

Manufacturing Plant for Production of Isocyanates



NTD designs and builds installations for production of isocyanates. We install from storage parks, circulation pumps, manufacturing agitators, nitrogen installations, and packaging systems.

The operation can be manual, semi-automatic or automatic. As a sample this plant is described below:

- Plant with computerized control system, production, formulation and dosing.

Installations with EExd protection (flame-proof).



Control system supplied by **NTD** is a data base developed in Windows environment with the following features:

- § General screen. It shows a diagram of all different processes of the plant. It gives a dynamic view of all control devices.
- § Possibility of action over components (motors, pumps, valves, etc..)
- § Setting-up masters: products, lines, workers, etc.
- § Starting and monitoring processes (M.O.)
- § Alarm management and setting.
- § User management (workers).
- § Reporting: formulas, consumption of products, alarms, etc..)

This system eases an absolute control over processes, not only operational, but also over production.

Link with other management systems (AS-400, BAAN, SAP, etc.) is also possible.

Easy use. Only basic knowledge of computers is required to work with the program.

SUPERVISION AND CONTROL SYSTEM FOR MANUFACTURING PLANT FOR PRODUCTION OF ISOCYANATES

MANUAL OF OPERATION

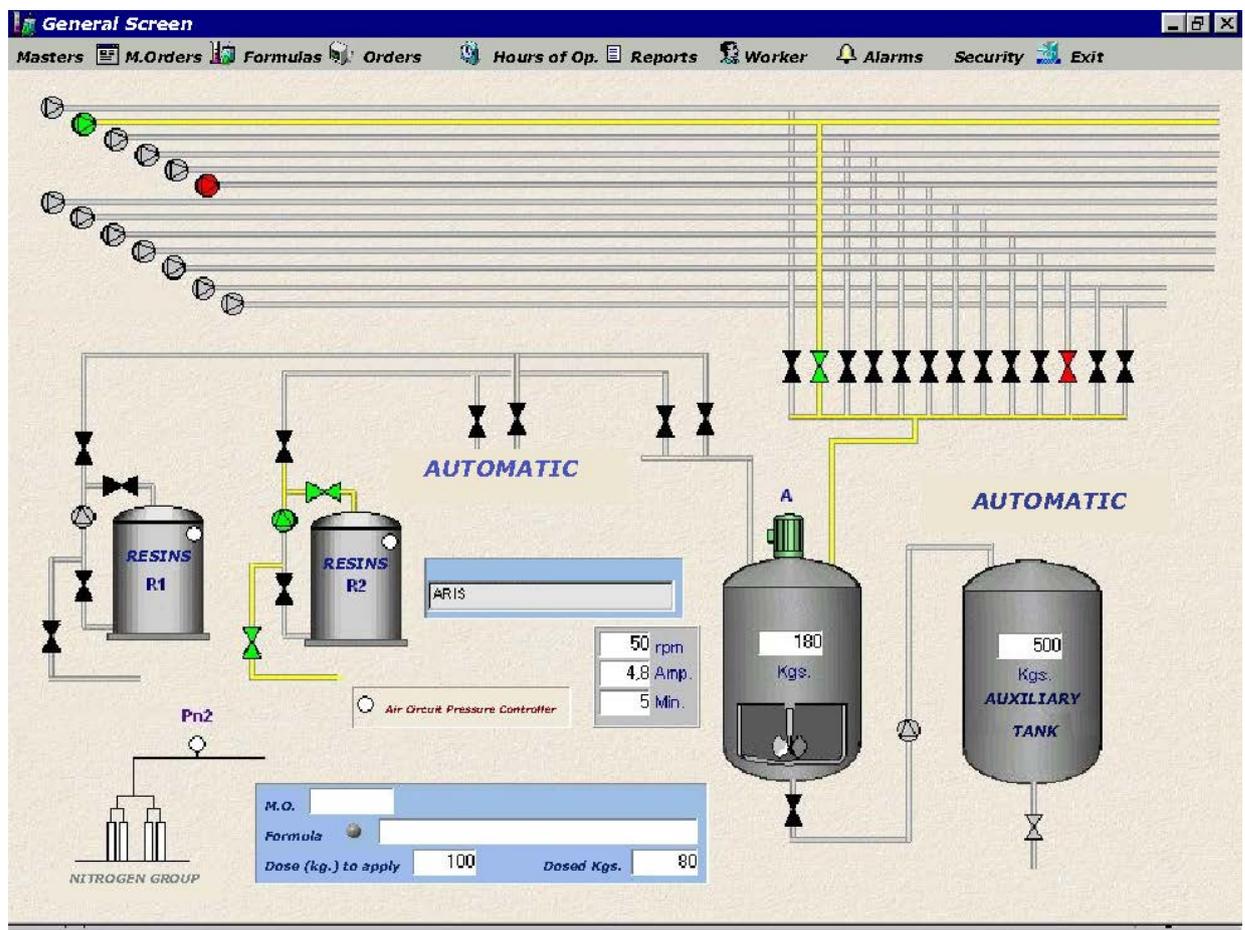
Screenplays containing options that are described in following pages, constitutes integrated Control and Supervision Program.

