number of opportunities for participants to queue their payments. Queue mechanisms are an efficient means to minimise the liquidity requirement, and also to minimise the risk of gridlocks in the system. Before the settlement day liquidity queues and stop-sending queues are used. In addition, participants can place their payments in a value queue up to 5 days ahead.

For the participants, queuing their payments via the queue functions in KRONOS is ideal. Firstly, they avoid payments being rejected in the event of e.g. insufficient cover, where participants would then be obliged to re-load the payments. Secondly, the queue functions give participants an overview of the payments. In this way, they can use the KRONOS functionalities to give priority to the payments, either individually or via e.g. the bypass function, which ensures execution of those payments for which there is cover.

The participants' payments are allocated to the liquidity queue automatically if there is no cover on the participants' accounts – either due to insufficient

funds or insufficient collateral for overdraft access. The participants themselves can set the priority of queued payments. See also the description under core principle II.

The stop-sending queue applies only to payments in EUR and is effected if one of the central banks participating in TARGET has a transmission failure, which makes payments to/from the country concerned impossible. The payments are queued automatically. The queue is effected when the country is again open for payments. In special cases, at the request of the participant, a payment from this queue can be forced through, provided that there is cover for the payment.

Settlement of the payments is first and foremost ensured via the access to overdrafts against collateral, which gives participants greater flexibility to settle payments. The system also includes a gridlock buster, that can simultaneously settle payments that are waiting for each other without the participants concerned incurring overdrafts, cf. also above under core principle II.

For payments in EUR, participants have only limited access to EUR credit facilities due to Denmark's non-participation in EMU. Each participant that subscribes for the option to send and receive payments in EUR has been allocated a maximum overdraft. This maximum overdraft is allocated quarterly on the basis of the participants' individual requirements, and is adjusted to the overall intraday credit allocated to Denmark if the aggregated maximum amount exceeds the total intraday credit limit. Cover controls and queue functions for payments in EUR and DKK are identical.

KRONOS is assessed to be structured to handle liquidity risks satisfactorily.

4.4.2.1. Other measures

The system's general rules and procedures take into account that a participant may become insolvent, since a possible overdraft can be covered immediately via access to the pledged collateral.

Fines are imposed on participants whose overdrafts are not covered within the stipulated periods. This measure provides an incentive for participants to ensure proper and correct management of their payments, and thereby their liquidity, in the course of the day.

With regard to overdrafts in Danish kroner, if an account holder has not otherwise covered its overdraft by 3.30 p.m., besides providing immediate cover for the overdraft, the account holder shall pay an amount to Danmarks Nationalbank equivalent to 0.02 per cent of the overdraft, but minimum Kr. 1,000.00 and maximum Kr. 25,000.00. In the event of repeated delays Danmarks Nationalbank may terminate the overdraft access without notice.

With regard to overdrafts in euro, if the account shows an overdraft after 6.00 p.m., the account holder shall pay interest at a rate fixed by Danmarks Nationalbank. This is calculated as the ESCB's marginal lending rate, with addition of 5 percentage points, on the first overdraft within a 12-month period. In the event of repetitions within a 12-month period the interest rate is increased by 2.5 percentage points per overdraft. If there have been four overdrafts within a 12-month period, the access to intraday overdrafts is suspended for one week.

The system gives participants access to real-time information concerning executed payments, queued payments and balances. Participants themselves can also determine the frequency at which this information is updated.

The system operator (RA) oversees the system and has access to an overview of all participants' accounts and transactions. At the request of participants RA can also enter and effect payments on their behalf. This option is primarily designed for emergency situations.

The other KRONOS measures appear to contribute adequately to efficient limitation of liquidity and credit risks in the system.

4.4.3. Assessment

KRONOS is assessed to comply with core principle III.

4.4.4. Comments

There are no comments in relation to this standard.

4.4.5. Reference

Documentation	Section
1	All
2	All
5	Section concerning core principle III
7	All
9	All

4.5. Core principle IV

The systems should provide prompt final settlement on the day of value, preferably during the day and at a minimum at the end of the day.

