RFI – Request for Information

KB Book location

*DISCLAIMER
Deze RFI is een bijlage die geen onderdeel uitmaakt van de contractdocumenten en scope van de aanbestedingsprocedure. De inhoud van de vraagspecificatie is leidend als contractdocument. In deze RFI is een mogelijke conceptoplossing (referentie-ontwerp) opgenomen voor het logistiek systeem, zoals deze met de KB is besproken. Deze mogelijke conceptoplossing kan als inspiratie worden gebruikt, maar behoeft niet gevolgd te worden. Aan de inhoud van dit document kunnen geen rechten ontleend worden in de aanbestedingsprocedure en uitvoering van de opdracht.

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DENC NETHERLANDS B.V.

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1. Introduction

The KB (Koninklijke Bibliotheek) is looking for a system integrator for a new automated system to store containers containing items such as books, periodicals and newspapers. The system integrator should deliver the new system turn-key and also maintain the system for a period of at least 10 years based on a DBM-contract (Design, Build, Maintain). The system will be located in a new building, which is currently in the design phase.

Background

The mission of the KB, National Library of the Netherlands, is stated below:

For centuries, the KB, National Library of the Netherlands has been a source of inspiration and innovation. Since our foundation in 1798, we have developed into a broad-based, versatile organisation, which guarantees the visibility, usability and sustainability of the national library collection for all Dutch people, for any purpose, both now and in the future. We are responsible for the written word, particularly Dutch publications, and for ensuring that everyone is able to read, learn and conduct research. This is our way of contributing towards making the Netherlands smarter, more competent and more creative.

The KB intends to move from its current location next to Central Station in The Hague to a new location in the city center in a few years' time. For financial and functional reasons, it was decided to move the book location with all the collections to a location at the outskirts of The Hague, so that there will soon be two locations:

- The main building (Head Quarters, HQ; a public building with a reading room)
- The book location (a non-public building; for storage purposes)

The Harnaschpolder has been chosen as a suitable place for a new, innovative warehouse where the KB wants to store the current collection of around 4,5 million items (books, newspapers and periodicals) and the expected growth of the next 15 years (1,5 million items) in an ultramodern, fully automated facility.

The warehouse is low in oxygen (no fire possible), has no climate installations to implement and is completely energy neutral by using solar panels. The main reason for not using HVAC climate control systems is to implement more sustainable collection care strategies. Extra benefit is the exclusion of water leakage from HVAC systems. It is a so-called passive building, which means that the indoor climate (temperature) moves slowly along with the outside temperature and always remains within the set requirements. The relative humidity also remains within the set limits, with the caveat that if it proves necessary, a facility for humidification/dehumidification can be installed quickly. This concept is rarely used in the library sector, and it is expected that the warehouse will attract a great deal of interest from colleagues at home and abroad.

Project goal

The current location of the KB is end of life and needs to be vacated by Q1 2028. KB wants to use this moment to change the current way of working. The main targets for a new solution are:

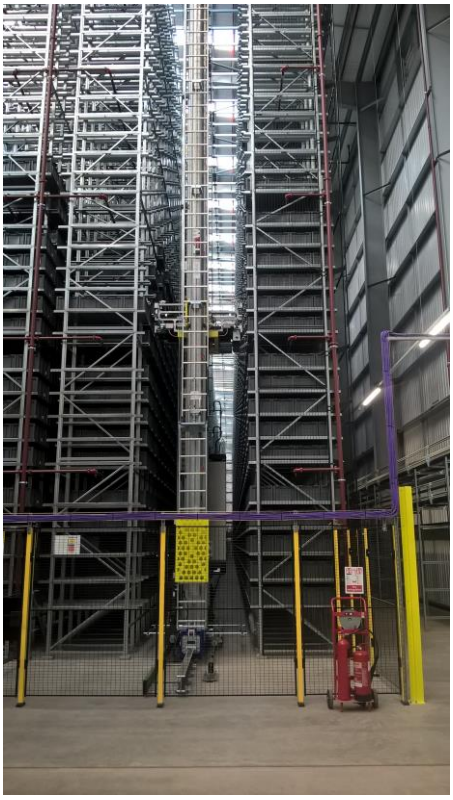
1. To be able to store the collection in a most safe and secure way;
2. To maintain the collection on this location for at least the next 100 years.

Concept Solution

KB and DENC have developed a concept solution for the storage and handling of the containers with books, periodicals and newspapers. The concept solution has the following characteristics

- Storage in containers of three different sizes. The outside sizes are 400x600mm (2 containers with different height) and 800x600mm (see chapter 2.). The 400x600 containers can be stored four (containers) deep, the 800x600 containers can be stored 2 (containers) deep.

- The system will consist of approx. 10 aisles with 5 miniload cranes. The concept is to have 1 crane serving 2 aisles. Therefore, the miniload cranes should be able to change aisles.
- The aisle changing miniload cranes can be transported to a dedicated area for maintenance outside the storage area. The idea is to use this area also for changing equipment after the technical life has expired.
- All miniload cranes will have one “fast-mover” area where all of the frontal positions are dedicated to fast-moving containers. The rest of the positions and the second lane will be stored with the other containers. Containers that are not full are classified as “fast-mover”.
- The miniload cranes will pick and drop containers at AMR’s (Autonomous Mobile Robots) at the frontside of the racking. The AMR’s will bring and take containers to the working stations.
- There are 6 picking stations. All picking stations can handle the 400x600 containers while two of them can also handle the 800x600 containers.



Example of 4 deep automated storage system

Example of AMR for horizontal transport

Scope of supply

The scope of the proposed solution consists of the supply of all labor, material, equipment and supervision necessary to create a turnkey logistics solution based on a BDM-contract for an automated storage system for KB, as described by, or reasonably inferred from this document.

It is assumed that the scope encompasses drawings, design, production, transportation assembly on site, testing, phased hand-over, training of personnel (operators/logistic employee/system administrator/maintenance employees) and start-up support including controls and all required interfaces with existing and new systems of KB. Documentation, certification of the system as a whole and its individual components as required by law as well as warranty documents are also deliverables.

The scope of supply consists of:

- Automated storage system for 260.000 racking-locations for containers, including conveyors for in- and outfeed, 5 mini-load cranes including aisle equipment, aisle changing equipment for mini-load cranes and outfit maintenance area.
- 223.000 containers of which 37.000 with size 600x800 and 186.000 with size 600x400. The containers with size 600x400 are divided in height. The number of containers with internal height 250 is 111.000 and the number of containers with internal height of 350 is 75.000.
- Transport to and from workstations-area to automated storage system, including horizontal transport from conveyors for in- and outfeed to workstations
- Workstation-area, including 6 ergonomic workstations and the conveyor-system for containers with weighing, dimension check, i-point.
- WCS and interfaces with WMS and ERP Alma
- Maintenance for the next 10 years.
- Critical Spare parts

RFI Terms and Conditions

Supplier is expected to treat this document and all accompanying information, whether obtained in writing, electronic or verbally, with full confidentiality. In responding to this document, you are accepting the conditions set out within this document.

All representations made in response to this RFI, whether verbally or in writing, will be accepted by KB in good faith.

Any costs made with regards to this RFI are not applicable for reimbursement, regardless of whether an order is granted after the application procedure or not. This also applies to any costs you may incur as a result of a request for additional information on the part of KB and/or the consultant.

For the avoidance of doubt, this RFI does not place any obligation upon KB to accept any of the responses made, nor to debrief Supplier on the reasons he was not successful.

Any ideas or concepts proposed in this manner are freely usable KB even in cases where the providing Supplier is not selected or in case the project is not continued. Furthermore, KB is completely free to select the Supplier who will supply the system or systems. If a Supplier is notified of having been rejected, the Supplier must completely distance himself from the project to be executed. The Supplier shall not, openly nor covertly, directly nor indirectly, be associated with, nor influence the procedure, the execution or the completion of the project.

