Central Monitoring System

User Manual

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Contents

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Introduction to this manual

Topics:

Scope of this Manual

This manual contains information for the safe and effective operation of the Central Monitoring System (CMS). The CMS is part of the MUSICA Acquisition Workstation software.

The MUSICA Acquisition Workstation software is further referred to as "NX" and the pc on which it runs the "NX workstation".

About the safety notices in this document

The following samples show how warnings, cautions, instructions and notes appear in this document. The text explains their intended use.

DANGER:
A danger safety notice indicates a hazardous situation of direct, immediate danger for a potential serious injury to a user, service engineer, patient or any other person.

WARNING:
A warning safety notice indicates a hazardous situation which can lead to a potential serious injury to a user, service engineer, patient or any other person.

CAUTION:
A caution safety notice indicates a hazardous situation which can lead to a potential minor injury to a user, service engineer, patient or any other person.

An instruction is a direction which, if it is not followed, can cause damage to the equipment described in this manual or any other equipment or goods and can cause environmental pollution.

A prohibition is a direction which, if it is not followed, can cause damage to the equipment described in this manual or any other equipment or goods and can cause environmental pollution.

Note: *Notes provide advice and highlight unusual points. A note is not intended as an instruction.*

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Note: *In the United States, Federal law restricts this device on order of a physician for prescription use only.*

Introduction to Central Monitoring System

Topics:

Intended Use

- NX Central Monitoring System is a CR/DR workstation for image processing and image transmission of digitized images created on NX Modality Workstations.
- The primary use of the NX Central Monitoring System is quality monitoring. With the additional diagnostic monitor, images are displayed with diagnostic quality. There is however no extensive toolset for softcopy reading available.
- NX Central Monitoring System is intended for preparing images for diagnostic use and sending them to a printer, an archive or a diagnostic station or burning them on CD/DVD.
- NX Central Monitoring System can be used to view and improve the images acquired and processed by NX Modality Workstations
- NX Central Monitoring System can be used to monitor CR/DR imaging from a central location.
- Study- and patient data can be edited.
- NX Central Monitoring System provides tools to improve image quality of the medical images and to predefine image processing settings.
- NX Central Monitoring System is not intended to be used as an archive.

Intended User

This manual is written for trained users of Agfa products and trained diagnostic X–Ray clinical personnel.

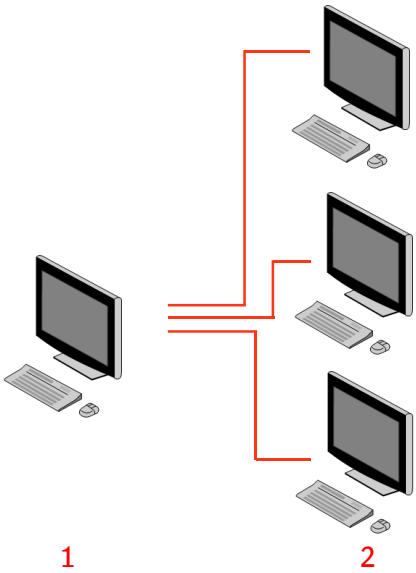
Users are considered as the persons who actually handle the equipment as well as the persons having authority over the equipment.

Before attempting to work with this equipment, the user must read, understand, note and strictly observe all warnings, cautions and safety markings on the equipment.

Specifically for Central Monitoring System, all users allowed to work with NX can use the Central Monitoring System, but especially the users with the following roles will be intended users:

- Users with a responsibility to train personnel or students.
- Users with a responsibility to discuss image quality aspects with personnel or students.
- Users carrying responsibility for administrative aspects concerning the workflow and quality control on several NX Workstations (managing and gathering statistics of different NX Workstations).
- Responsible users in a domain of imaging quality control (for example window/ level).
- Operators and radiographers can use Central Monitoring System in situations where they want to monitor more than one examination room.

Configuration



1. Central Monitoring System
2. NX in-room Workstations

Figure 1: Configuration of 1 Central Monitoring System with three NX in-room workstations

A typical configuration is shown in the figure above. One Central Monitoring System is connected with three NX-in room workstations.

This configuration can be extended. Contact your service representative to go through the possibilities.

Limitations:

- The Central Monitoring System can be configured to view and process images of maximum 5 in-room workstations. The in-room workstations must be on the same subnet as the CMS.
- The Central Monitoring System can collect and process dose records and reject records from more than 5 in-room workstations, but the database can store maximum 850.000 dose records and 850.000 reject reports as a total for all connected in-room workstations. If more records are submitted than the maximum allowed, the oldest records in the database are deleted.