4.5.1. Description

KRONOS is an RTGS system. This means that all payments are settled individually and immediately. When a payment is sent Danmarks Nationalbank checks for cover on the sender's account. If there is cover for the payment, either as an account balance or sufficient collateral in the relevant collateral safe custody account, the payment is booked by debiting the sender's account and simultaneously crediting the recipient's account. If there is no cover, the payment is queued and is not processed until there is cover.

No payments can be held for more than 24 hours. If there are still queued payments when the system closes, or payments are received after closing time, they are rejected by the system unless they have forward value. Received payments with forward value are queued for execution on the stated value day.

When the sending of queued payments depends on receipt of payments from other participants that are also queued, these mutually dependent payments can be settled simultaneously by means of a gridlock buster. The design of the gridlock buster ensures that the sequence of payments chosen by the participant is not changed, and that no account holder shows an overdraft. According to test results the settlement of the gridlock buster does not delay settlement, and is *de facto* not a barrier to compliance with core principle IV.

4.5.2. Assessment

KRONOS is assessed to comply with core principle IV.

4.5.3. Comments

There are no comments in relation to this standard.

4.5.4. Reference

Documentation	Section
1	Terms and Conditions for a Current Account in DKK and EUR, Section 4 for both.
5	4.1-4.3
7	Annex 1, Sections 1.1-1.3. Volume 1, Section 8.1.

4.6. Core principle V

A system in which multilateral netting takes place should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single settlement obligation.

4.6.1. Description

As KRONOS is an RTGS system, this core principle is not applied to assessment of the system.

4.6.2. Assessment

The core principle does not concern KRONOS.

4.6.3. Comments

There are no comments in relation to this core principle.

4.7. Core principle VI

Assets used for settlement should preferably be a claim on the central bank; where other assets are used, they should carry little or no credit risk and little or no liquidity risk.

4.7.1. Description

KRONOS is operated by Danmarks Nationalbank and payments are settled via the participants' accounts at Danmarks Nationalbank. The balance of these accounts is a claim on Danmarks Nationalbank, and they are therefore settlements as claims on the central bank. This applies to both DKK and EUR. For EUR, each morning funds are transferred to Danmarks Nationalbank from a bank in a country, which participates in EMU.

4.7.2. Assessment

KRONOS is assessed to comply with core principle VI.

4.7.3. Comments

There are no comments in relation to this core principle.

4.8. Core principle VII

The system should ensure a high degree of security and operational reliability and should have contingency arrangements for timely completion of daily processing.

4.8.1. Description

With regard to KRONOS in general, the system's design and set-up are intended to ensure a security level, in order to safeguard operational reliability. In cases of breakdown there must be emergency procedures both internally and in relation to participants. Security is also subject to regulation under Danmarks Nationalbank's IT security policy, which also applies to services from external suppliers, including BEC.

Operational reliability is ensured via a closed network between all participants, their computer centres, BEC and Danmarks Nationalbank. Moreover, transmission of data in this network is encrypted. Furthermore, there are two operations centres for the system, as a consequence of the rules for TARGET. These are 4 km apart and are *de facto* mirror images of each other. All transactions are mirrored between the centres immediately and a transaction is not approved until the mirroring is completed. Danmarks Nationalbank's responsibility extends to, and includes, the routers placed in each of the computer centres that service participants. From these routers to each PC the participants and their computer centres are responsible for transmission and security.

4.8.1.1. KRONOS risk analysis

Since KRONOS is part of TARGET, due to the opportunity to receive and send EUR payments, the mandatory risk analysis of the system has been carried out with regard to the part of the system that handles EUR. The part of the system that solely handles payments in DKK is explicitly omitted from the risk analysis. The risk analysis was prepared with the help of an external consultant from an internationally recognised firm of auditors.

The TARGET risk analysis assesses the system complex within a number of specific areas. The risk analysis is based on the BS7799 standard for IT systems. The risk analysis sums up outstanding issues to be handled. These are categorised in three risk levels (Low, Medium and High). 6 outstanding issues have been identified in the last update made February 2002. None of these issues are assessed to present a high risk, while 1 is assessed to entail medium risk. The rest are allocated to the lowest category, or considered not to entail any risks at all.