2. Product specifications

Product description

The KB will store items (books, periodicals and newspapers) in containers in the new automated warehouse.

Of these items, 400.000 are part of the “special collection”. These items will be placed in the center of the storage area for the most stable preservation.

Containers

The system must be able to handle and store the following types of containers:

1. 400x600 (outside) x 250 (inside). Average weight 30 kg and maximum weight 45 kg
2. 400x600 (outside) x 350 (inside). Average weight 40 kg and maximum weight 60 kg
3. 800x600 (outside) x 250 (inside). Average weight 60 kg and maximum weight 90 kg

The following specifications are valid for the containers:

- Material PP or PE
- Emission-free material
- Non-recycled material
- No lid
- No holes in bottom and/or sides
- Expected lifetime of at least 100 years
- Suitable for O_2-reduction environment (13% O_2)
- Containers will not be stacked.

3. Process description

New warehouse processes

A complete overview of the processes for the new warehouse of the KB can be found in appendix A.

The main functions of the warehouse are:

1. Storing of the current collection and taking in new items for the collection. The physical collection is not static and will continue to grow.
2. In addition, items of the collection can be requested for different purposes. Requested items will be retrieved from storage and stored back in the same container at a later date.

The main processes of the automated warehouse are:

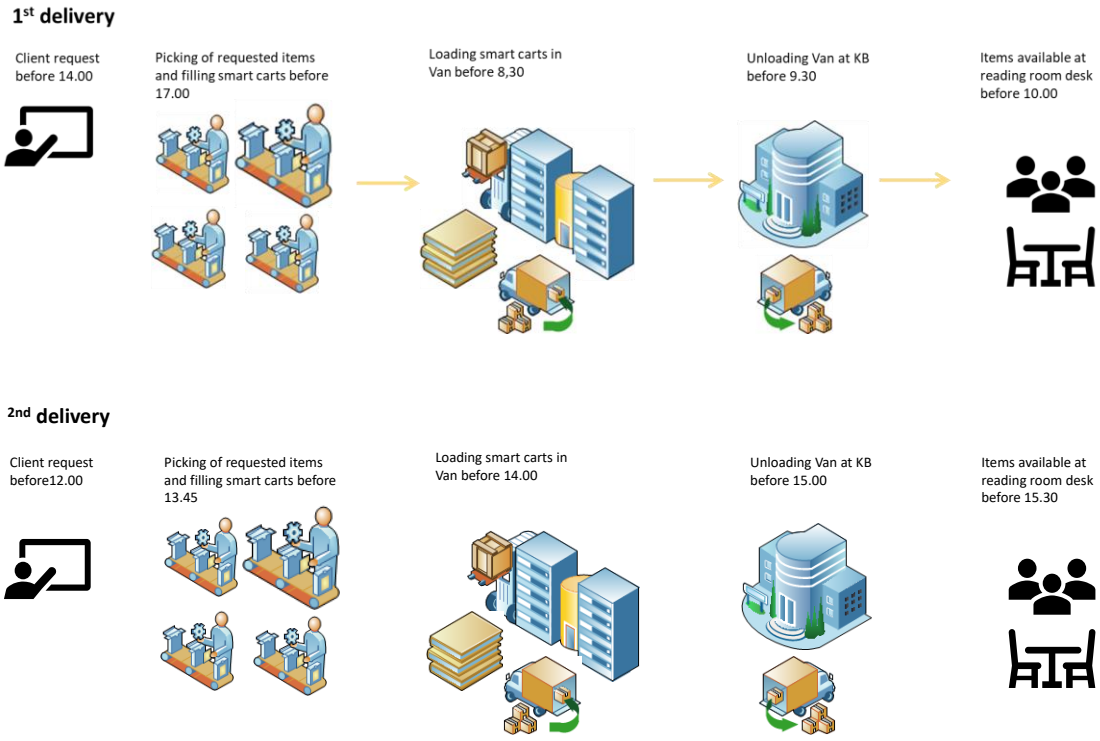
- Request of items for loan & digitization (Regular request of items)
- Ingest new items
- Ingest of collection items
- Special request of items

Regular request of items (loan & digitization)

A customer of the KB can request an item via the library registration system Alma. The requests, which can and must be fulfilled are sent to the WMS. For regular requests the following service levels apply:

- An item requested before 14:00 on day 1, will be available at the reading room desk at KB the next day before 10:00. This is called the first delivery.
- An item requested before 12:00, will be available at the reading room desk at KB the same day before 15:30. This is called the second delivery. The second delivery will have a limited number of items.

The general request process is shown in the following picture for 1st and 2nd delivery



The automated warehouse process related to picking regular requests is straight forward.

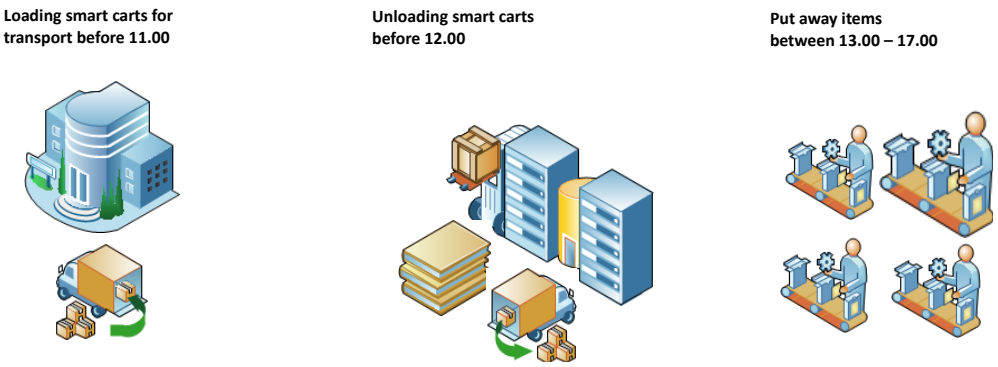
Requests to be picked are sent by the WMS to the WCS of the automated warehouse system. The automated warehouse system will send the containers which contain the requests to the picking stations. The sequence of the containers is not relevant.

Operators at the workstations will pick the requests from the container and will check if the correct item is picked by scanning the item. The operator will place the item in a smartcart and will place a placeholder in the container from which the item was picked. The placeholder marks the place of the picked item to ease the put away process. The operator confirms that the correct item is picked. The container will return to the storage area and will be placed in the “fast-mover” area of the automated warehouse until it is retrieved to put-away the returned items. The next container is delivered to the operator for picking. The picking process continues until all requested items are picked.

The other steps in the process are controlled by the WMS and Alma.

All picked items are put in a smartcart, until the smart cart is full or the delivery time to KB HQ is due. The smartcart will be scanned and will move through the warehouse building to the outbound area. At the outbound area, the smartcart can be stored depending on the delivery schedule in a special conditioned area.
The smartcart is scanned again when it is loaded into the Van to update the status in the WMS to “in transit”. Upon arrival at KB HQ, the smartcart is scanned again to update status to “at KB HQ” and is transported to the KB reading room. At the reading room, the smartcart is unpacked and each individual item is scanned and placed in temporary storage. The item is then ready for pick-up by the customer.

The item can return to the warehouse once the customer is finished with the item. This process is shown in the following figure.



The item will be scanned at the KB reading room desk and placed at a smartcart. Once the smartcart is full and/or ready for transport, the smartcart is scanned and will move to the outbound area. At the outbound area, it is once again, scanned to set the status to “in transit” once it is loaded into the van.

At arrival at the KB warehouse it is scanned again to update the status to “at KB warehouse” and is moved internally to the workstations and is scanned again at arrival to update to “at workstation”. The operator will scan all items in the smartcart in the sequence that items are to be put away in containers.