  Take these limits into account when deciding on the frequency for systematically exporting all records.
- Depending on the installation, your workstation will be configured in such a way that the dose monitoring will make use of LGM (Logarithmic Median) values or Exposure Index (EI) values. In a Central Monitoring

System configuration, all systems must share the same dose monitoring configuration.

- NX Workstations may need an upgrade before they can be connected to a Central Monitoring System. Contact your service representative for compatibility of NX versions, operating system and hardware.

System Documentation

This document describes tasks and provides reference information on Central Monitoring System.

For product safety directions, general information on the NX Workstation and an overview of the NX User Documentation, refer to the NX User Manual (document 4420).

The documentation shall be kept with the system for easy reference. Technical documentation is available in the product service documentation that is available from your local support organization.

Using the Central Monitoring System for viewing and processing images

Topics:

About the Central Monitoring System

The Central Monitoring System is developed to extend the NX workflow in the following scenarios:

- A user needs to look for an image in the Central Monitoring System if it is not found (or not found fast enough) on the PACS or hardcopy.
- A user needs to check the work of students at the Central Monitoring System.
- A user needs to check the "sent" status of examinations centrally.
- A user wants to use the Central Monitoring System as an additional station for quality control, for example while the in-room station is busy.
- A user wants to perform supervisory tasks centrally: managing repeat reject statistics, dose monitoring data, queues and image transfer

During configuration (refer to the NX Key User manual) you will define which rooms a Central Monitoring System will see.

Note: There may be a short delay between making changes to an image/examination on the In-room NX workstation and seeing these changes on a Central Monitoring System and vice-versa.

Searching for an examination

Procedure:

1. In the Worklist window, enter the Search criteria in the Search pane:

Figure 2: Search pane

You can search using the following criteria:

- **Search BY:** patient name, patient ID, accession number, examination group, examination date, sent state, contains rejected images, locked.

  You can refine the search BY query by entering the first letters of a name in the Search By-field next to the drop down list.
- **Seach IN:** all rooms, examination room 1, examination room 2, ...
- **Search FOR:** open examinations, closed examinations or all examinations.

2. In the Search pane, click **Search**.

   Central Monitoring System will query the database and display the examinations matching the search criteria.

   If too many examinations are displayed, you can refine your search criteria.
3. The third step.

You can also search by typing in the selected list. Type a letter on the keyboard, the first entry starting with this letter will be highlighted in the selected column.

You can sort a list alphabetically or by number by clicking on the column header. A small arrow will appear. Click once to arrange the list, click twice to reverse the order. A third click will return to the default sort criteria.

Opening an examination on the Central Monitoring System

Procedure:

1. Search for an examination and select it.

   In a standard configuration, the following parameters are displayed for each exam in the list:

Parameter	Explanation
	This icon is displayed when the exam is open in the Examination window.
	This icon appears next to the examination in the worklist if the same examination is being displayed on the In-room NX Workstation. It could be changed by another user.
Patient Name	The name, unique ID, birth date and gender of the patient. When several exams are planned for the same patient at the same time, this is indicated by a '+' sign. Click the '+' sign to view all planned exams for that patient.

2. Click **Open Exam** at the bottom of the Image overview pane, double-click on the exam in the list or click a thumbnail in the Image Overview pane.

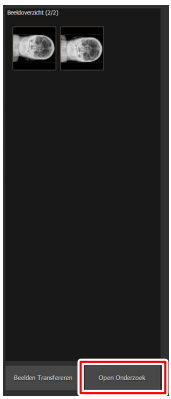


Figure 3: Opening an examination

The examination will be displayed in the NX Examination window. In the Central Monitoring System, all QC tasks possible on an NX Workstation are possible.

Note: You cannot identify cassettes on the Central Monitoring System, this must be done on an NX in-room workstation.

The drop-down list in the title bar of the window shows the name of the patient for which the exam is performed. If there is another exam open, you can select another name from the list to display the exam of the patient.

Note: Note: If the  icon is displayed next to the patient name in the dropdown, the same examination is being displayed on the In-Room NX Workstation. If someone else is making changes to the same image or exam data, at the same time, some of your changes may be undone by the other user.