The one medium risk is:

1. Lack of oversight of whether the system has sufficient capacity to handle payments.

2.

The identified risk in the medium category is expected to be solved during 2002. Experience from the first 6 months of operation has not shown any problems regarding capacity in the system. The unclear deadline for solving risk no. 1 gives rise to comment.

In addition, a number of questionnaires used for previous risk analyses have been assessed. These questionnaires focus on the operational risks in the systems and consider issues such as accessibility, continued operation, emergency procedures and critical areas for operation of the systems.

The Interim Risk Analysis document has been approved and signed by the head of BFK and the head of IT, and is also audited by Rev.kt. with subsequent reporting to the ECB's Internal Auditors Committee (IAC).

In addition to the TARGET risk analysis, the entire system has been assessed by Danmarks Nationalbank's external auditors. The outstanding issues identified are completion of procedures for RA and change management procedures between BEC and Danmarks Nationalbank. The outstanding issues have either been closed, or are expected to be closed before the end of 2002.

Danmarks Nationalbank's internal auditors have reviewed the system in relation to the project process and the quality and security of the completed system. An analysis has also been performed by Danmarks Nationalbank's Security department in cooperation with BEC's head of Security, in order to consider aspects related to the IT security policy.

4.8.1.2. Manuals for internal use

For internal users at Danmarks Nationalbank a manual has been prepared. The manual was given to the users in RA on 13 May 2002. The manual is to be used by RA's users as the basis for e.g. service to participants and in connection with the day-to-day management of KRONOS and the development of the system. BEC is responsible for updating the manual in step with the ongoing development of KRONOS. RA has commented that the manual not entirely reflects the latest updates to the system. This gives rise to comment.

4.8.1.3. Backup

The system is designed so as to duplicate all programs, databases and hardware, cf. ESCB's requirements of RTGS systems participating in TARGET. The system is based on both mainframes and servers. The programs and databases that run on mainframes are run from either BEC 1

or BEC 2¹⁴ with online mirroring of data to the site that is not a primary site. Switching from one site to the other requires a number of measures to be implemented. As required by the ECB, the switch must be handled within 4 hours.

On the server side, there are two servers at each site. The server technology enables them to switch automatically between each other, without other measures being required. Successful tests have been completed to check that this is possible prior to the implementation of KRONOS.

Platform switch (mainframe) for the entire system from BEC1 to BEC2 has been tested in February 2002. The switch was held within the defined timeframe. Quaterly tests of platform switch are scheduled. The next test will take place at the beginning of June 2002. It should be noted that the tests performed as well as the tests planned took and will take place during weekends, which does not reflect a "real-life" situation where it is necessary to switch between the platforms on a normal working day. This gives rise to comment.

Finally, a measure is initiated to ensure copying of relevant bookkeeping data to a database outside the system. This database can be used in emergencies when there is no other access to the system and data. This ensures access to data even in emergency situations, so that payments can take place without the risk of overdrafts on the participants' current accounts at Danmarks Nationalbank.

4.8.1.4. Emergency procedures

A number of emergency procedures of both technical and operational nature have been established for the system. The technical emergency procedures are assessed in the section below. The operational emergency procedures are described in RA's procedures, while the participants' roles and responsibilities are described in the documentation basis. Escalation procedures for KRONOS to regulate decision-making authority between RA and BEC are anchored with RA and BEC. A general plan for all systems owned by DN and operated by BEC is prepared, but is not yet in place.

4.8.1.5. Separation of function and control

The system is designed to segregate the management of respectively master data and transactions. This is an essential prerequisite to a secure system, so as to avoid transactions influencing master data with regard to both the system and the individual participants.

The system and the related procedures at RA have been built up with controls to safeguard against errors. This is ensured by the introduction of

¹⁴ BEC1 and BEC2 refer to the two BEC centres which are primary and secondary sites. These are 4 km apart, and are interconnected via optical fibre cables.

4-eyes control. If faults occur in the system, an oversight module ensures that they are discovered and corrected. Rev.kt. has assessed this area.