The put-away process in the automated storage system starts when the WMS inform the WCS about the containers needed for put-away and the sequence of the containers. The sequence of the containers is based on the scans. The WCS will deliver the requested containers to the workstation in the requested sequence. The ID of the containers is automatically scanned at the workstation and on

a display is shown which items needs to be placed in the containers by the operator. The operator will take this item and scan this item to check that the right item will be stored. The operator will place the item into the container at the right position marked by the placeholder remove the placeholder. The weight of the container will be checked and when approved send back to the automated storage area.

For items requested for digitization the client is different and transport will also be to KB HQ. The process for the automated storage system is the same, but there are no specific delivery moments or lead-times.

New items (regular acquisition)

New items (regular acquisition) arrive at the KB HQ. After receipt and cleaning, the items are added, labeled and linked to the digital library system and the WMS (in case of new items). The KB HQ employee will add all metadata of this item to the Alma software.

New items can be books (AC = Algemene Collectie or BC = Bijzondere Collectie), periodicals (T = Tijdschriften) or newspapers (K = Kranten) or varia.

On a daily basis AC, BC and periodicals are delivered to the warehouse from the KB HQ. Newspapers are collected first at the KB and then sent by title, once per month. Transport to the warehouse from the KB HQ is by van together with the return of the regular requests.
When the item fits in a container, the item is scanned and placed in the smartcart. Once the smartcart is full and/or ready for transport, the smartcart is scanned and moved to the outbound area.

Subsequently, the smartcart is scanned when put in the van and scanned again when it arrives at the KB warehouse. In the KB warehouse, the smartcart moves internally to the workstation at which it is scanned again.

At the workstation, the operator will select all items for AC and BC that will be placed in the same size container and will request a container of the corresponding size. BC items will be placed together in the containers and are not mixed with AC items. An empty or if available partially filled container will be supplied from the system. Upon arrival of the container, the container will be automatically scanned. The operator will scan the first item that will be added to the container on the right location indicated on the display-screen. The operator will repeat this action until the container is full (to be decided by the operator) or until all the items for this container-size are placed in the container.

The operator will confirm that the container is full or will confirm that all items are container in the container. When marked as “full”, the container is weighed and the weight of the container is linked to the container in the system. The “partial” container will move to the “fast-moving area” in the automated warehouse and the “full” container will move to a regular location in the automated warehouse. Items that are labelled as BC will move to the locations dedicated for storage of these items.
Small weight changes of the items are possible in the reading room as a result of humidity. Although these changes will be very small, they have to be registered.

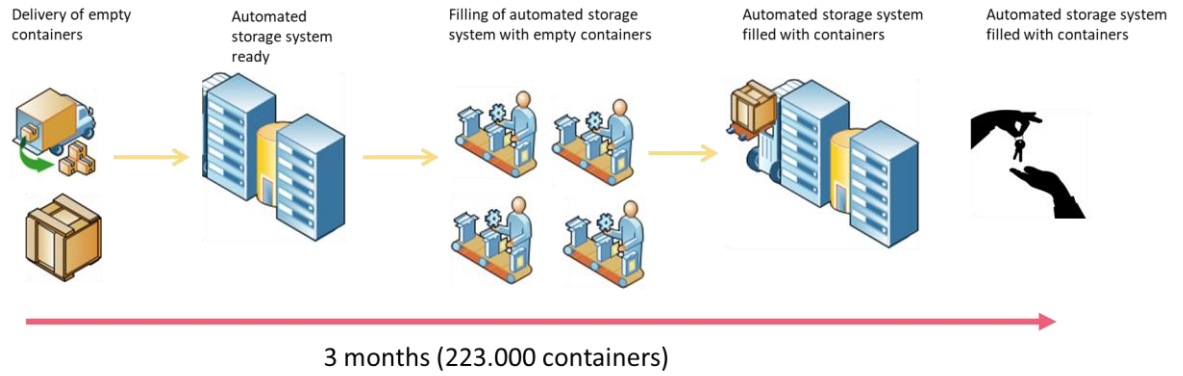
The process for periodicals and newspapers is different. Periodicals and newspapers must be stored on title. The put-away process is in principal the same as for regular request. Periodicals and newspapers will be scanned in the sequence of the put-away. The WMS will inform the WCS about the containers needed and the sequence. The automated storage system will supply the containers in the right sequence at the workstation, where the put-away process is done by the operator. Some items (approx. 80) will need to be added to a series catalog in the storage container.

The operator will confirm if the container is full. When the container is full, it will move to a regular location in the automated warehouse. If the container is not full, it will be put in the fast-moving area of the automated warehouse.

If the item is too big for a storage container in the KB automated warehouse, the item is put on alternative transport and will be put away in the KB warehouse in the manual section.

Ingest of collection items

The requirement is to store all empty containers in the automated storage before the hand-over of the automated storage system. This process is done by scanning each container. The system will measure the dimensions and weight of the containers automatically. The measurement is sent to the WMS and compared with the data available in the WMS about the dimensions of the container. The empty container is stored in the system on a location, which is decided by the WCS.



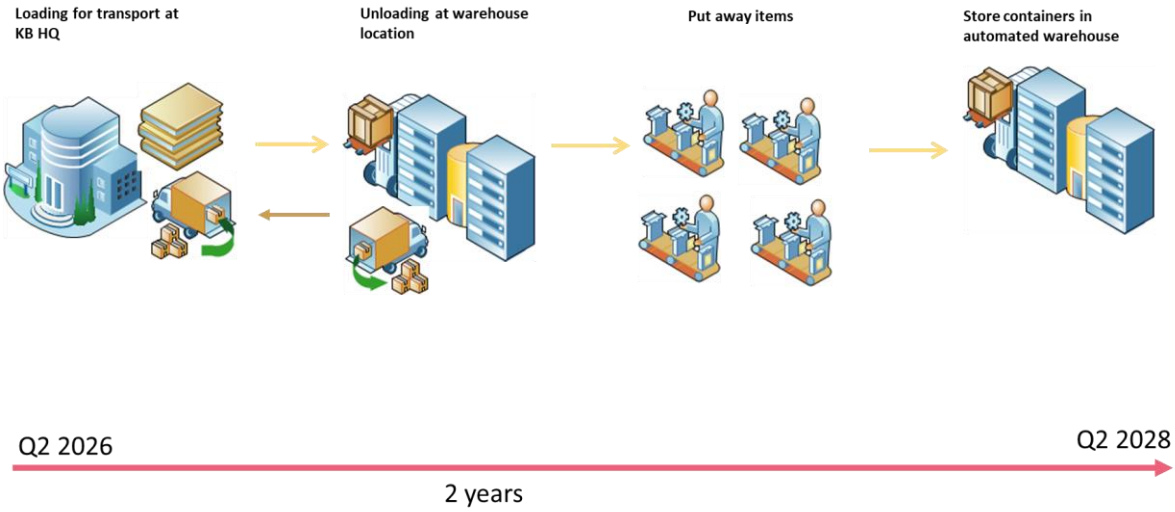
The ingest of collection starts at the current KB warehouse by checking, cleaning and coding the items. Daily about 2 truckloads are delivered at the new booklocation for the ingest.

At the workstation a cleaning system might be added to do final checks and extra cleaning of items before the storage takes place, both for the ingest process or regular work processes. This addition might be realized to keep the collection as clean as possible.

At the workstation, the operator will select all items for AC and BC that will be placed in the same size container and will request a container of the corresponding size. An empty or if available partially filled container will be supplied from the system. Upon arrival of the container, the container will be automatically scanned. The operator will scan the first item that will be added to the container and puts the item on the right location indicated on the display-screen. Out of conservation it might be needed to change the order of the filling of the container, mainly for BC but also possible for AC items. Further, in some occasions the operator has to add protection material such as separation foam, in order to prevent the items from shifting in the container. The operator will repeat this action until the container is full (to be decided by the operator) or until all the items for this container-size are placed in the container.