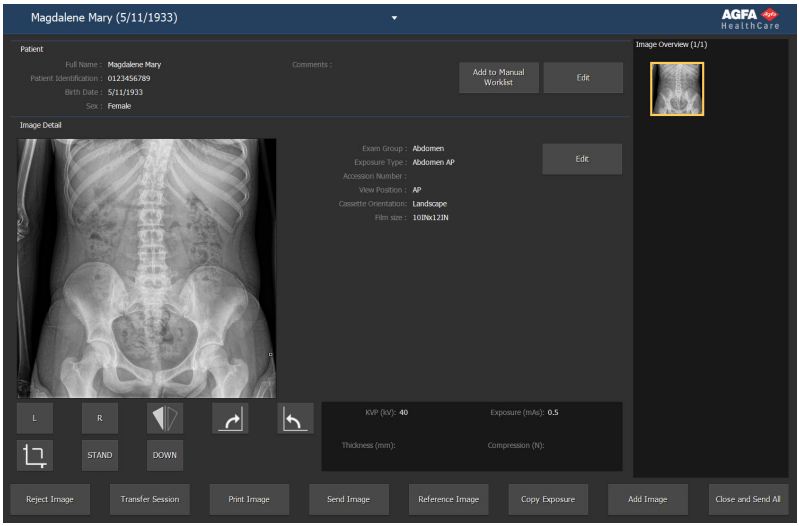


Figure 4: Examination window

3. Perform any QC task in the Examination window or in the Editing window.

   Examples can be adjusting window/level or recollimating an image.

   You can switch between the **Examination** window and **Editing** window by using the action buttons at the bottom of the screen.

4. After the work is completed and you want to close an examination, there are two possible choices:

- **Close and Send All** Closes the exam and sends all images to a printer or to a PACS archive.
- **Close** This closes the examination on the Central Monitoring System. It will not be sent to its destination. Continue the rest of the examination on the NX in-room workstation.

Delete Examination

The Key user can select closed examinations and remove them.

Note: *The complete examination with all images will be deleted.*

Note: *If you want to delete images on the Central Monitoring System, first perform a query in the Worklist Overview window. Only the search results will be displayed in the Delete Images pane.*

To delete examinations from the history list exams:

1. Click **Delete Examination** in the Functionality Overview pane of the Main Menu window.

   The Delete Examination pane is opened:

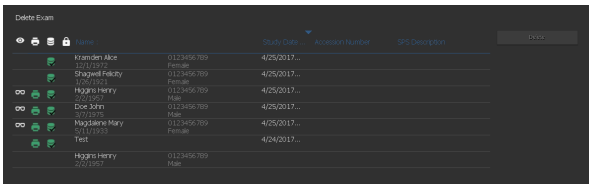


   Figure 5: Delete Images pane.

2. Select the examination you want to remove from the list.

   The images of the selected examination are displayed in the Image overview pane.

3. Click **Delete**.

   The selected examination is deleted.

Lock Examinations

To prevent exams from being deleted from the workstation, the user is able to lock them. A locked examination can be unlocked using a toggle mechanism.

Note: If you want to lock exams on the Central Monitoring System, first perform a query in the Worklist Overview window. Only the search results will be displayed in the Lock Examinations pane.

To lock exams, proceed as follows:

1. Click **Lock Examinations** in the Functionality Overview pane of the Main Menu window.

   The Lock Examinations pane is opened:

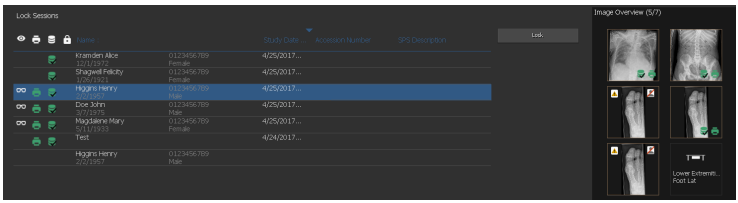


   Figure 6: Lock Examinations pane.

2. Select an examination from the list and click **Lock**. A lock icon will appear next to the examination:

   To unlock an examination, select a locked examination and click **Unlock**.

Transferring images from one exam to another

Procedure:

1. In the **Worklist** window, select the exam from which you want to transfer the images. The images are displayed in the **Image Overview** pane.
2. Click **Transfer Images**.

   The **Transfer Images** wizard opens:

Figure 7: Transfer Images wizard view 1

3. In the **Image Overview** pane, select the image(s) that you want to transfer.

   The image is displayed in the wizard.
4. Click **Continue**.
5. In the **Worklist** pane, select the exam to which the image should be transferred.

   The patient data is displayed in the wizard.
6. Click **Continue**.

   A transfer overview is displayed to check if all information is correct.

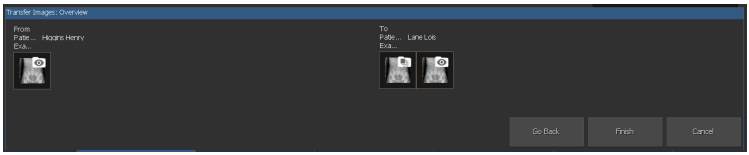


Figure 8: Transfer Images wizard view 2

7. Click **Finish**.

   The image is transferred.