4.8.2. Assessment

KRONOS is assessed to comply with core principle VII.

4.8.3. Comments

The outstanding risk (ensuring capacity) identified under Section 5 of the Interim Risk Analysis, matrix item 2.4.1, should have a more specific deadline than described under "status and plan". At the same time, an execution plan should be drawn up, stating *inter alia* persons responsible, milestones, etc. This work is recommended to take place in close cooperation between Danmarks Nationalbank and BEC.

The manual for the internal users at Danmarks Nationalbank – RA – should be revised in order to reflect the latest updates to the system.

Solutions should be sought that will make the switch tests from BEC1 to BEC2 more true to life than has been the case so far.

Escalation procedures for crisis situations remain to be determined.

4.8.4. Reference

Documentation	Section
1	General: Part 1, item 5. Fax formats for emergency procedures: Parts 1-2 and 7-8.
2	All
6	5
9	All
12	All

4.9. Core principle VIII

The system should provide a means of making payments which is practical for its users and efficient for the economy.

4.9.1. Description

The KRONOS project was launched for a number of obvious reasons. The DN Inquiry and Transfer System dated from 1981. Even though as an RTGS system it fulfilled a number of functions, it was becoming obsolete in terms of both functionality and presentation vis-à-vis users. Moreover, the system's design impeded technical upgrading to meet the requirements for a modular structure and parameter management. Finally, at the time of the decision to implement KRONOS it was known that there would be a new global system for reduction of risks in connection with currency trades – CLS¹⁵ – that would make requirements of the central banks' RTGS systems which the DN Inquiry and Transfer System would be unable to meet. It was furthermore decided that it was also to be possible to settle both Danish kroner and euro payments in the new system. This will make it possible to replace the existing RTGS system in euro, DEBES, and thereby offer participants one single access point, instead of two separate ones.

After the decision to implement a new RTGS system the market for RTGS systems was investigated, and it was found that it would be less expensive to develop one's own system than to buy a product "off the shelf". It was also found that adapting a "shelf product" to the existing system structure and technical platform would present major problems. In order to ensure that a system was developed that would live up to international standards and future requirements of such systems experience was gathered from a number of other central banks and suppliers of RTGS systems.

Throughout this process there was ongoing dialogue with the future participants. This accords with Danmarks Nationalbank's project model that prescribes the establishment of user fora, or reference groups, to ensure that users' requirements are incorporated in the system requirements, thereby ensuring greater usability and user satisfaction. From the very outset, the users have been aware that they would be required to bear the costs of developing the system, and this has been taken into account in all considerations regarding the requirements of the system. The system's modular structure has also helped to ensure that to a great extent the individual participants have been able to tailor the choice of services offered by the system to their own requirements.

The system helps to facilitate payments to/from financial institutions in Denmark and the rest of Europe and is also the basis for, or an element of,

¹⁵ CLS stands for Continuous Linked Settlement. The system reduces the risk concerning the principal that exists today between banks that settle currency trades.

the settlement via Sum clearing and the money side of Securities settlement. The high rate of connection to the system indicates that it is assessed to be practical for the users and efficient for the economy and the financial system in Denmark.

This is emphasised by the fact that via the structure of KRONOS, as stated, participants have been able to choose the solution that best suited each participant. So minor participants for example do not incur SWIFT costs since the basic version of the system meets their requirements. Likewise, participants with a large transaction volume and technically sophisticated internal solutions have been able to choose the Poseidon module, which provides for use of SWIFT and STP, thereby enabling participants to reap the full benefits of economies of scale.

In implicit terms, a number of cost/benefit analyses have thus been conducted, because all requirements have entailed a certain cost.

4.9.2. Assessment

KRONOS is assessed to comply with core principle VIII.

4.9.3. Comments

There are no comments in relation to this standard.

4.9.4. Reference

Documentation	Section
3	Section on core principle VIII
5	Items 8.1-8.4

4.10. Core principle IX

The system should have objective and publicly disclosed criteria for participation, which permit fair and open access.