The Program is developed in WindowsNT environment; therefore, the appropriate icon must be clicked on desktop to execute the program.

Name of icon in this guide is “NTD”.

Mouse double click on the icon executes the program, coming out the general screen. This is the centre of operations and the access to detailed screens and Menu options, which links with the operations.

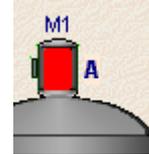
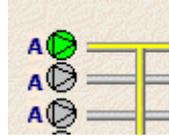
GENERAL DISPLAY



As you can see on pictures below, there is a general view of all components of installation. State of control elements are classified with different colours:

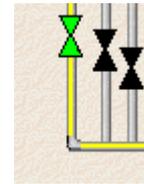
Pumps, motors

- Green – In Process
- Grey - Stop
- Red – Thermal difference

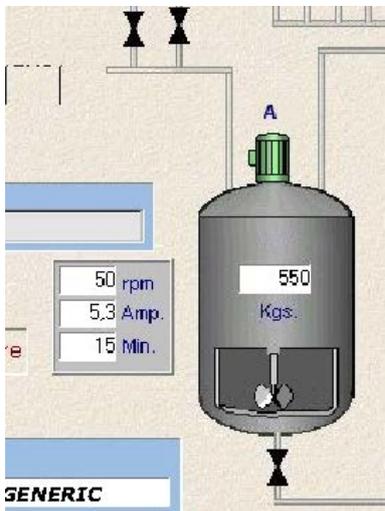


Valves

- Green - Opened
- Grey - Closed
- Red – Irregularity: after request of open, the valve remains closed



Besides, when product is circulating (valve opened and pump in operation) the line is coloured.



System analogue variables (rpm, amperes, weight) appear in digital values on the body of respective components.

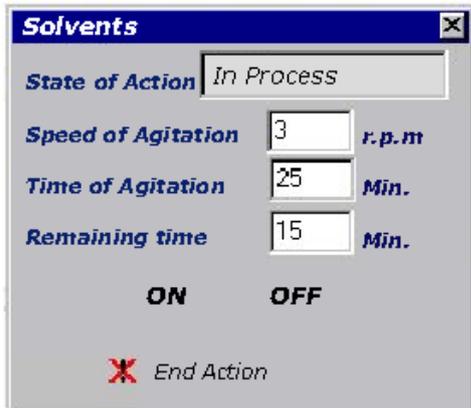
In addition, letter indicates on control components their operation mode:

- A – Automatic
- M – Manual
- L – Local

Click on line pumps to open a display, which indicates the product in circulation.

