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GENERAL INFORMATION

The software product "Intelligent Dispatching System" (hereinafter referred to as ISD) version 1.0 is a prompt for the train dispatcher on the optimal distribution of trains between quartzite and rock passages. The ISD consists of 2 modules:

- A module for the train dispatcher designed directly to calculate and display the recommendation for the redirection of trains.
- Module for the concentrator of the concentrator designed to enter the forecast for the reception of ore at the KKD and the level of ore in parabolic bunkers

Based on the forecasts entered by the dispatcher for the reception of ore and the level in the bunkers, as well as information about the movement of trains and the condition of reloading excavators, the ISD issues a recommendation for the train dispatcher to choose the optimal route (quartzite or rock overburden) for each empty train approaching the Kvartsitnaya station.

MODULE FOR TRAIN DISPATCHER

Installation

1. Get and unzip the archive with the program

It is necessary to get an archive containing 3 files:

- ISD v.0.00.xlsm (where 0.00 is the current version of the program)
- CDK.xlsx
- LOG.xlsx

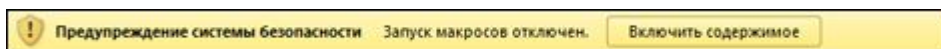
The archive must be unpacked into any convenient folder.

2. Make sure you are connected to NLMK's corporate network
3. Connect the ODBC database
 - Start Button - Control Panel - Administration
 - In the Administrative Tools window, click Data Sources (ODBC)
 - Select "Custom DSN"
 - Click the Add button. The Create New Data Source window appears
 - Select the SQL Server driver, and then click Finish. The Create a New Data Source for SQL Server window appears
 - In the Name box, type a name for the ISD data source
 - In the server field, type: **SG-S-SQL01**

- Select the SQL Server account authentication option and set the required user credentials to access the database (you can get the credentials from Andrey Teplov). Click Next.
 - On the next screen, don't change anything. Click Next.
 - When you're finished, click Finish. A window will open with a summary of the parameters you have set.
 - To verify that the settings are correct, click the Check Data Source button. When you report that the validation was successful, click OK.
4. Make sure that the connections in the Excel file are working.
 - Open the CDK.xlsx file from the previously unpacked archive
 - In MS Excel, on the Data tab, in the Connections group, click the Update All button (the location of the Update All button may vary, depending on the version of MS Excel)
 - After some delay (5-60 seconds), the data in the tabs of the CDK.xlsx file should be updated. If you don't see an error message, it means that the system is ready to go.

Launching

1. Open 3 files:
 - ISD v.0.00.xlsm (where 0.00 is the current version of the program)
 - CDK.xlsx
 - LOG.xlsx
2. When you open a file that contains macros, a yellow message bar appears with a shield icon and a **Enable Content button**.

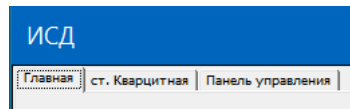


3. Click Include Content, **and** then click **Always Include Active Content in this Document**
4. (the procedure may differ in different versions of MS Excel)
5. In the ISD file v.0.00.xlsm, open the Home page
6. Click on the "Start ISD" button
7. Upon successful launch, the main screen of the IUD interface should appear.

Interface Description

The ISD interface, designed for the train dispatcher, consists of three pages: "Home", "Quartzite Station" and "Control Panel". Switching between pages is done by clicking on the corresponding tab at the top of the screen (Figure 1)