4.10.1. Description

Danmarks Nationalbank has formulated the access criteria so as to ensure access for virtually all financial institutions in Denmark. Moreover, it is not possible to hold a current account at Danmarks Nationalbank without participating in KRONOS, and vice versa. It has also been considered important that the price of the system does not impede fair access for those institutions that are eligible for access via the current-account rules.

The access criterion is that participants belong to one of the following categories:

- Credit institutions and investment companies subject to the supervision of the Danish Financial Supervisory Authority.
- Branches in Denmark of foreign credit institutions and investment companies that are subject to the supervision of another EU member state or of a country with which the EU has concluded a cooperation agreement on home country supervision.
- Branches in Denmark of foreign credit institutions and investment companies that are subject to the supervision of the Danish Financial Supervisory Authority.
- Foreign credit institutions and investment companies that are subject to the supervision of another EU member state or of a country with which the EU has concluded a cooperation agreement on home country supervision and which conducts cross-border activities in Denmark.
- Other participants that, in the judgement of Danmarks Nationalbank, are of vital significance to the settlement of payments at Danmarks Nationalbank. With regard to the euro, such parties must, moreover, be subject to the supervision of the Danish Financial Supervisory Authority, or of another EU member state, or of a country with which the EU has concluded a cooperation agreement on home country supervision.

A more detailed definition can be found in "Terms and Conditions for a Current Account in Danish Kroner" and "Terms and Conditions for an Euro Current Account".

The criterion is chosen on the basis of the need to contain systemic risk and to support other central-bank tasks. Moreover, participants can reasonably be expected to hold technical know-how and to have a general

understanding of the problems related to payment systems, since this is an element of their business activity¹⁶.

These terms and conditions are based on Denmark's financial infrastructure as well as current practice over several decades.

On joining the system, a participant can make a number of selections, depending on its requirements. The SWIFT format (Poseidon) can be selected (standard is the KRONOS terminal) and payment in EUR (TARGET) can be selected. All account holders have been informed of the price structure in KRONOS and on this basis could make their final choices. A description of the structure and its background are issued on request, and is also published on Danmarks Nationalbank's Web site. In brief, the price structure is based on a key that is founded on the participants' working capital as compiled by the Danish Financial Supervisory Authority. Via this key minor participants pay less for joining the system than major participants that select the same modules. Participants with no working capital, e.g. branches of foreign banks, are placed according to their proportional share of the transaction volume in the previous system.

In line with international recommendations, the system is based on the participants' reimbursement of costs. The participants pay a connection fee to cover the development costs, a fixed monthly charge to cover fixed operating costs, and a variable monthly consumption charge to cover the participants' actual use of the system. The transaction prices are publicly available. After one year of operation the prices are re-assessed, e.g. on the basis of the degree of utilisation of the system.

In overall terms, the fixing of the price structure key is not assessed to distort competition. Moreover, the key contributes to ensuring that costs as a ratio of the size of each participant do not distort competition.

In technical terms, participants are required to use a PC with Microsoft Windows 2000 or NT as operative system. Connection from the participants to BEC is via a closed network with communication based on Internet technology (IP).

On the basis of *inter alia* of the size of the participants (small balance sheet, few transactions, few employees, price of the system in relation to its usefulness, choice of technical platform or participation via a fax solution, which is no longer possible) a number of account holders have chosen to close their current accounts at Danmarks Nationalbank. This is not found to distort competition, since the size of the participants and their use of the

¹⁶ Retail payments such as transfers between non-financial institutions and private individuals are handled via retail payment systems, whereby final settlement (net) takes place via settlement accounts at Danmarks Nationalbank, and ultimately to the financial institutions' current accounts at Danmarks Nationalbank.

previous system (the DN Inquiry and Transfer System) have been very modest.

The rules are issued in hard copy to all account holders and can also be found on Danmarks Nationalbank's Web site in both English and Danish versions.

The terms and conditions for a current account describe how Danmarks Nationalbank can terminate an account without giving any grounds, while a participant can request closure of an account. The terms and conditions do not describe the procedures for closing an account in more detail. There are procedures at Danmarks Nationalbank to ensure that any overdraft/maximum is covered before the account is closed.