Motor-Agitator

Click on motor and enter on a pop-up window speed and time of agitation. It shows the remaining minutes to finish the process. If user wants to keep the agitator working (non-stop), “0” must be written on time field.

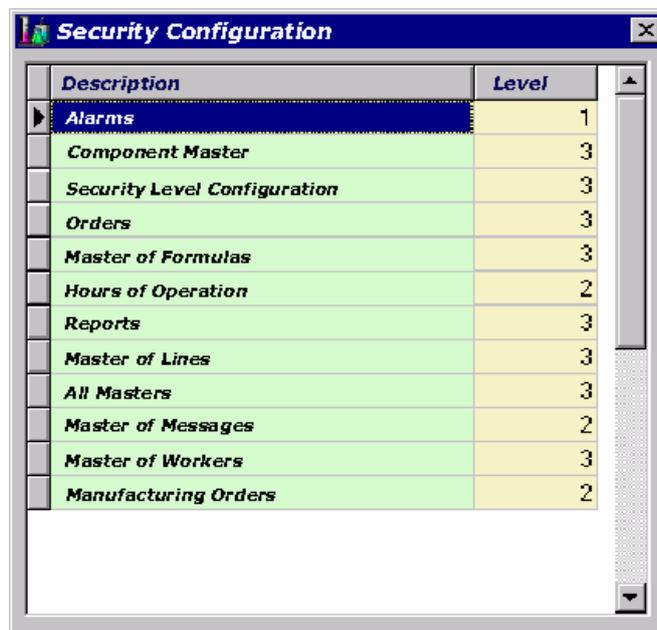


State of action field indicates state of agitation process: In process, Interrupted or Finished. Action must be finished to change rpm and time of agitation.

Apart from showing state and actions of different components, on the upper side of general screen, there is a general menu, which gives access to different options of the program. They are described below.

MENU

The program has three access levels with their respective passwords. Number 3 means maximum priority and 1 minimum priority.



The screenshot shows a window titled "Security Configuration" with a close button (X) in the top right corner. The window contains a table with two columns: "Description" and "Level".

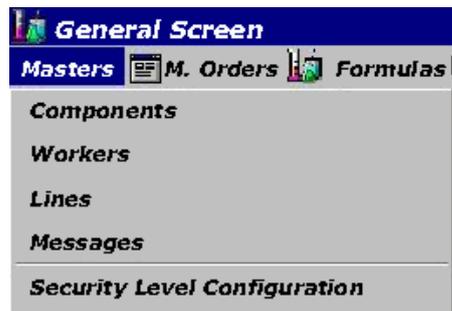
Description	Level
Alarms	1
Component Master	3
Security Level Configuration	3
Orders	3
Master of Formulas	3
Hours of Operation	2
Reports	3
Master of Lines	3
All Masters	3
Master of Messages	2
Master of Workers	3
Manufacturing Orders	2

Set up the access level on menu option “**Security Level Setting**”.

According to the configuration, we have access to some of the functions after clicking on enable options and enter the appropriate password.