The operator will confirm that the container is full or will confirm that all items are placed in the container. When marked as “full”, the container is weighed and the weight of the container is linked to the container in the system. The “partial” container will move to the “fast-moving area” in the automated warehouse and the “full” container will move to a regular location in the automated warehouse. Items that are labelled as BC will move to the locations dedicated for storage of these items.

The process is shown in the figure below.



Special requests of items

Beside the regular requests for load and digitization there are special requests for items. These special requests can be for administrative checks, physical checks, maintenance of items, audits, changing of packing materials, etc.

Starting point for these actions will be orders for containers made directly in the WMS by KB operators or orders made in Alma by KB operators and sent to the WMS.

For the automated storage system the starting point will be a request for a container. The automated system will deliver the container on the workstations requested by the WMS, where the operator will perform the activity needed and log the results of the activity in the WMS or Alma.

4. Project constraints

Building
Sizing of building

The building dimensions are given in the following drawings:

- to be added

The building can be divided in two main parts:

- The automated storage area
- The expedition area in front of the automated storage are with several floors.

The automated storage area has the following inside dimensions: 70.500 x 47.000 x 16.500 mm. The only obstructions to be considered in this space is a column zone with a width of 500 mm. These columns (1 per 3 m) will be placed in a row approximately in the middle of the automated storage system. The exact location depends on the design of the system.

The reserved space for the area for the workstations is 125 m2.

The reserved space for the maintenance and exchange area for large material handling equipment is approximately 25 m2.

Free height

The available free height for the automated storage system in the automated storage area is 16.500 mm.

Floor specifications

The floor in the automated storage area has the following specifications:

- Thickness will be 600 mm
- Concrete reinforcement of … (tbd in the next phase) kg/m3. Reinforcement will not be present in the top … (tbd) mm of the floor.
- Maximum static load will be 60kN/m2
- Maximum point load of … (tbd by supplier) kN
- Flatness meets FEM 9.832 (miniload system)

The floor in the area for the workstations has the following specifications:

- Channel plates of 400 mm
- With a pressure layer of 80 mm flatness
- The floor meets FEM 9.832

Building interface

The automated storage area has a system for oxygen reduction and has strict requirements for humidity and temperature. Access to the automated storage area will be designed that these requirements can be kept. The following concepts are implemented to achieve this:

- An airlock between the workstation-area and the automated storage area. Through this airlock:
  - Containers can be exchanged between the workstations and the automated storage area.
  - Material Handling Equipment can be exchanged between the expedition area and the automated storage area for loading battery, maintenance and replacement of material handling equipment.

    - Operators can access the automated storage area for solving problems

  To minimize the influence of the opening and closing of the airlock on the conditions of the automated storage area, the opening and closing time should be minimized by fast shutters and by transporting several containers in the same interval. The number of containers to be transported in the same interval will be decided in the design stage.
- A separate maintenance area in the expedition area for large material handling equipment. This area is accessible by a large opening, which will be automatically controlled. This maintenance area will also be used to initially bring in the large material handling equipment to the automated storage area and for future replacement of large material handling equipment.

Electrical and other installations

Electrical installations not related to the system (interface: Motor Control Cabinets and electrical distribution cabinets) and other installations are supplied by RVB. The system integrator will arrange the following information necessary to assure a proper working for the system:

- For the purpose of sizing the transformer provide required power connection (kW), peak amperage (A).
- Provide calculations of the peak heat generated by the system in the automated storage area.
- Provide requirements for data network and Wifi.
- Inform where temperature and other sensors in the automated storage area cannot be placed
- Provide space requirements for MCC and main electrical distribution cabinets as well as the location during the design phase of the building.
- Provide drawings detailing the services zones.
- Collaborate with KB on any other mechanical and electrical services that are required in the building for a proper working of the system.

The following electrical installations are supplied by RVB:

1. Lighting in the automated storage area
2. Emergency lighting
3. Earthing Wiring for the system
4. Low voltage power supply

Oxygen reduction and climate control

The automated storage area has the following specifications:

- Storage temperature 10-22°C (short fluctuations of 2°C per 48h and seasonal fluctuations of 2°C per 30 days)
- Relative humidity 40-55% (short fluctuations of 5% per 48h and seasonal fluctuations of 5% per 30 days)
- O_2-reduction environment (13% O_2)

5. Functional requirements proposed solution

Required storage capacity

KB wants to use 3 types of containers in the automated storage system for storage of items. KB has estimated the required number of containers of each type, based on the current collection. The estimation can be found in the following tables.

Container 25 (inside) x 40 x 60 (outside)	height books	position books	items	items in one container	total of containers
Books	till 24.0 cm	standing	2.450.284	29	84.493
Periodicals	till 24.0 cm	standing	118.010	29	4.069
Books	34 to 46 cm	laying	23.304	29	804
Periodicals	34 to 46 cm	laying	24.595	29	848
Newspapers tabloids	34 to 46 cm	laying	23.625	5	5.250
total			**2.639.818**		**95.464**

Container 35 (inside) x 40 x 60 (outside)	height books	position books	items	items in one container	total of containers
Books	24 till 34 cm	standing	1.199.169	29	41.351
Periodicals	24 till 34 cm	standing	501.375	29	17.289
total			**1.700.544**		**58.639**

Large size container 25 (inside) x 60 x 80 (outs	height books	position books	items	items in one container	total of containers
Books		laying	9.256	3	3.085
Newspapers broadsheet boxed		laying	17.588	2	8.794
Newspapers broadsheet		laying	70.875	3	23.625
total			**97.719**		**35.504**
Container 25 (inside) x 40 x 60 (outside) equivalent					**71.008**

The total number of containers required is almost 190.000.

The large size container is double the size of the 400x600 container. The equivalent of the large size container in containers with a footprint of 400x600 is about 70.000. Based on a foot print of 400x600 the number of containers for the current collection is about 225.000.

KB wants the storage capacity of the system to be sufficient for the expected growth of the collection for the next 15 years. KB has estimated this growth and this leads to the required storage capacity of 223.000 containers and 260.000 containers equivalent with a foot print of 600x400.

The average growth per day is about 9 containers.

Container type	containers	Growth in one year	Growth in 15 years	Required storage
Container 25 (inside) x 40 x 60 (outside)	95.464	1.063	15.939	**111.402**
Container 35 (inside) x 40 x 60 (outside)	58.639	1.084	16.263	**74.902**
Container 25 (inside) x 60 x 80 (outside)	35.504	120	1.800	**37.304**
Total	189.607	2.267	34.001	**223.608**

Required handling capacity

The automated system consists of an automated warehouse and the workstations. At the workstations items are picked and stored in the automated system. The required handling capacity for an average day in 2019 can be found in the following table for requests.

Requests	Items/year	Items/day	Cont./day
BC	10.297	40	40
AC/Incl. IBL	71.169	279	279
IBL fysiek	2.000	8	8
Digi	28.850	113	113
Total	**112.316**	**440**	**440**

Regular requests are about 440 per day in 2019. The expectations are that these numbers will decrease in future. The assumption is that for each item one container will be retrieved from the warehouse. The container will be put away after picking. When the item returns the same container will be retrieved and the item will be stored in the same container. For each requested item the requested container will be retrieved and stored twice.

The number of items for new arrivals can be found in the following table.