Exporting images

It is possible to export images from an examination to CD or DVD.

To export images

1. Go to the **Main Menu** window.
2. Click **Export images** in the **Functionality Overview** pane.

   The **Export Images** pane is opened.

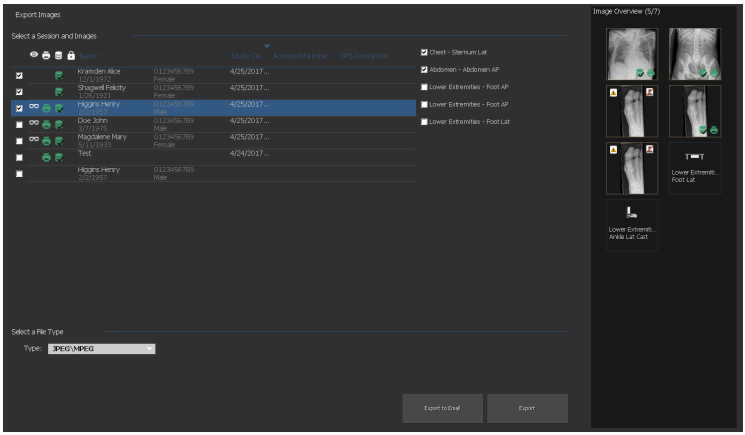


Figure 9: Export Images pane

3. Perform one of the following actions:

   - Select the checkboxes of the examinations you want to export (1) in the first column of the **Export Images** pane.
   - Decide to include or exclude images by selecting or deselecting the checkbox of the image in the **Image Selection** pane (2).
   - Select a file type in the **File Type** drop down box (3).

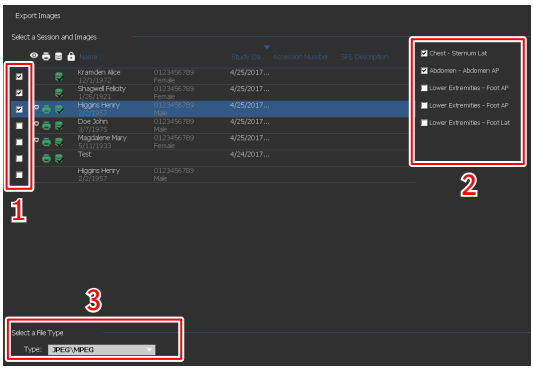


Figure 10: Export Images actions

If you choose **DICOM** or **Native** as export format, you have the option to include patient demographics, patient identification images, patient positioning images and derived images for pathology detection.

Changes applied to derived images for pathology detection are not burnt into the image, but saved separately in a DICOM Grayscale Softcopy Presentation State object.

Multiple DICOM export profiles can be configured. The DICOM export is IHE compliant only if the user or the RIS has provided a value for the **Patient ID** field.

If you choose **Native** as export format, you have the option to include derived images for pathology detection.

4. Click **Export**.
5. Select a destination folder.
6. Click **Save**.
7. Alternatively, click **Export to Email** to send the images by email.

   The message including the images as attachments is composed and opened in the default email client that is configured on the PC.
8. Fill in the destination address and send the email.

Queue Management

To monitor the work queues using the Queue management tool:

1. Click **Queue management** in the Functionality Overview pane of the Main Menu window.

   The Queue Management pane is opened:

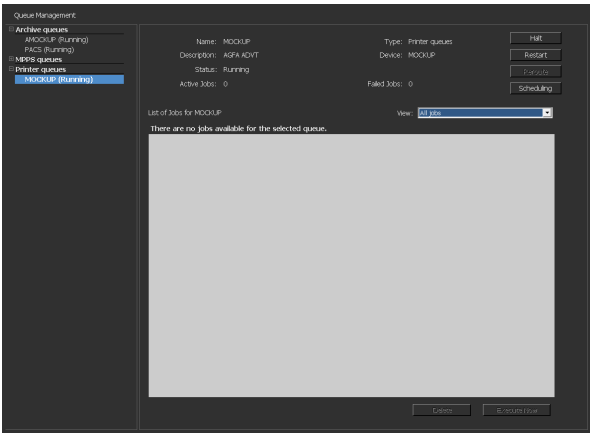


Figure 11: Main Menu window with Queue Management pane open.

2. If you are working on the Central Monitoring System, first select the NX Workstation of which you want to observe a queue. It is not possible to view the queues of all NX rooms at the same time.