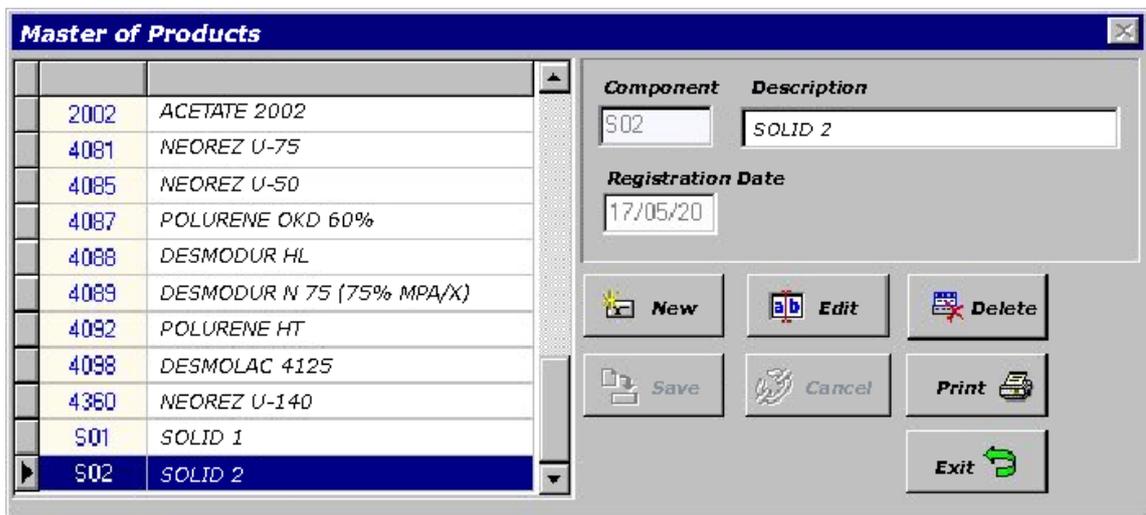
Masters

Masters are described below.



Components

Set up products used in the processes in this master.



Data fields are Component, Description, Registration date.

Action buttons in all masters have the same meaning:

- **New**. Create new register
- **Edit**. Allow to modify registered data

- **Delete.** Eliminate a register
- **Save.** Record new data
- **Cancel.** Modifications are not saved.
- **Print.** Print data from master.
- **Exit.** Close the window and return to general diagram

Workers

Set Workers in this master assigning them Code, Name, Security Level and Password.

Code	Name
0092	JOSE LUIS
1111	FELIX
9999	ARIS

Code: 0092
 Name: JOSE LUIS
 Level of Security: 3
 Password: 3

Buttons: New, Edit, Delete, Save, Cancel, Exit

Lines

Assign products to automatic lines

Line	Product	Inertia
D1	TOLUENE	10
D10	ETHYLGLYCOL ACETATE	10
D11	XYLENE	10
D12	PROPYLENE GLYCOL	0
D13	BUTYL ACETATE (reserve)	8
D2	MIBK	8
D3	ETHYL ACETATE	8
D4	ACETONE	8
D5	BUTYL ACETATE	8
D6	MEK	8
D7	ETHYL ACETATE	8

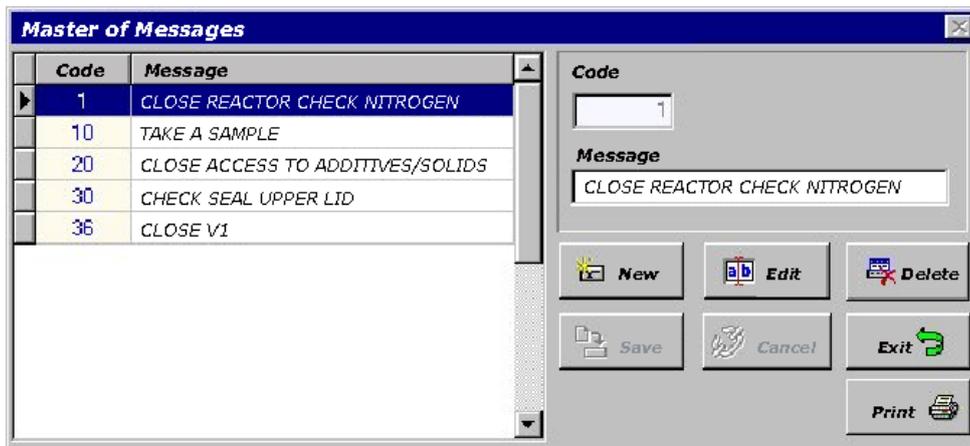
Line: D1
 Product: 1071
 Inertia: 10
 Product Description: TOLUENE

Buttons: Edit, Save, Cancel, Exit

In this master, you can also enter inertia data in kg. used to close the valve in order to compensate pipe inertia.