New arrivals	Items/year	Items/day	Cont./day
T (tijdschriften)	41.630	163	163
K (Kranten)	19.464	(210 /month)	47
AC (Boeken)	49.325	193	7
BC	2.895	11	11
Totaal	**113.314**	**368**	**228**

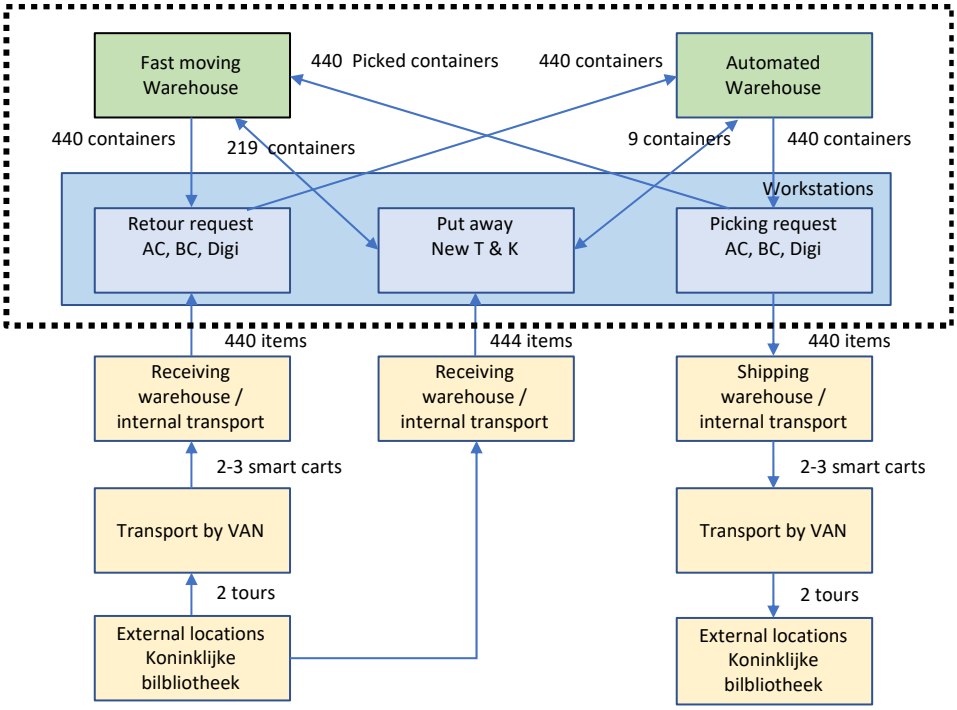
New arrivals result in on average 9 new containers per day, which will be stored in the automated warehouse. The required number of containers needed to put away the new items is on average 228 per day.

The required number of containers per day is based on the assumptions that:

- AC (books) are received and put away every day. This results in 7 containers per day (average 29)
- BC are received and put away every day. This results in 11 containers per day
- Periodicals (T = Tijdschriften) are received and put away every day. This results in 163 container moves per day (average put away is 1, since periodicals must be put away on title)
- Newspapapers (K = Kranten) are received per month. This results in 47 container moves per day.

The new arrivals require on average 228 containers per day and result in 9 new totally filled containers. The expectation is that the future required handling capacity will be less than the required handling capacity in 2019.

The following material flow chart shows the material flow in the warehouse based on the required average handling capacity in 2019



The total number of containers on an average day in 2019 is 219 + 9 + 440 = 668 containers. The following tables shows the restrictions (1st and 2nd tour) for the regular requests. The other activities have no time restrictions and can be done when capacity is available.

Regualr request	first tour	second tour	no restriction
BC	27	13	
AC/Incl. IBL	186	93	
IBL fysiek	8		
Digi			113
subtotal	221	106	113
New arrivals			
T (tijdschriften)			163
K (Kranten)			47
AC (Boeken)			7
BC			11
subtotal	-	-	228
Total	**221**	**106**	**341**

The following table shows the required capacity when all activities are spread out during the day based on the time restrictions defined for each activity.

	8	9	10	11	12	13	14	15	16	17	Total
First tour							110	110			221
Second tour						106					106
Digi									113		113
Returns		147	147	147							440
New arrivals	114									114	228
Total DC/hour	**114**	**147**	**147**	**147**	**-**	**106**	**110**	**110**	**113**	**114**	
Total SC/hour	**228**	**294**	**294**	**294**	**-**	**213**	**221**	**221**	**226**	**228**	
Peak											

We assumed no peak factor because:

- The activities with no time restrictions give an excellent change to limit the peaks in operations on a weekly base.

- The working hours considered are from Monday - Friday from 8:00 – 17:00 with a break of one hour for lunch. In peak times it might be considered to extend working hours.
- The required capacity is not used 100% during the day.
- It is expected that the required handling capacity will be decrease in future.

The required operational handling capacity per hour is for the automated storage system:

- 150 Single cycles for the fast-moving area
- 150 Single cycles for the regular storage area

The required operational handling capacity for the workstations is 150 containers per hour.

This required handling capacity for the ingest of current collection will in the last period of the ingest, be on top of the required handling capacity for regular request. The number of items ingested per day during the period 2026 – 2028 will be 10.000. Based on 29 items per container this results in about 350 containers per day and about 50 empty containers in and full containers out per hour. This can be seen as a peak in operations and planned as has been described for handling peaks.

Availability

The required availability of the system should be at least 98%. The availability is defined and measured following FEM 9.221 and 9.222, and:

1. Excludes downtimes on parts of the systems that would not be in use if they were not down; and
2. Excludes downtimes caused by factors not attributable to or outside the span of control of system integrator, to be mutually agreed with KB.

The system integrator should create an availability model which shall be submitted to the KB for approval. The availability model should be based on the following starting points:

- to be added

To ensure that the system is available for operations the distribution of the duration of downtime events that impact the system availability should be within the boundaries of the values in the table below

Downtime	0 -15 minutes	15 – 45 minutes	>45 minutes
Percentage	>55%	<30%	<15%

To ensure the 98% total system availability, spare parts and maintenance are required, the contractor is responsible for specifying the necessary provisions.

Reliability

Due to the high standards to which the KB core business adheres, reliability of the system is of key importance. The contractor shall therefore commit to all reasonable effort to ensure and improve reliability of proposed designs / the system and its components.

The reliability of the total system should be in excess of 99.999%.
Reliability will be determined using FEM 9.221 and FEM 9.222.

Ergonomic requirements (user friendliness)

Workstations

The system integrator should optimize employee ergonomics on all workstations and the peripheral components (shelves, printers, containers, etc.) such that the employee can interact efficiently and safely with objects around their position. This should be within the boundaries of health and safety regulations.

Ergonomic principles should be applied to the design of the workstations.

- Containers must be supplied in such a way that they can easily be accessed by the operator and that the operator has the shortest reach to pick and place items in the container.
- Activities at the workstations, beside pick and place, should be supported by the design of the workstations. This includes the placing of display screens, type and placing of scanner, vacuum cleaner for dust removal, working way to exchange information with WMS, working way to handle items for ingest, etc.

Solving issues

Solving issues in the automated storage area should be avoided as much as possible. For this reason the system integrator should only use electrical components and no compressed air.

To facilitate problem detection and solving a CCTV system is needed in the automated storage area that enables to sufficiently monitor the relevant parts of the system from the control room, the maintenance room and remotely via mobile devices.

Areas were issues are expected should be easy to reach by operators, mainly mechanics, carrying tooling. Staircases to reach these areas should be avoided as much as possible. Staircases should be easy to walk, in case staircases are unavoidable.

Maintenance and cleaning

System design should allow for easy access to components and areas that require maintenance and / or cleaning, particularly if said services are required on a regular basis. The system design will be inspected thoroughly to ensure the system integrator is compliant with this prerequisite. Provisions for moving, installing or handling high-volume or heavy spare parts are to be specified by the system integrator. In cases were such provisions are not expected to be available, the system integrator must explicitly mention them to KB to come to an agreed solution.