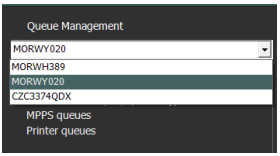


Figure 12: Selecting in-room NX Workstations for Queue management viewing.

3. In the tree view, select a destination type (archiving, printing or MPPS Reporting).
4. Select the name of a destination.

   In the main window, the destination parameters appear, together with the list of jobs for that particular destination. The main window also has a number of buttons for controlling the queue on the right side of the screen.

Button	Action
Halt	Use this button to stop the queue temporarily.

Button	Action
Restart	Use this button to restart the destination.
Reroute	Use this button to change destinations.
Scheduling	Use this button to define and schedule routing destinations.

Topics:

Reroute to another destination

Procedure:

1. Select an archive or a print device.
2. Click the **Reroute** button.

   The Reroute Queue dialog box appears.

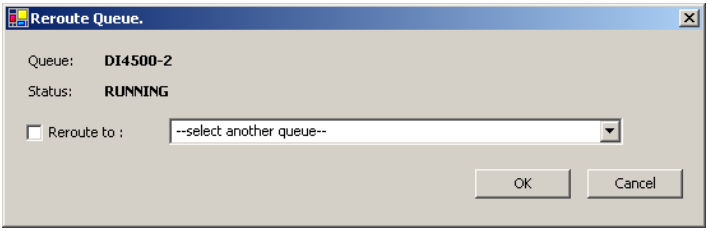


Figure 13: Reroute Queue window.

3. Check the reroute check box and select a destination.
4. Click **OK**.

Note: *When the user works with MPPS reporting, the Reroute button is disabled.*

Schedule the selected queue

Procedure:

1. Click the **Scheduling** button.

   The Scheduling Overview dialog box appears.

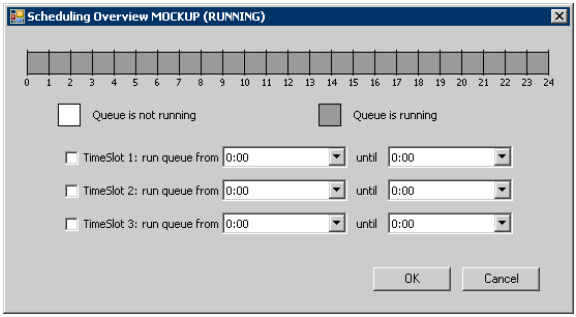


Figure 14: Schedule Queue window.

2. Define which and how many time slots must be used for the selected destination.
3. Click **OK**.

Note: When the user works with MPPS reporting, the Scheduling button is disabled.

Sorting

In the main window, queues can also be sorted using a number of filters.

Procedure:

1. From the **View** drop down list, select the jobs you wish to see:
2. Click the header cell of the column that will be used for sorting.
3. Click the header cell again to reverse the sort order.

Musica MCE Engine archive

If NX is configured to perform Micro Calcification Enhancement (MCE) on mammography images, a special archive queue is listed, that is not intended to store images. The Musica MCE Engine archive queue manages the MCE image processing jobs. The processed images are stored on a PACS archive, managed by a normal archive queue.

Using the Central Monitoring System for collecting dose records and reject records

Topics:

Modifying Dose Monitoring Statistics

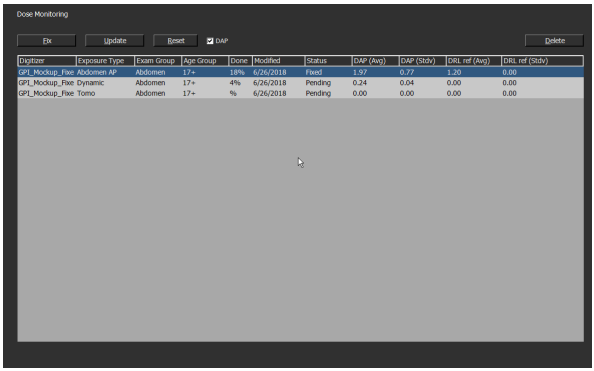


Figure 15: Main Menu window with Dose Monitoring pane.

Using Dose monitoring, on the Main Menu a list of all received exposure types per Digitizer technology and per speed class can be viewed.

For each entry in the dose reference value list, the median and standard deviation is calculated and the reference median and standard deviation is displayed.

LgM and EI values are derived from the pixel histogram of the image. DAP values are obtained from the X-ray modality. Toggle the DAP checkbox to display the relevant set of values.

For each exposure type it is possible to set a reference value or to update the reference value with the median and standard deviation of the 50 latest exposures or to remove exposure types.

An external dose consistency analysis program calculates several statistics with regard to doses, answering questions such as what sort of exposures are likely to be under- or overexposed.