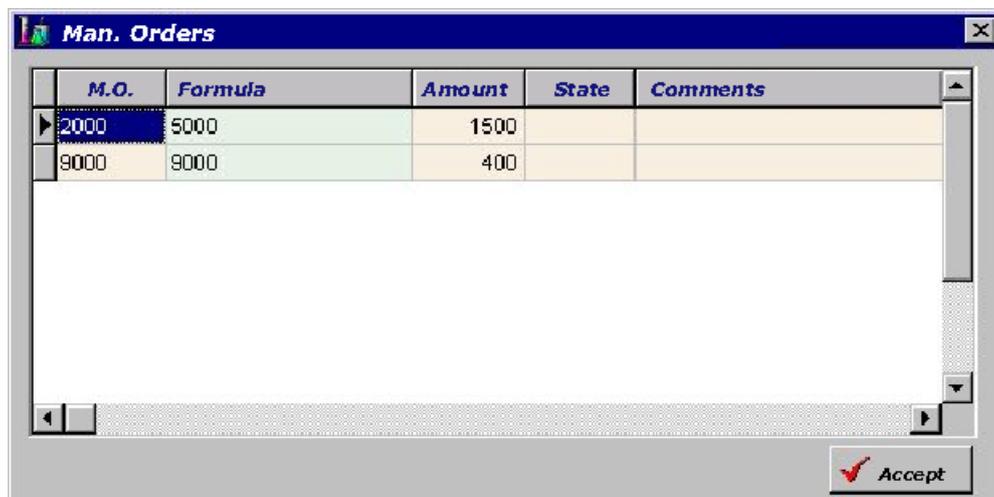
Messages

Set any possible messages that will pop up during automatic execution of formulas.



Orders

Click on this menu option to open manufacturing orders tab. You can create or assign new orders.



Go to the last line and enter No. of M.O (Manufacturing Order), formula and amount.
There is a field to add comments.

Formulas

You can set up formulas for different manufacturing processes.

Seq.	Process	Product	Batch	Mes.1	Mes.2	% Kgs.	r.p.m.	Min.Ag
10	1 SOLVENT	2000 TOLUENE 33		1		10		
20	1 SOLVENT	2001 ACETATE 1678				30		
30	1 SOLVENT	2002 ACETATE 2002				10		
40	1 SOLVENT	2000 TOLUENE 33				45		
50	4 ADD SOLID	S01 SOLID 1				5		
60	2 AGITATE				10		45	10

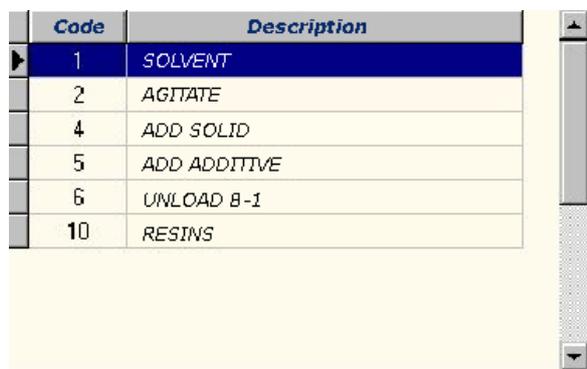
On the lower side of the screen, there are buttons to **Create** new formulas, **Edit** formulas, **Delete**, **Delete line**, **Print** and **Save as**. You can create a new formula making changes on an existing one and changing the name clicking on **Save as**.

Set the formula entering parameters of action and sequence of execution.

Enter data as follows:

Sequence No: Better, enter from 10 to 10 to enable the addition of steps between sequences.

Process: Go to this field and press Enter. An info window drops down a list with all possible actions. Go to the wanted option and press Enter to select it.



Code	Description
1	SOLVENT
2	AGITATE
4	ADD SOLID
5	ADD ADDITIVE
6	UNLOAD B-1
10	RESINS

Product. Double click on this field or press Enter. An info window appears with a list of products. Go to the product required and press Enter for selection.