The robotsystem itself should produce dirt and dust at an absolute minimum, by using high quality and wear-resistant materials.

Operators, mainly mechanics, entering the warehouse should bring their own equipment to work safely in a low oxygen environment. Also, these operators should work in a very clean way without leaving any dirt of dust in the building.

Sound level

Average sound levels of the system in operation (only excluding sound made by products whilst being transported and components out of scope of the contractor) may not exceed 40 dB(A).

Measurements shall be taken at 1m distance from installed components / the system and will not be corrected for ambient sound and/or building related amplification.

Furthermore average sound levels at workstations or other locations where operators are expected to be present for prolonged periods of time may not exceed 40 dB(A) including sounds generated by products.

The contractor is requested to make a provision to minimize the inconvenience of noise and dust for operators at the workstations.

Shock free system

Parts of the collection carried and stored in the logistic system are vulnerable. Therefore the logistic system should be shock free and create vibrations at an absolute minimum during storage and transport in the system, comparable with the storage and transportation of glass objects without creating any damage.

Energy use

The temperature conditions for the conservation of items in the automated storage area are very strict. The energy use and the heat generated by the material handling equipment in this area is one of the main factors influencing temperature.

Since January 1st, 2017 all electrical motors from 0.75 kW to 375 kW must comply with energy efficiency class IE3 or IE2 level if fitted with a variable speed drive (inverter). This requirement is also valid for electrical motors smaller than 0.75 kW

The system integrator should design a system with a minimum heat generated.

Power outage

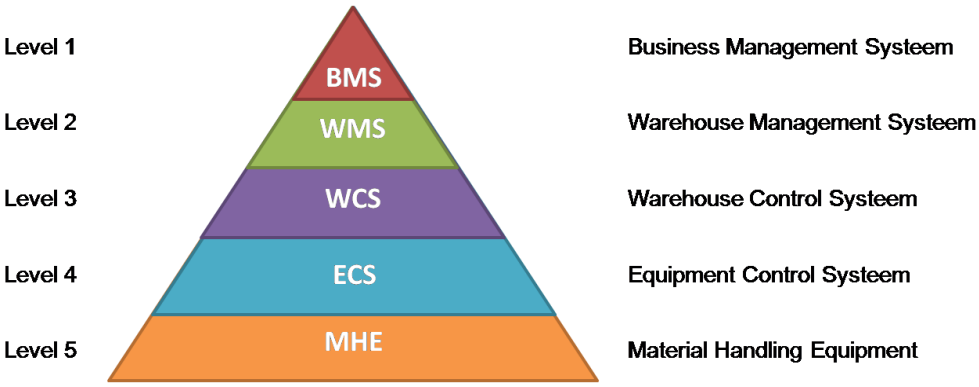
In case of a power outage (not in scope system integrator), the system integrator must insure that the system will stop in a controlled way and no information is lost by supplying a sufficient UPS. The system should start up smoothly after the power outage is solved without involvement of employees and the need to physically adjust containers or data in the system. The health of UPS's must be remotely monitored by system integrator.

Furthermore, in case of malfunction the part of the collection which is in transport in the system, should be returned safely to the storage area. In case of a power outage the system should be brought back in a safe status. AMR's are returned to their home-base. The parts of the collection in the picking stations can stay there until the power is recovered.

6. IT Requirements

General description

Controls for material handling systems can be grouped using the automation triangle, commonly consistent of 5 layers and schematically depicted below.



The scope of supply for system integrator is:

1. IT that can function as a WCS and that is needed to operate the proposed solution;
2. The hardware that is needed for all operations within the proposed solution;
3. The hardware that is needed for daily operations with levels 3 through 5, including but not limited to:
    a. Weight measurement and dimension check of containers
    b. Peripherals at workstations (Screens, scanners, printers)
    c. Servers for WCS & SCADA

Functionality WCS

The WCS will be responsible for retrieving and storage of containers in the automated storage system.

The WCS will have at least the following functionality for the automated storage system:

Location management

In the WCS all storage locations are created and managed. Blocking of storage locations can be done by operators for different reasons such as availability of the system, etc.

Put away strategy

The WCS will decide the storage location of a container. The WCS will do this based:

1. Type of content of a container (BC, AC, etc.)
2. Filling degree of a container (partial or full)
3. Type of container
4. Weight of container

Retrieving strategy

The WCS will optimize the retrieval of containers to minimize the movement of containers in the aisles and the movement of miniload in the aisles and between the aisles.
The WCS can optimize the movements especially in case of special request of items. Special request of items are related to administrative checks, physical checks, maintenance of items, audits and changing of packing materials. This can be done based on a certain group of locations in the warehouse.

Empty location check

Besides regular cycle counting, it should be possible to generate an empty location check for the automated storage system to be able to check if an administrative location is also physically empty. Any containers found on "empty" locations will be booked and checked.

The WCS will also control:

1. horizontal transport system
2. the conveyor systems at the workstations
3. the in- and outfeed conveyors for the miniload cranes.
4. The transfer bridge for the aisle changing of the miniload cranes

SCADA

For the automation a Supervisory Control and Data Acquisition (SCADA) is required. Productivity and capacity must be continually measured and reported (real-time) in a transparent manner.

Individual operator productivity as well as component performance must be made clearly discernible and should be unambiguous, further more reasons / logging will be created for all relevant disruptions in the logistics flow clearly stating cause.

The system should supply KB with sufficient information to fully control its logistics process and manage its personnel. This includes operational and management reports. Data should be kept for an extensive period of time equaling at least one year. Controls should be user friendly, flexible and well documented. The Supplier is requested to be explicit in the cost charged for controls and provides the Buyer with a separate price for them (also distinguishing hard- and software).

Operational control (supervisor)

The following requirements apply for the operational controls:

- Blocking of parts of the system can be done by operations. This can be done if parts of the system are not available during a long time.
- Other operational actions to be decided during design phase.

Information exchange systems KB – WCS

KB will provide the following information to the system:

1. Picking regular request for containers
    a. Container ID (barcode)
    b. Type of container
    c. Class of content (BC, AC, etc.)
    d. Dimension of container
    e. Weight of empty container
    f. Weight of full container
    g. Type of order (loan or digitalization)
    h. Urgency (1st or 2nd delivery or maximum date/time for completion)
    i. Destination of container (workstation)
2. Returns regular request for containers
    a. Container ID (barcode)
    b. Sequence number container
    c. Type of container
    d. Class of content (BC, AC, etc.)
    e. Dimension of container

   f. Weight of empty container
   g. Weight of partial filled container
   h. Destination of container (workstation)
3. Storage of new items in partially filled containers
   a. Container ID (barcode)
   b. Type of container
   c. Class of content (BC, AC, etc.)
   d. Dimension of container
   e. Weight of empty container
   f. Weight of partial filled container
   g. Destination of container (workstation)
4. Storage of new items in empty containers
   a. Request empty container
   b. Type of container
   c. Class of content (BC, AC, etc.)
   d. Dimension of container
   e. Weight of empty container
   f. Destination of container (workstation)
5. Ingest of collection items in empty containers
   a. Request empty container
   b. Type of container
   c. Class of content (BC, AC, etc.)
   d. Dimension of container
   e. Weight of empty container
   f. Destination of container (workstation)
6. Special request of items
   a. Container ID (barcode) or a range of container ID's
   b. Type of container
   c. Class of content (BC, AC, etc.)
   d. Dimension of container
   e. Weight of empty container
   f. Weight of full container
   g. Type of order (check, count, administration, etc.)
   h. Urgency (maximum date/time for completion)
   i. Destination of container (workstation)

The system will provide the following information to KB:

1. Container ID and content of container
2. Container dimensions and weight as captured by weigh check and dimension check
3. Real time status container
   a. Requested to send to workstations
   b. In progress by system
   c. In buffer at workstation
   d. Processed at workstation
   e. In progress by system
   f. On location in automated storage system
   g. Special handling such as: On error handling station
4. Monitoring of IT including interfaces;
5. Information about the system:
   a. Technical availability of components (miniload cranes, conveyors, etc.)
   b. Operational information such as:
      i. Filling degree of buffer and number of containers in the buffer.
      ii. Number of free buffer-positions in the automated warehouse (total, per aisle, etc.)
      iii. Signal when the buffer has reached his limit (filled buffer positions).