Open access to the system is ensured by giving participants that hold a current account at Danmarks Nationalbank access to the system. None of the participants that today have access to a current account at Danmarks Nationalbank have been refused access to the new system. Danmarks Nationalbank has also provided fair access, since the price key for system participation ensures that competition is not distorted in relation to the financial infrastructure in general.

4.10.2. Assessment

KRONOS is assessed to comply with core principle IX.

4.10.3. Comments

A detailed description of the procedures for discontinuing an account (e.g. a written form like that used to open accounts) would ensure greater clarity vis-à-vis participants if an account is closed at the request of the account holder.

4.10.4. Reference

Documentation	Section
1	General: Parts 1 and 3 Settlement of payments in Danish kroner and monetary-policy instruments: Part 1 Settlement of payments in euro: Part 1

4.11. Core principle X

The system's governance arrangements should be effective, accountable and transparent.

4.11.1. Description

In many respects this core principle is assessed in relation to the other 9 core principles. The decision-making process and governance in relation to the development and operation of the system are also considered.

4.11.1.1. Development of KRONOS

Danmarks Nationalbank's IT project model also sets out rules for the decision-making process and the management of projects. The overall management of the development of KRONOS is a steering committee comprising the heads of the relevant departments of Danmarks Nationalbank, as well as BEC. Moreover, members of the boards of governors of Danmarks Nationalbank and BEC are represented in the steering committee. The steering committee is responsible for the project's adherence to the IT project model, Danmarks Nationalbank's IT strategy and Danmarks Nationalbank's IT security policy. The steering committee also ensures that the necessary resources are available for execution of the project. These can be human resources as well as financial resources. The steering committee also approves key decisions, as well as the documentation that the various phases of the project can be concluded.

The project manager is designated by the system owner and reports directly to the steering committee. The project manager is responsible for the performance of the project, setting up goals within the framework set by the steering committee (purpose, time and finance), as well as contact with external stakeholders, e.g. the reference group. The project manager heads the group – the project group – working on the project.

In addition, a number of individuals are designated as responsible for e.g. testing and implementation of the system, as well as review of the project group's work and documentation.

4.11.1.2. Operation of KRONOS

RA is responsible for the system's operation, in close cooperation with BEC as technical operator. Descriptions of rules and procedures have been drawn up and issued in hard copy to all system participants. They can also be seen on Danmarks Nationalbank's Web site. Finally, procedures for internal handling of the system are drawn up in RA. In business terms, these are based as far as possible on the existing procedures for respectively DKK and EUR, which are amalgamated into one procedure since KRONOS handles both currencies. The material for the participants, as well as internal procedures, are updated in step with any changes that take place.

There are also rules for who at RA is responsible for issuing information to participants, e.g. if there is a need to issue information immediately when any problems arise. There are also rules for who is to make decisions internally within RA. These reflect the rules for TARGET, where responsibility for day-to-day operations rests with a "settlement manager", while crisis management is the responsibility of a "crisis manager". With regard to system errors it should be specified who is to make which decisions in relation to BEC. This escalation plan has been discussed for a long period. The people involved are in practice aware of who does what and who to contact, but formal preparation of this plan is still outstanding at the present time.

4.11.1.3. Future development of KRONOS

The system is developed in cooperation between RA and BFK. The development adheres to Danmarks Nationalbank's IT project model that is the template used for developing IT projects at Danmarks Nationalbank. BEC is contractually obliged to adhere to Danmarks Nationalbank's project model. The project model is structured in phases, and also states a number of tools to be used. To ensure optimum dissemination of information, Danmarks Nationalbank's IT project model prescribes that key stakeholders must be involved in the development of the system. This is already anchored in KRONOS via reference groups whose participants are briefed on Danmarks Nationalbank's work on the system, while at the same time participants can put forward their requirements regarding the further development of the system. As a consequence of TARGET participation, the participants who have opted for access to send and receive payments in EUR are part of the TARGET User Group, which considers both general and more specific issues regarding settlement of payments in EUR. The reference group and the TARGET User Group ensure that no major decisions regarding the system's design and functionality are changed without the prior involvement of the participants.