Batch. Enter the No of batch

Message 1. This messages appear before starting an action. Press Enter to open master of messages and select the messages.

Message 2. This message pops up when an action is finished. Click on Accept to execute next action.

%Kg. Kg percentage of product to be dosed.

Rpm. This parameter shows agitation speed.

Min Agit – Set time of agitation in minutes. To keep agitator working without stop, write “0”.

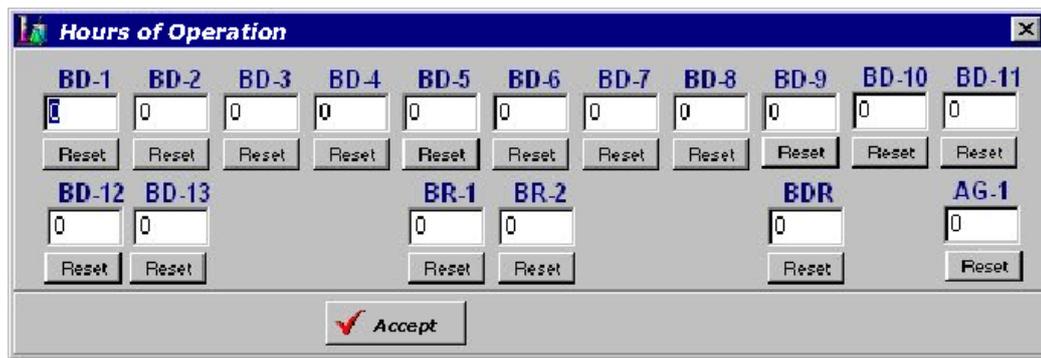
Orders

Set security orders to control kg of product in agitators. This way, disk agitator is not damaged as it is always submerged.



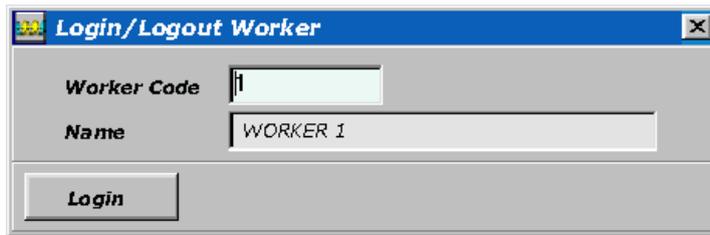
Hours of operation

Click on this menu option to enter in a new window, data of hours of operation and control elements (pumps and motor). You can reset separately each element. This is a helpful option in maintenance of components.



Worker

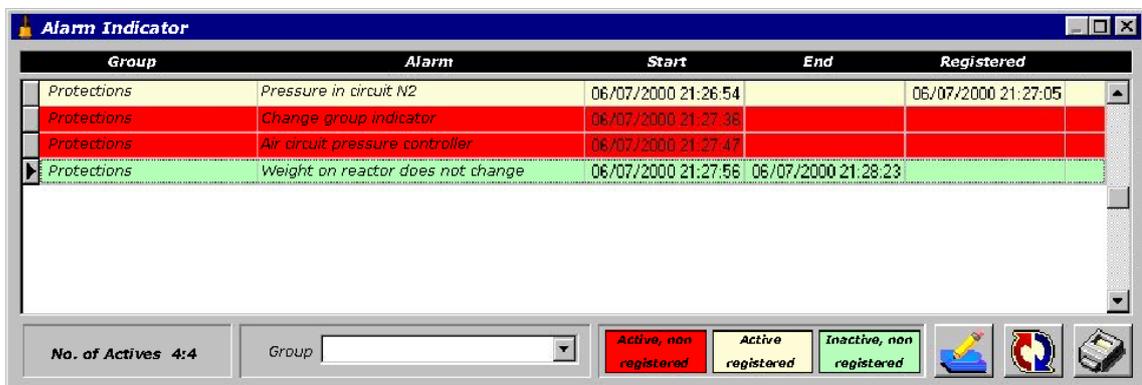
Click on this option to enter the worker code that works on the process. This data is important as data processed is assigned to one worker.