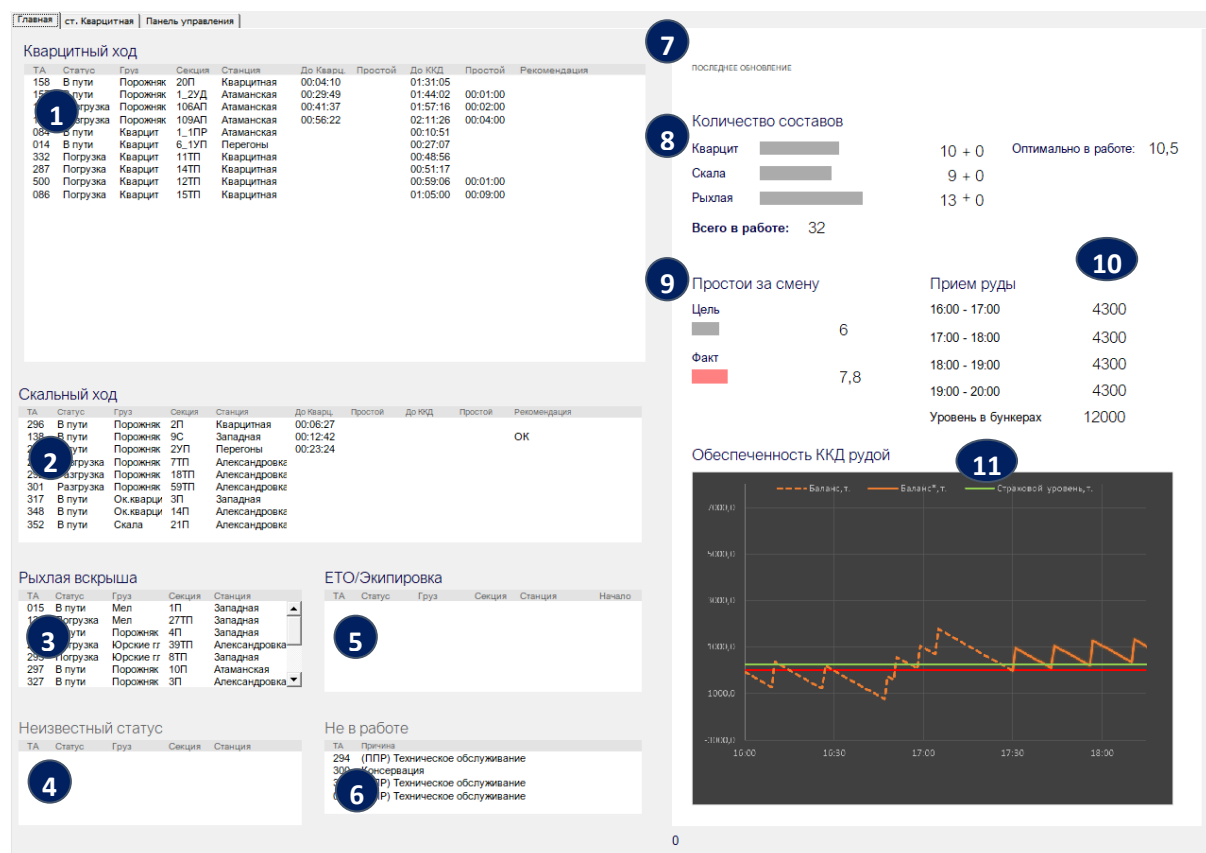
Figure 1



Home Page

This page displays the basic information necessary for the train dispatcher and recommendations for the optimal distribution of trains between quartzite and overburden. Figure 2 shows the general appearance of the user interface of the Home page.

Figure 2.



The interface consists of the following elements:

1. A panel displaying the locomotives on the Quartzite Passage. In this panel, you can see:

- a. "TA" is the number of the traction unit,
 - b. "Status" - loading/unloading/en route
 - c. "Cargo" means a type of cargo
 - d. "Section" is the last section occupied by the
 - e. "Station" means the station where the train is located
 - f. "To Quartz." - the estimated time after which the train will arrive at the unloading dead end at the Kvartsitnaya station (for empty and unloaded trains)
 - g. "Demurrage" - the estimated idle time at the Kvartsitnaya station in anticipation of a loading dead end (for empty and unloading trains)
 - h. "To CCD" is the estimated time after which the train will arrive for unloading at the CCD
 - i. "Downtime" is the estimated downtime waiting to be unloaded at the CCD
 - j. Recommendation - the route recommended by the program for this train: "OK" - leave on the Quartzite Passage, "On the Rock!" - transfer to the Rock Passage
2. A panel showing the locomotives on the Rock Passage (the Rock Passage includes combined rock overburden, shale, and oxidized quartzite):
 - a. TA" is the number of the traction unit,
 - b. "Status" - loading/unloading/en route
 - c. "Cargo" means a type of cargo
 - d. "Section" is the last section occupied by the
 - e. "Station" means the station where the train is located
 - f. "To Quartz." - the estimated time after which the train will arrive at the unloading dead end at the Kvartsitnaya station (for empty and unloaded trains)
 - g. "Demurrage" - the estimated idle time at the Kvartsitnaya station in anticipation of a loading dead end (for empty and unloading trains)
 - h. "Pre-CCD" - not used
 - i. "Simple" - not used
 - j. Recommendation - the route recommended by the program for this train: "OK" - leave on the Rock Passage, "On Quartzite!" - transfer to the Rock Passage
 3. A panel displaying locomotives that are in the areas for the removal of loose overburden, rich ore and other types of cargo. The columns on this panel are identical to the first 5 columns of the Quartzite and Rock Passages panels.
 4. A panel that displays locomotives for which no status or group is defined. The columns are identical to the first 5 columns of the Quartzite and Rock Passages panels.
 5. A panel displaying the trains that are on equipment or daily inspection. Columns 1-5 are identical to columns 1-5 of panels of the Quartzite and Rock Passages. Column 6 ("Start") shows the start time of the equipment or ETO
 6. A panel that displays compositions that are not in operation:
 - a. "TA" is the number of the traction unit
 - b. The "reason" is the reason why the roster is not in progress.
 7. Date and time when the data was last updated.
 8. A section showing the current number of compounds at the Quartzite, Rock, and Loose Passages and the optimal number of compositions at the Quartzite Passage with the current forecast of ore reception at the mill
 9. A section that indicates the total downtime due to the lack of stope at the Quartzitnaya station (by cargo types quartzite, rock, shale and ok.quartzites) and due to the non-

acceptance of ore at the KKD since the beginning of the current shift in hours. The target amount of downtime for these reasons per shift in hours is also indicated.

10. A section that shows the hourly forecast for ore intake at the KKD (in tons) and the total level of ore in parabolic bunkers (in tons)
11. A graph showing the receipt and consumption of ore at the KKD, depending on the time of arrival of the compositions and the forecast of ore consumption:
 - a. The horizontal axis of the graph is time.
 - b. The vertical axis is the volume of ore.

"Balance, t." is a line displaying the volume of ore (in tons) located at the KKD and ready for unloading. The balance includes trains already on the unloading tracks, as well as those trains that will stand in front of the entrance to the KKD, ready for unloading. At the time of the planned arrival of the train at the KKD, the balance is increased by the volume of ore in this composition. Further, the balance gradually decreases as the ore is planned by the concentrator.

"Insurance level, t" is a line displaying the current insurance level. The insurance level is the minimum level of ore in tonnes that the algorithm that calculates recommendations for the redirection of compounds seeks to keep ready for unloading at the KKD.

For more information about each locomotive and comment on the recommendation, double-click on the row with that locomotive, depending on its location in panels 1-6. After clicking, a panel with detailed information will appear (Figure 3).

Figure 3

Рекомендация

Информация о ТА

1

Номер ТА:

327

Тип груза:

Порожняк

Состояние:

В пути

Модель думпкаров:

2BC-105

Количество думпкаров:

10

Количество загруженных думпкаров:

0

Текущая секция:

6_2УД

Станция:

Перегоны

Последняя активность:

04:59:55

Прогноз движения

2

Время прихода на ст. Кварцитная:

05:10:21

Секция погрузки:

6_15ТР (расчетный)

Простой в ожидании забоя:

00:00:00

Начало погрузки:

05:10:21

Продолжительность погрузки:

00:38:00

Окончание погрузки:

05:48:21

Время прихода на ККД:

06:23:16

Простой в ожидании ККД:

00:33:00

Начало выгрузки на ККД:

06:56:16

Рекомендация

3

Простои при текущем маршруте

Ожидание забоя:

00:00:00

Ожидание ККД:

00:33:00

Суммарные:

00:33:00

Простои при изменении маршрута

Ожидание забоя:

00:00:00

Ожидание ККД:

00:00:00

Суммарные:

00:00:00

Достаточность составов на кварцитном ходе:

-1

Уровень в бункерах:

49000

Приход ближайшей вертушки со скалы:

Возможность возить скалу:

Да (105т)

Рекомендация:

Скала

Комментарий:

Есть возможность снизить простои без дополнительного риска на ККД

This panel consists of 3 sections

1. Information about the traction unit. Detailed information about the current traction unit is provided.
2. Movement forecast. A detailed forecast of the movement of this train for the current run is presented.
3. Recommendation:
 - a. "Idle time on the current route" - prediction of what downtime will occur for this train when the current route is saved (Rock Passage or Quartzite Passage)
 - b. "Downtime when changing the route" - a forecast of what downtime will occur for this train if the route is changed (for trains on the Quartzite Passage - in case of redirection to the Rock Passage, for trains on the Rock Passage - in case of redirection to the Quartzite Passage)
 - c. "Level in Bunkers" - the current total level of ore in parabolic bunkers (in tons)
 - d. "Arrival of the nearest turntable from the rock" - for trains on the Quartzite Passage, this line indicates how long it will take for the nearest empty train from the Rock Passage to arrive at the Kvarzitsnaya Station. Only those trains that will arrive at Kvarzitsnaya station later than the current one are taken into account.
 - e. "Ability to carry rock" - it is indicated whether this train can carry rock (depending on the type of dump cars)
 - f. "Recommendation" means a recommendation on the choice of route for a given convoy
 - g. "Comment" means a comment in text form about the reasons for providing this recommendation

Moving Trains Between Panels

To move a train from one panel to another (for example, if the train dispatcher has decided to transfer the train from the Quartzite Railway to the Rocky Railway), you need to drag the corresponding train with the mouse to the desired panel. At the same time, after the move, all data will be recalculated.

Art. Quartzite

This page displays the status of dead ends at the Kvarzitsnaya station and manually controls the type of cargo, the number of the excavator and the occupancy of the dead end, if necessary. The interface of the page is shown in Figure 4.

Figure 4.

ИСД

ГлавнаяСт. КварцитнаяПанель управления

Станция Кварцитная

Секция	Состояние	Тип груза	Экскаватор	Состав	Начало погрузки	Окончание погрузки	Закрытие
6_10TP	Свободен	Скала	51				
6_11TP	Занят	Кварцит	90	084	03:13:51	04:00:00	
6_12TP	Занят	Кварцит	84	139	03:38:09	04:14:09	
6_14TP	Занят	Кварцит	80	086	03:39:03	04:15:03	
6_15TP	Свободен	Кварцит	88				
6_16TP	Занят	Скала	31	138	03:48:32	04:42:32	
6_17TP	Занят	Скала	75	015	03:29:30	04:17:30	
6_19TP	Свободен	?					
6_22TP	Занят	Кварцит	49	343	03:59:17	04:53:17	
6_7A	Свободен	Скала	60				

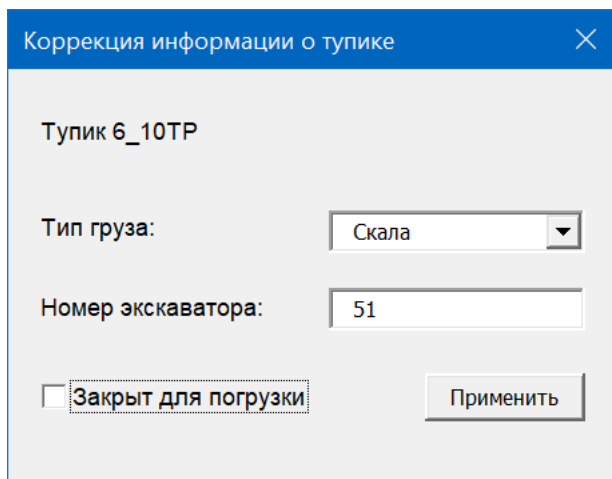
The interface consists of a panel that presents the loading sections at the Kvartsitnaya station:

1. "Partition" is the identifier of the boot section
2. "Status" - the current state of the boot section (busy/free)
3. "Type of cargo" means the type of cargo that is loaded in this section
4. "Excavator" is the number of the excavator that loads in this section.
5. "Composition" means the number of the TA located in this section (if it is occupied)
6. "Start of loading" means the time when loading was started in this section (if it is occupied)
7. "End of loading" - the predicted time of completion of loading in this section (if it is occupied)
8. "Closing" is an indication that the section is not in progress.

Manual control of the condition of the loading sections

If the train dispatcher receives information that any loading section will be out of operation for a long time, then it is necessary to manually enter this information into the program for the correct operation of the algorithm. It is also possible to manually adjust the type of cargo and the number of the excavator in each section if the automatic update of this information is incorrect for any reason. To do this, double-click on the row with the loading section for which you want to change the state. After clicking, a window will appear to change the state of the loading section (Figure 5)

Figure 5. Loading Section Status Change Window



In this window, you can adjust the following parameters:

- type of cargo by selecting the required type of cargo from the drop-down list
- the number of the excavator, indicating it in the appropriate text line
- Closing a dead end by ticking the appropriate box

For the changes to take effect, you must click the "Apply" button

Manual changes to the load type and excavator number will remain in effect until loading takes place in this section. As soon as loading begins, the load type and excavator number will automatically change to the actual load type and excavator number in that section.

Manual "closing" of the loading section will be in effect until it is canceled by unchecking the corresponding checkbox. If a loading section is marked as "closed", the algorithm will assume that loading in this section is not possible. The "closed" section will be marked in the "Closing" column in the main panel with the list of loading sections on the "Art. Quartzite".

Control panel

On this page, you can manually manage the forecast of KKD ore intake, the level of ore in parabolic bunkers, and the insurance level setting. The interface of the page is shown in Figure 6.

Figure 6

Manual control of ore reception forecast

This function is necessary if, for some reason, it is necessary to adjust the forecast of ore reception received from the concentrator of the concentrator (or the forecast did not get into the system due to technical problems).

To do this, check the box "Manual control of ore reception forecast", enter the hourly forecast in tons/hour and click the "Apply" button.

IMPORTANT: the forecast is entered in tons/hour, even for a partial hour. For example, you enter a forecast at 12:24 p.m. for an hour between 12:00 p.m. and 1:00 p.m. You need to enter the ore reception rate in tons/hour, not the remaining amount of ore that is planned to be accepted from 12:24 to 13:00.

If there is a checkbox in the "Manual control of ore reception forecast" field, the forecast specified on this page will be applied. The forecast received from the PF dispatcher will be ignored. In order to cancel the manual entry of the forecast, you need to uncheck the corresponding box. After clearing the checkbox, the forecast from the system submitted by the PF dispatcher will be used again.

Manual level control in bunkers

Similar to the manual control of the ore reception forecast, it is possible to manually control the value of the ore level in parabolic bunkers. This function is necessary if for a technical reason the dispatcher does not receive up-to-date data from the OF.

To correct the data, you need to check the box "Manual level control in bunkers", set the values for the level in each section in tons and click the "Apply" button. If there is a checkbox in the "Manual control of the level in bunkers" field, the algorithm will take into account exactly the level that is specified on this page and ignore any data received from the PF dispatcher.