Finally, a plan is currently under preparation to ensure optimum focus on KRONOS in connection with system changes, both within KRONOS and in systems that interface to KRONOS. This plan is designated the Change Management Procedure.

4.11.1.4. Compliance with the other core principles

The other 9 core principles in CPSIPS, cf. the assessment thereof, are either fully or almost fully complied with by KRONOS. The outstanding issues identified have all been addressed, and plans for corrective action have been set up. Outstanding issues are commented on under the relevant core principles.

4.11.2. Assessment

KRONOS is assessed to comply with core principle X.

4.11.3. Comments

It is recommended that resources are devoted to completion and incorporation of escalation procedures to govern the cooperation between RA and BEC in the event of major operational disruptions to KRONOS.

4.11.4. Reference

Documentation	Section
See other core principles	
11	All

5. Summary

In overall terms, KRONOS is assessed to comply with CPSIPS.

In general, KRONOS complies with the first three core principles that are directed at the system's rules and procedures, and its legal aspects, including sufficient information to the participants, and ensuring that participants understand the system and any risks they incur as a consequence of their participation therein.

Core principles IV-VII concern the system's ability to minimise credit and liquidity risks and the risks associated with the actual operation of the system, including safeguarding operations in emergencies. The system is structured so as to exclude credit risk for either the participants or Danmarks Nationalbank. Since KRONOS is an RTGS system, and thus entails a greater liquidity requirement, mechanisms have been introduced to minimise the risk of payment queues as a consequence of limited liquidity. Concerning core principle VII, a number of issues that should be focused on in the near future have been identified. This has given rise to comment. However these do not affect the overall impression, that the system complies with core principle VII. Core principle V is not assessed to be relevant to KRONOS as this core principle addresses systems that use multilateral netting. KRONOS is considered to comply with core principles IV and VI.

Finally, core principles VIII-X concern the system's efficiency for participants and for society, criteria for participation, and management principles. The system is assessed to be efficient and of useful value to the participants. This is based *inter alia* on the comparisons made to standard systems for the area, as well as the participants' active involvement in the system's design and function, including its modular structure. The criteria for participation are public and the key for the distribution of costs to the participants has been published, and is based on criteria otherwise used by the participants in other contexts, which cannot as such be assumed to affect the existing infrastructure. Finally, the management principles are reviewed, including the decision-making process and participants' involvement prior to important decisions that affect them. KRONOS is assessed to comply with core principles VIII-X.

6. Recommendations

The recommendations concerning KRONOS focus on the fulfilment of core principle VII, where a number of areas requiring greater focus and attention in the future have been identified. These are described in further detail under the comments on the core principle and concern measures to ensure the continued operation of the system in emergency situations, as well as the system's operational stability in normal conditions.

7. Documentation

The assessment of KRONOS in relation to CPSIPS applies a number of sources to analysis of the various core principles. The documentation used is presented below.

1. The documentation basis for monetary-policy instruments and settlement of payments in DKK, EUR and SEK. This is divided into the following sections:
 - General
 - Settlement of payments in Danish kroner and monetary-policy instruments
 - Settlement of payments in euro
 - Settlement of payments in Swedish kroner
 - Fax formats for emergency procedures

The documentation basis has been issued to all participants and can be seen on Danmarks Nationalbank's Web site.

2. Auditors' assessment of KRONOS.
3. Written questions to and replies from the persons responsible at RA and BFK.
4. Interview with relevant personnel at RA, BFK and Rev.kt.
5. Self-assessment of KRONOS of 31 October 2001. Prepared by the project manager at BFK and the head of department at RA.
6. Interim Risk Analysis. Document prepared in accordance with the ECB's procedures for systems that are part of TARGET.
7. KRONOS system description version 5.0.
8. Letter to account holders of 10 October 2001.
9. Training material and information on Danmarks Nationalbank's Web site.
10. Business procedure and work descriptions - Accounts, Euro group.
11. Danmarks Nationalbank's IT project manual and IT tool manual.
12. Status memorandum for KRONOS security analysis of 8 November 2001.