Alarm indicator

Alarms

When an alarm goes off during the process, a window comes out (alarm indicator). It shows in red, date/time of the alarm.



When alarm is registered and is still active you will get a green indication. If the alarm is no longer active and nobody has registered it, the indication is yellow.

Likewise, if an alarm is registered and after that, it loses the “alarm condition”, the alarm is deleted automatically from the window and registered in Alarm history.

Double click on alarm to register it.



Click on that button to register all alarms. You will be prompted with a dialogue box to confirm the action.



There are two more buttons:



Click on this option to add comments about alarms. Single click on alarm wanted opens a window with a blank field to write comments.



Click here to print the alarm report.

Reports

This option gives access to all processed and stored data. Data is stored in different reports that are described below:



Alarm report

Order the report within dates.



Data included in the report are alarm occurred, date/time of start, End date/time, date/time of registration, duration and worker.

Code	Group	Alarm	Start	End	Registered	Duration	User
Printing Date 06/07/2000 01:39							
Alarm report							
From 19/06/2000 01:28:10 To 06/07/2000 01:30:48							
41	Protections	Pressure in circuit M2	19/06/2000 12:58:04	19/06/2000 12:58:20	19/06/2000 14:52:47	16 s	13
41	Protections	Pressure in circuit M2	19/06/2000 12:58:28	19/06/2000 12:58:56	19/06/2000 14:52:47	26 s	
60	Protections	Electrovalve malfunction VD5	19/06/2000 17:25:00	19/06/2000 17:25:02	19/06/2000 17:25:17	2 s	
74	Protections	Irregular connection to PLC	20/06/2000 08:06:22	20/06/2000 08:11:06	20/06/2000 11:30:22	2 m 44 s	

Informe de Producción

La petición de este informe, se realiza también entre fechas, pudiéndose también filtrar de fabricación. Así mismo, puede ser resumido o detallado. En Of

Production report

Production report is ordered between dates or by manufacturing order. The report can summarized or detailed. To get all reports, leave fields empty. If you want specific report, fill data field required. The screen shows the report and can be also printed.