To cancel the manual mode, uncheck the corresponding box. After the manual mode is canceled, the data automatically received from the PF dispatcher will be used

Manual management of the insurance level

This function is necessary if you want to set an insurance level that differs from the standard one (determined depending on the level of ore in the bunkers). To do this, you need to tick the "Manual management of the insurance level" field, enter the required level in tons in the text field and click the "Apply" button. If there is a checkmark in the "Manual management of the insurance level" field, the algorithm will take into account exactly the level that is set on this page. To return to automatic level detection, uncheck the corresponding box.

Ability to carry quartzite

This function allows you to specify the possibility/impossibility of transporting quartzite for each composition. To indicate the possibility of transporting quartzite, it is necessary to move the number of the train to the left field ("Can"), to indicate the impossibility of transporting, it is necessary to move the number of the train to the right field ("Cannot").

How to Use

1. Launch the ISD module for the train dispatcher.
2. Make sure of the following:
 - a. The system functions correctly and is updated. To do this, you need to check the time of the last update (it should be no more than 1-2 minutes ago). In the event that the update does not occur, the system recommendation cannot be used.
 - b. Squads on ETO and Equipment are correctly displayed in the corresponding panels. In case the composition on the ETO/Equipment is not displayed on the "ETO/Equipment" panel, it is necessary to

inform the computer operator about it and make sure that the problem is fixed.

- c. The forecast from the concentrator and the level of ore in the bunkers are within the normal values (forecast: 3000-7000 t/h, the level in the bunkers is 10,000 – 30,000 tons). In case of deviation from normal values, it is necessary to contact the dispatcher of the OF and confirm the correctness of the data. If, for some reason, the data from the PF dispatcher is not received in the system, then it is necessary to enter it manually on the "Control Panel" tab.
3. If there is information about the closure of the loading section for a long period of time (more than 30 minutes), ensure the manual closure of this section on the page "Art. Quartzite"
4. Enable trains to carry quartzite on the "Control Panel" tab
5. For each composition that is suitable for the Quartzite station, track the recommendations for redirection on the "Home" page.
6. Evaluate the recommendation and make a decision on the further route of the train.
7. In the event that a decision is made to redirect the train from the Quartzite Passage to the Skalny Passage and vice versa:
 - a. Inform the duty officer at the Kvartsitnaya station about the change in the planned type of cargo
 - b. Move the composition on the Home page to the appropriate panel (from the Quartzite Passage panel to the Rock Passage panel or vice versa, depending on the decision made)

ISD MODULE FOR CONCENTRATOR DISPATCHER

The utility for the concentrator dispatcher is designed to enter into the system the forecast for the reception of ore at the KKD and the current level of ore in parabolic bunkers. This data is necessary for the correct distribution of railway trains for different types of cargo

Launching

The utility is launched using the "isd" shortcut on the desktop of the OF manager computer.



isd.exe

Interface

The interface of the utility consists of a single screen divided into 2 parts. The left part is used to enter the forecast for ore intake at the KKD. The right side is for entering the level of ore in parabolic bunkers.

Drawing

How to Use

The data must be updated at least once an hour before the start of the next hour. If there are significant changes in the ore acceptance rate and/or ore level in the parabolic bunkers, it is necessary to update the data off-schedule. With each new entry, all previous forecast values and ore levels in the bunkers are overwritten with new ones. The procedure for updating the values is as follows:

1. Open Utility
2. Click the "Refresh" button on the left side of the screen.
3. Enter a forecast for the reception of ore at the KKD in tons for the next 3 hours. For example, if you update the data at 10:45 a.m., you need to enter a forecast for:
 - 11:00 – 12:00
 - 12:00 – 13:00
 - 13:00 – 14:00

4. If necessary, adjust the forecast for the current hour (for example, if there is a breakdown of equipment that slows down the reception of ore). **Important:** **the** forecast is entered in tons per hour even for the current partial hour.
5. Click the "Save" button on the left side of the screen.
6. On the right side of the screen, enter the current level of ore in the parabolic bunkers (in tons for each section)
7. Click the "Save" button on the right side of the screen.