Cancellation procedure

Cancelation of released order(line)s will be avoided. However, this is not always possible. Below some cancellation procedures are mentioned on several occasions in the process:

1. Cancellation before start production

   If an order is not yet planned for production by the WCS, the order can be cancelled in WMS/Alma and a zero confirmation will be communicated to the WMS by the WCS. No other activities are necessary.

2. Cancellation after order release

   If an order is already released but pickings is not executed the order can be cancelled by the WMS and a zero confirmation will be communicated to the WMS by the WCS.

3. Cancellation after picking

   If an order is picked this order should be confirmed and communicated with the WMS. A return order should be created for this order. The items will be received against this return order and put away to stock.

Process management requirements

Management info / Performance KPI's

- # containers in and out the buffer on hour- and weekly base
- Average # containers on hour-, week and daily base.
- # containers recirculated at conveyor loop at workstations
- # containers no-read or other errors (dimensions, weight)
- # containers handled on time

Server requirements

System integrator will supply a fully redundant server, including a 50 % spare capacity for memory, hard disk (at least RAID 5) and processor capacity during optimal use of the material handling system. A fully redundant server means that hardware components can take over each other's function in case of failure of one of the components.

System integrator must involve KB in choosing server/hardware suppliers and supplies. Selected suppliers and supplies must be approved by KB HQ.

Future developments

The IT solution should include the ability to add functionalities that are needed for likely future changes in processes.

7. Service & Maintenance Contract

Introduction

KB requires an availability of the system > 99,0%, measured on a monthly base.
In order to reach the required availability, the system needs service and maintenance and critical spare-parts should be directly available.

KB intents not to have an own maintenance department or to have inhouse maintenance support.
The basic concept for service & maintenance is as follows:

1. The system integrator will be contracted for remote & hotline support, preventive maintenance and corrective maintenance.
2. KB will be responsible for daily cleaning and solving minor issues.
3. The system integrator is responsible for the training of KB to perform cleaning and solving minor issues.

Outline service & maintenance contract

The service & maintenance contract should be based on the following requirements:

1. The service & maintenance contract includes as a minimum the following items:
    a. Preventive maintenance (2x per year during normal working hours)
    b. Remote and hotline support
    c. Corrective maintenance
        i. Labour and labour related cost
        ii. Material and equipment
        iii. Delivery and replacement of used spare parts
    d. Long term maintenance based on expected life time and service-ability of parts and components
    e. Maintenance management
2. The system is operational from Monday to Friday from 7.00 – 18.00.
3. The duration of the service and maintenance contract is for a period of 10 years, with the option to extend with periods of 5 years at the time.

Requirements corrective maintenance / Remote and hotline support

Response time

Fast response times are needed to ensure an availability of 99,0% of the system. Response times are divided in:

- Response time remote & hotline support
- Response time on site

The following table shows the required response time based on the priority of the defect.

Priority	Description	Response time remote & hotline support	Response time on site

Prio 1	Urgent	< 30 min	< 2 hours
Prio 2	High	< 30 min	< 4 hours
Prio 3	Normal	< 30 min	To be planned, within 2 working days
Prio 4	Low	< 30 min	To be planned, within 5 working days

Prio 1	Incidents with a direct impact. A situation in which one or more critical processes are not available. This can be when a large number of users or an entire department can no longer work. There is no workable work around available.
Prio 2	Incidents with a direct impact. A situation in which one or more critical processes are not available. This can be when a large number of users or an entire department can no longer work. A work around is available but is temporary or not desirable.
Prio 3	Incidents with a direct impact. Important processes have not been affected. The number of users affected by the incident is low
Prio 4	Incidents that concern functionalities, configurations, etc. Little or no impact for the user and critical processes.

The system integrator must ensure that the corrective maintenance work and the remote and hotline support will be carried out by skilled staff to limit the down-time of the system. The required skills depend on the incident. The required staff can be either a mechanical engineer, an electrical engineer, an PLC/MFC or WCS technician or an IT hardware engineer or a comcontaineration of skills. The system integrator may use subcontractors for the execution of its work, but will be fully responsible for their works.

Procedure for incidents

The procedure for incidents follows the steps below:

1. **Identification**.

   Whenever KB or system integrator observes an incident, the other party must be notified. The incident is to be registered in the ticketing system by the observing party or by the system integrator if KB informs the system integrator by hotline. Tickets must be created with definition of a priority. Time of creating a ticket is the starting time of the incident.

2. **Analysis**.

   When system integrator is the responsible party, system integrator is required to analyze the incident, to find a temporary resolution, perform root cause analysis and to prepare a permanent remedy. Priority defined by system integrator may in any case be adjusted by KB at any time, but it may also be proposed by system integrator once the ticket has been analyzed.

3. **Preparation of the remedy**.

As long as the incident is not resolved, system integrator shall allocate the appropriate resources towards preparing a remedy. Compliance with protocols surrounding the release of software updates in a controlled manner is considered part of this preparation. System integrator shall give regular updates to KB about the status of the analysis and solution depending on the priority of the incident.

4. **Application of the remedy**.

   When a remedy to the problem has been prepared, system integrator must obtain permission from KB to apply the remedy. This permission must be registered in the ticketing system and contain a proposed time window for applying the remedy.

5. **Resolution**.

   An incident is considered resolved if KB and system integrator agree that the applied remedy is sufficient and an incident report has been written by system integrator and communicated to KB.

Time to resolve incidents

Incidents with Priority 1 & 2 will be resolved according to the following table. The corrective maintenance of incidents with Priority 3 & 4 is planned together with KB.

	Priority 1	**Priority 2**	**Priority 3 & 4**
Identification	Create a ticket within 5 minutes after reporting	Create a ticket within 5 minutes after reporting	Create a ticket within 1 working day
Analysis	Start the analysis within 15 minutes after identification	Start the analysis within 15 minutes after identification	Start the analysis within 2 working days after identification
Preparation of the remedy	Report every 30 minutes after start of the analysis	Report every 2 hours after start of the analysis	Report every working day after start of the analysis
Application of the remedy	As soon as possible, but not later than 1 hour after the remedy is prepared	As soon as possible, but not later than 4 hours after the remedy is prepared	As soon as practically possible, but in any case as part of the next scheduled maintenance release

Maintenance Management System

Service & Maintenance

The system integrator will keep an up-to-date computerized maintenance management system (CMMS). The system integrator will record all breakdowns, details and repairs of the systems in a chronological manner. With this CMMS system integrator will actively monitor the maintenance status of parts, components and the system and take maintenance actions if needed.

The CMMS will use the information of the SCADA system. Qualified personnel of KB can also add information to the CMMS about all incidents.

System integrator will yearly inform KB about the maintenance status of the system and inform KB about preventive actions to be expected the coming year. System integrator will update the Long-term maintenance plan based on the current status and info.

Long term maintenance

System integrator will be responsible for the long term maintenance plan. The system integrator will hand-over a long term maintenance plan at hand-over of the system. The long term maintenance plan will indicate for the main part and components the expected life-time measured in operational hours. Based on this information the system integrator will indicate when parts and components must be replaced and the expected necessary cost for replacement.

System integrator will update yearly the long-term maintenance plan.