Possible actions in the Dose Monitoring pane are:

- **Fixing reference values.**

  This is a reference LgM value (refLgM), reference Exposure Index (target Exposure Index, TEI) or DAP value which can be used as a guidance value when not enough statistics are available.
- **Updating reference values.**

  This is updating the fixed reference value with the average LgM, EI or DAP value when a proper average value is available.
- **Resetting reference values.**

  This is resetting the running average for the selected exposure type.
- **Delete exposure types.**

This is removing all statistics for the selected exposure type from the NX workstation.

Topics:

Fixing reference values

1. Select an exposure type by clicking the row of the exposure type.
2. Click the **Fix** button.

   The **Fix reference value** dialog box appears.
3. Enter a new value and click OK.

   The value is added to the refLgM (Avg), the TEI (Avg) or the DRL ref (Avg) column of the Dose Monitoring pane.

Updating reference values

1. Select an exposure type.
2. Click the **Update** button.

   The value of the refLgM (Avg), TEI (Avg) or DAP (Avg) column is updated with the calculated average value.

Resetting reference values

1. Select an exposure type.
2. Click the **Reset** button.

   The running average in the refLgM (Avg), TEI (Avg) or DAP (Avg) value is reset.

Deleting an exposure value

1. Select an exposure type.
2. Click the **Delete** button.

   The exposure type is deleted from the list.

Note: *The dose reference list will be empty if the room has no dose monitoring license.*

Note: *If you want to modify dose monitoring statistics on the Central Monitoring System, you first have to select a room.*

Dose monitoring

In computed radiography or direct radiography the image processing automatically adjusts the image density independently of the applied dose. In fact, this is one of the key advantages of the new technology. It helps to reduce the retake rate significantly, but at the same time this feature may hide occasional or systematic under- or overexposure.

While in conventional radiography or direct radiography the amount of exposure is directly related to average density, in computed radiography it determines the signal-to-noise ratio, not the image density. The higher the dose, the better the SNR. This is good news as such, but in the long term there is a risk of gradually drifting to higher doses, as the more exposed images tend to look better. For that reason Agfa has developed a quality control tool called Dose Monitoring Software.

Depending on the installation your workstation will be configured in such a way that the dose monitoring will make use of LGM (Logarithmic Median) values or Exposure Index (EI) values.

Both are derived from the pixel histogram and only apply to the Region of Interest (areas with direct radiation on the detector and collimated areas on the tube are left out). Manual collimation will affect these values, only the area within the collimated zone is taken into account.

LgM is a logarithmic value that will respond in a logarithmic way to changes in the detector dose, EI is a linear value that respond in a linear way to changes in detector dose.

The higher the value the higher the detector dose (relatively) was. Since the X-ray beam quality influences the values, this is not an absolute dose measuring tool, but a good relative dose indicator to monitor your applied doses.

Dose monitoring will compare the LgM or EI of a image with a “reference LgM” or a reference EI (“Target Exposure Index”: TEI) and calculates the deviation which will be kept into the statistics and can be visualized on the NX by means of a bar graph.

In case of LGM values the system stores a reference LGM and a standard deviation on this reference value.

In case of an EI the system stores a Target Exposure Index (TEI) and a standard deviation on this TEI. Besides the EI, a Deviation Index (DI) is calculated and displayed on the NX for every image. The DI expresses the deviation of the EI from its TEI.

To manage the reference values for dose monitoring, click Dose Monitoring in the Functionality Overview pane of the Main Menu window.

Refer to "Suggested Radiographic References and User Guides" for more information on determining Target Exposure Index values.

Dose Statistics

NX stores records of the dose value (LgM or EI) and the deviation to the reference value for each exposure.

To export the dose record data, click **Export Acquired Dose Records** in the Functionality Overview pane of the Main Menu window. By default, only the records that have been added since the last export are exported.

To analyse the dose record data, click **Extended Dose Reporting** in the Functionality Overview pane of the Main Menu window. Extended Dose Reporting is available on installations configured to use Exposure Index (EI) values.

Extended Dose Reporting

Using Extended Dose Reporting, you can analyse the records of the dose value (EI) and the deviation to the reference value and the records of the dose area product (DAP) values, that are stored for each exposure. Records can be filtered and grouped on a set of attributes, e.g. exposure type, patient category, modality, equipment, operator, date and time. Outliers can be analysed separately.

To analyse the dose records:

1. Click **Extended Dose Reporting** in the **Functionality Overview** pane of the **Main Menu** window.

   The **Extended Dose Reporting** window appears.
2. On the Central Monitoring System, select a room.
3. Limit the analysis by selecting specific values or by specifying a date range.
4. Select the type of values to be analyzed:

   - EI-DI Statistics: analyze EI and DI values for all selected exposures, grouped by exposure type and digitizer or detector type.
   - DAP Statistics: analyze DAP values for all selected exposures grouped by exposure type and digitizer or detector type.
   - DAP Statistics Protocol Code: analyze DAP values per protocol code for all selected exposures grouped by protocol code.
   - Outliers: analyze EI and DI values for all selected exposures for which the deviation of the dose value (EI) to the reference value corresponds to a specific overexposure or underexposure, grouped by exposure type and digitizer or detector type. The overexposure or underexposure is expressed by a minimum and maximum deviation index value (DI).
   - Exposure Info: list EI, DI and DAP values for each selected exposure.
5. Filter the data to be displayed by patient category, exam group, exposure type, operator, digitizer or detector type.
6. Click **Start Analysis**.

   The results of the analysis are displayed in the table.

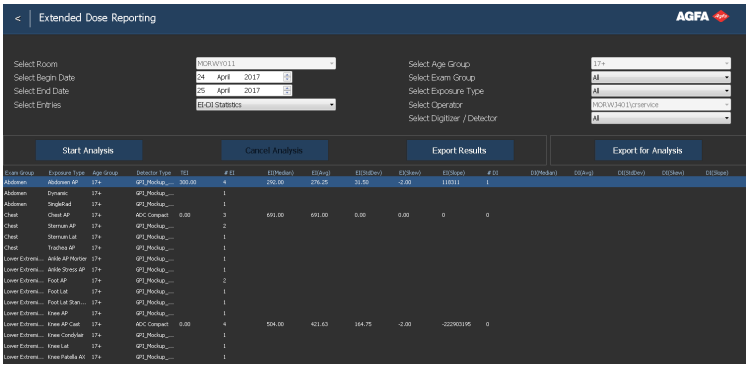
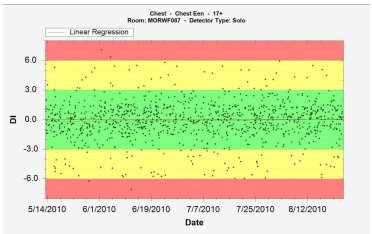
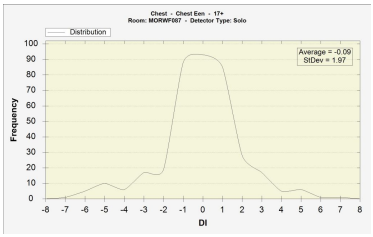


Figure 16: Analysis results

- TEI is the Target Exposure Index for the exposure type
- #EI is the number of exposures
- #DI is the number of exposures for which a deviation has been calculated
- EI is the Exposure Index
- DI is the Deviation Index
- DAP is the dose area product value
- #DAP is the number of exposures
- DRL is the diagnostic reference level. Click the table cell to enter a value. The DRL value will be visible in the trend and distribution charts.
- Median, Avg, StdDev; Skew and Slope indicate the statistic analysis results

7. Double-click a row to view basic trend and distribution charts. Charts can only be viewed in views containing statistical data and if sufficient data is available.

trend chart	distribution chart
	

Right-click the chart to save or print the chart. Click the chart to switch to the next chart or return to the Extended Dose Reporting window.

8. Click **Export Results** to export the results of the analysis.

A Windows **Save As** dialog box appears. A default name and the format (xml) of the file are already displayed.

9. Select a location and click **Save**.

   The files can now be found in the destination folder. Two files are exported: an xml file and a html file. Use the html file to view the analysis results in a browser. Use the xml file to import the data in a third party software tool. The html file is automatically opened in a browser window.

   The html export can only be executed when the amount of records is less than 1000.

10. If the destination folder is a CD-writer drive, the following extra steps are required to perform the CD writing operation.
    a) The “Burn a Disk” window appears. Follow the instructions to write the file to CD/DVD.
    b) A dialog box may be displayed asking how the disk will be used. Depending on this choice, the disk may not be usable on other computers.

Exporting Repeat / Reject statistics

The Key user can export the Repeat/Reject logging files. This information, stored in XML format, can then be easily imported into a 3rd party software tool (not provided by Agfa) for consultation, for example Microsoft Excel. Also a formatted HTML file is automatically created in the same folder.

Procedure:

1. Click **Export Repeat/Reject Statistics** in the **Functionality Overview** pane of the **Main Menu** window.

   A dialog is displayed to specify the filename for the logging files.