Spare-parts

The system integrator is responsible for the availability of critical spare-parts. The system integrator can store critical spare-parts at the new premises of KB. The system integrator remains owner of the spare-parts in stock.

Stock management is to be done by the system integrator. The system integrator is responsible to monitor the availability of used parts and components in the system. The system integrator will take measurements and inform KB when parts and components are not available anymore at the OEM. The system integrator will be responsible for the availability when spare-parts are used for maintenance. The system integrator will become owner of the replaced parts.

The system integrator provides a guarantee for six months on all the work carried out on all parts and components used in the maintenance of the system. This guarantee means that during this period system integrator repairs free of charge any defects with regard to the work carried out.

Other obligations of the system integrator:

1. Perform a component or part criticality analysis on the Solution prior to completion of detailed engineering, to be shared with KB. The criticality analysis should include, but not be limited to, repair times, failure impact, procurement lead time, repairability and component lifetime.
2. Propose an initial Spare Parts Package based on this criticality analysis, structured in ABC categories as listed below, or in categories as in use by system integrator:
    a. Category A: The nature and number of items in this group are selected taking into account the anticipated effect of a failure. The failure interrupts the material flow and, therefore, interrupts production;
    b. Category B: Failure of items belonging to this group has a less critical impact on the material flow;
    c. Category C: Failure of items belonging to this group does not have a critical impact on the material flow.
3. Use off-the-shelf and proven components and Spare Parts where possible.
4. Guarantee availability of Spare Parts or alternatives for the installation for a period of at least ten years.
5. Ensure that Spare Parts that are held on site are documented, including:
    a. Part number and part description;
    b. Manufacturer;

c. Supplier;
d. Unit cost;
e. Lead time;
f. Criticality category;
g. Parts type (tear/wear, replacement, other);
h. Alternative part number if available.

6. Ensure 100% availability of on-site Spare Parts of category A and B (critical parts)

Duration of the service & maintenance contract

The service and maintenance agreement is entered into for a period of 10 years and comes into effect after final hand-over of the system.

This agreement will, with the exception of termination by one of the parties, thereupon always be renewed by five year.

The notice of termination period amounts to three months. Termination must take place in writing.

Obligations of KB

1. KB will maintain and use the systems in conformity with the accompanying manual and any accompanying documents in accordance with the designated use. KB will not burden the systems more than is prescribed.
2. KB will provide system integrator with the access required for the performance of this agreement. If necessary KB will unlock all spaces, buildings and sites for this purpose.
3. KB will ensure circumstances under which the system integrator, its staff and its subcontractors can safely carry out the work to be executed on the basis of this agreement. are situated by or on behalf of the Client at the sites or in the buildings of the Client.

Commercial conditions

The annual amount for the service and maintenance contract will be annually paid on the 1st of July for that calendar year.

The system integrator can index the agreed rates once per year. Indexation always takes place on 1 January of each calendar year. In case of indexation one assumes the CSO consumer price index all households 2006 = 100. If the CSO has already ceased the publication of the aforesaid index all households a comparable index of the CSO will be used.

Force majeure

Force majeure includes every circumstance which system integrator has not been able to reasonably avoid and as a result of which the usual performance of the agreement concluded with the KB is prevented.

Termination of the contract

- to be added

Liability

The liability of the system integrator is limited to the fulfilment of its guarantee obligations;

The liability of system integrator is in any event limited to material damage to the system up to a maximum amount of … (tbd) per incident.

Appendix 1: Definitions of capacity, availability and reliability

Capacity

Capacity of the proposed solution will be assessed assuming working hours meaning a one shifts five days a week operation from 8:00 – 17:00.

In order to validate that the system integrators meets the functional requirements, the following attributes of the offered system are to be described:

- **Overall operational system capacity**
  Defined as the output of the entire system and measured in containers stored and retrieved per hour. The overall operational system capacity must be sustainable for an extensive period of time. A constant hourly flow during the working day is a requirement.

  Overall operational system capacity is leading for the principal, since it will determine whether functional requirements for the operational process are met. The system integrator must give full insight into how overall operational system capacity for proposed solutions is calculated and assist the principal in validating assumptions on which calculations are based.

- **Overall technical system capacity**
  Defined as the output of the entire system and measured in containers stored and retrieved per hour.

  To ensure required overall operational system capacities are feasible, overall technical system capacity should be at minimum 115% of overall operational system capacity. However, the system integrator bears full responsibility for designing a system with sufficient overall technical system capacity to meet the functional requirements of principal's process including its growth scenario and the overall operational system capacity reported.

- **Component technical capacity**
  The system integrator shall provide the KB with technical capacities per component, defined as the output for the component measured. Due to alignment between components within the system, sometimes the technical capacity must be higher than the minimum of 115% of the operational capacity to be able to meet the overall technical system capacity. This will be the responsibility of the system integrator.

Availability

Methods to measure availability are to be based up on FEM 9.221 and FEM 9.222, however in case of deviations the proposed method in this document supersedes that off the above mentioned guidelines.

Availability will be measured using the following formula:

$$\eta_E = \frac{t_E - \sum t_{downtime}}{t_E} * 100\%$$

η_E : availability
t_E : measured time frame
$\sum t_{downtime}$: sum of all individual downtimes during the measured time frame

Redundancy will not be taken into account unless full functionality is still guaranteed, both theoretically and practically. Redundancy only applies to availability in case of similar and parallel (sub)components where the sum of capacities minus the capacity of the component in downtime exceeds the required operational capacity and / or functional requirement.

Weighing factors for components

For measurement of system availability or sub-system availabilities weighing factors are applied to components, since failure of one component does not necessarily constitute a failure of the whole (sub)system. However overall availability of the system (expressed in capacity over time) is reduced when this occurs. Weighing factors scale from '0' (fully redundant components) to '1' (single point of failure / critical components). Provisions for other components to partially take-over workings of failing components are not taken in to account when determining weighing factors. In case of failing components in sub-systems which are weighted themselves, component weighing factors are summed to a maximum of '1' for the purposes of determining the weighing factor for the sub-system in calculations. Weighing factors are to be determined collaboratively between system integrator and KB.

Individual downtimes consist of separate sub-periods as listed in FEM 9.221 using the following formula:

$t_{downtime} = t_1 + t_2 + t_3 + t_4$

t_1: period between stoppage of machine and start of search for fault by appropriate personnel t_2: time needed to identify cause of failure
t_3: time needed to preparation and organizing to correct the fault
t_4: time needed to correct fault and restore serviceability

For all testing purposes this partitioning of downtime is to be disregarded. All parts of the above equation shall therefore be considered part of the measured downtime for which the contractor is responsible.

Scheduled maintenance will not be seen as downtime, unless the maintenance exceeds the planned time. Scheduled maintenance must be aligned with the KB.

Reliability

Reliability will be determined using FEM 9.221 and FEM 9.222 and is defined as follows:

$\varphi = {}^{\eta_r}\eta_r + \eta_f$

φ reliability for system, sub-system or component

η_r: number of correctly processed orders, lines or other unit of measure applicable for system, sub-system or component

η_f: number of incorrectly processed orders, lines or other unit of measure applicable for system, sub-system or component

System reliability is the product of all individual sub-system or component reliability calculations. Reliability is therefore to be determined not only on system level but also on sub-system levels.

Incorrect operations are to be defined, based on the following general guidelines (example list):

Automatic storage systems:

- Incorrect location selection for containers
- Putting container on an occupied location

Transport systems:

- Incorrect or failure to detect barcode or other individual transport unit identification methods
- Damage to products or its carries, transport system, or racking during movement or moving of product in crates or carries resulting in contour / product outline anomalies

Controls:

- Generation of incorrect orders for in- and outbound flows for all systems and sub- systems
- Erroneous workload balancing between similar components and workstations, as far as attributable to the system.