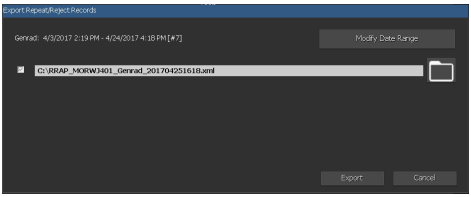


Figure 17: Export Reject Statistics

2. Check the checkboxes to export statistics for genrad or mammography exams or both.
3. To export data for a specific timeframe, click **Modify Date Range** and select a start and end date and time.

   By default, only the records that have been added since the last export are exported.

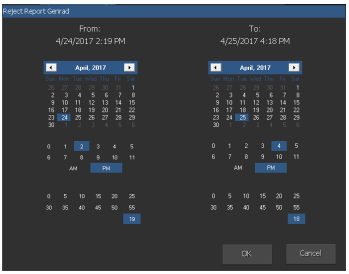


Figure 18: Start and end date and time dialog

4. For each file, click the folder button.

   A Windows **Save As**-dialog box appears; a default name and the format (xml) of the file are already displayed.
5. Select a location.
6. Click **Export**.

   The XML and HTML files can now be found in the destination folder.

   You can open the HTML by clicking it:

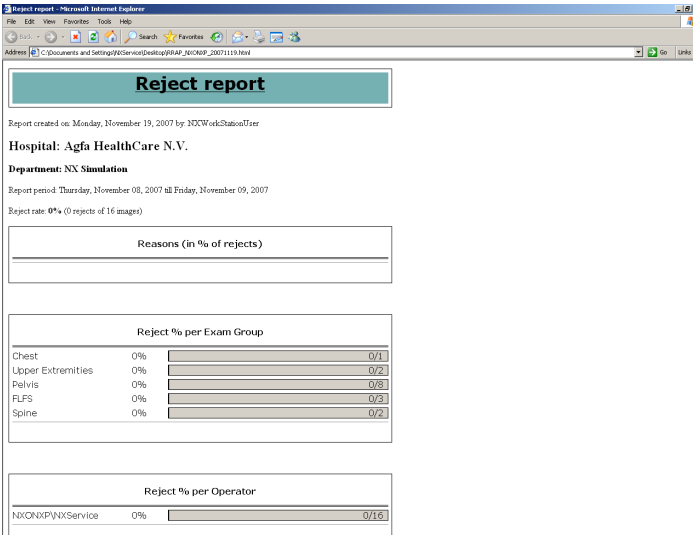


Figure 19: HTML report with Repeat/Reject statistics.

For printing the HTML report from your browser, it is advised to use landscape page orientation in the printer settings.

7. If the destination folder is a CD-writer drive, these extra steps are required to perform the CD-writing operation.
   a) The “Burn a Disk” window appears. Follow the instructions to write the file to CD/DVD.
   b) A dialog box may be displayed asking how the disk will be used. Depending on this choice, the disk may not be usable on other computers.

Exporting Acquired Dose Records

The Key user can export acquired dose records. This information, stored in XML format, can then be easily imported into a 3rd party software tool (not provided by Agfa) for consultation, for example Microsoft Excel.

To export acquired dose records:

1. Click **Export Acquired Dose Records** in the **Functionality Overview** pane of the **Main Menu** window.

   A dialog is displayed to specify the filename for the logging files.

Figure 20: Export Acquired Dose Records

2. To export data for a specific timeframe, click **Modify Date Range** and select a start and end date and time.

   By default, only the records that have been added since the last export are exported.

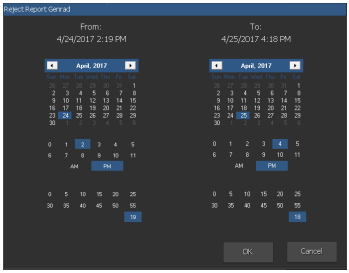


Figure 21: Start and end date and time dialog

3. Click the folder button.

   A Windows **Save As**-dialog box appears; a default name and the format (xml) of the file are already displayed.

4. Select a location.

5. Click **Export**.

   The XML files can now be found in the destination folder.

6. If the destination folder is a CD-writer drive, these extra steps are required to perform the CD-writing operation.

   a) The “Burn a Disk” window appears. Follow the instructions to write the file to CD/DVD.

b) A dialog box may be displayed asking how the disk will be used. Depending on this choice, the disk may not be usable on other computers.

Problem solving

Message "Database is empty"

Details	When **Extended Dose Reporting** is selected in the **Main Menu** of NX CMS, it is possible that a message appears saying the database is empty.
Brief Solution	Go back to the **Main Menu** and open the **Extended Dose Reporting** again.