Production Report

From: 24/05/2000 To: 30/05/2000

M.O. Batch Agitator

Type of Report

Summarized Detailed

Accept Cancel

Formulation Summary

Page 1
Date 06/07/2000

NTD

Isocyanates

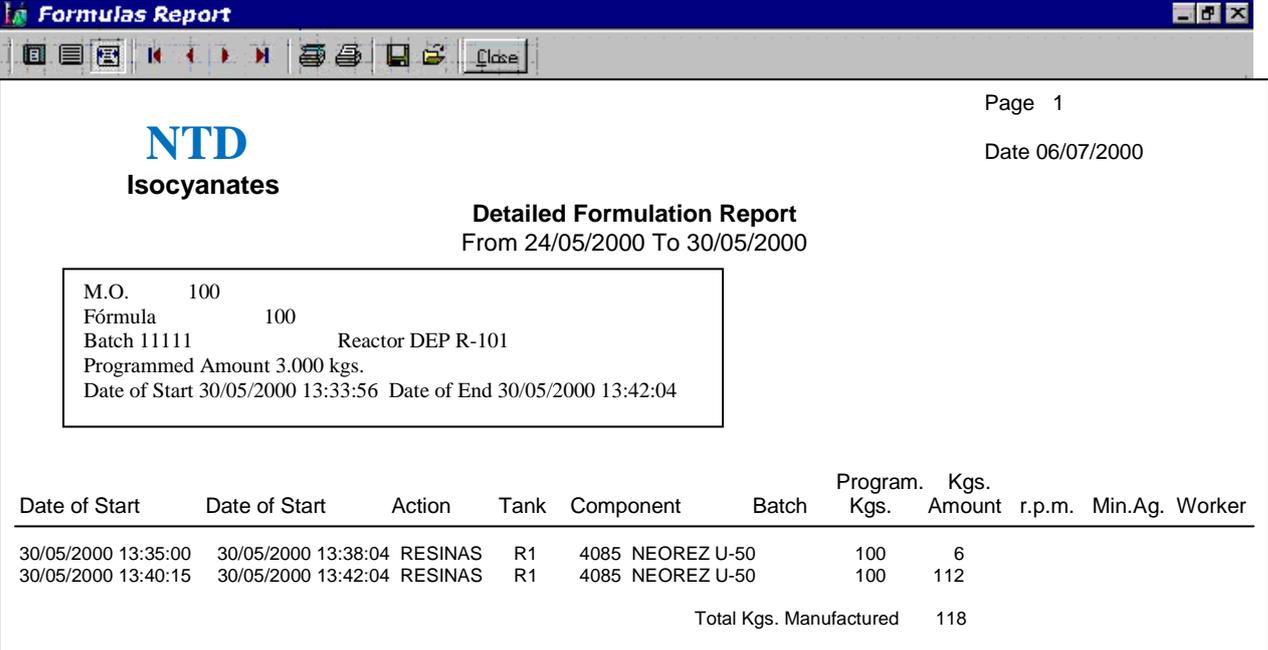
Summarized Formulation Report
From 24/05/2000 To 30/05/2000

M.O.	Reactor	Fórmula	Batch	Date of Start	Date of End	Prog. Kgs.	Real Amount
9999	DEP R-101	9999 INERTIA	9999	24/06/2000 17:15:30	24/06/2000 17:19:20	500	
8888	DEP R-101	8888 INERTIA		24/06/2000 17:19:16	24/06/2000 18:16:23	500	380
9999	DEP R-101	9999 INERTIA		30/06/2000 13:42:10	30/06/2000 17:13:25	100	58
Total Kgs. Manufactured						1.100	430

Summarized

As you can see in this detailed report following data are included: MO, Reactor, Formula, Batch, startD/T, end D/T, and planed and real amount of product.

Detailed



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Detailed Formulation Report
From 24/05/2000 To 30/05/2000

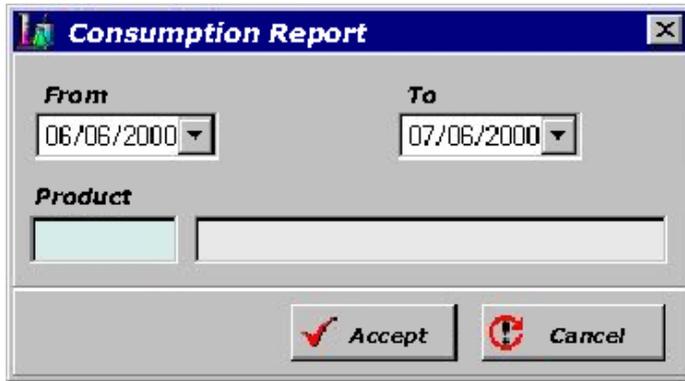
M.O.	100
Fórmula	100
Batch 11111	Reactor DEP R-101
Programmed Amount 3.000 kgs.	
Date of Start 30/05/2000 13:33:56 Date of End 30/05/2000 13:42:04	

Date of Start	Date of Start	Action	Tank	Component	Batch	Program. Kgs.	Kgs. Amount	r.p.m.	Min.Ag.	Worker
30/05/2000 13:35:00	30/05/2000 13:38:04	RESINAS	R1	4085 NEOREZ U-50		100	6			
30/05/2000 13:40:15	30/05/2000 13:42:04	RESINAS	R1	4085 NEOREZ U-50		100	112			
Total Kgs. Manufactured							118			

This report details all formulation steps and indicates start D/T, end D/T, and planed and real amount of product.

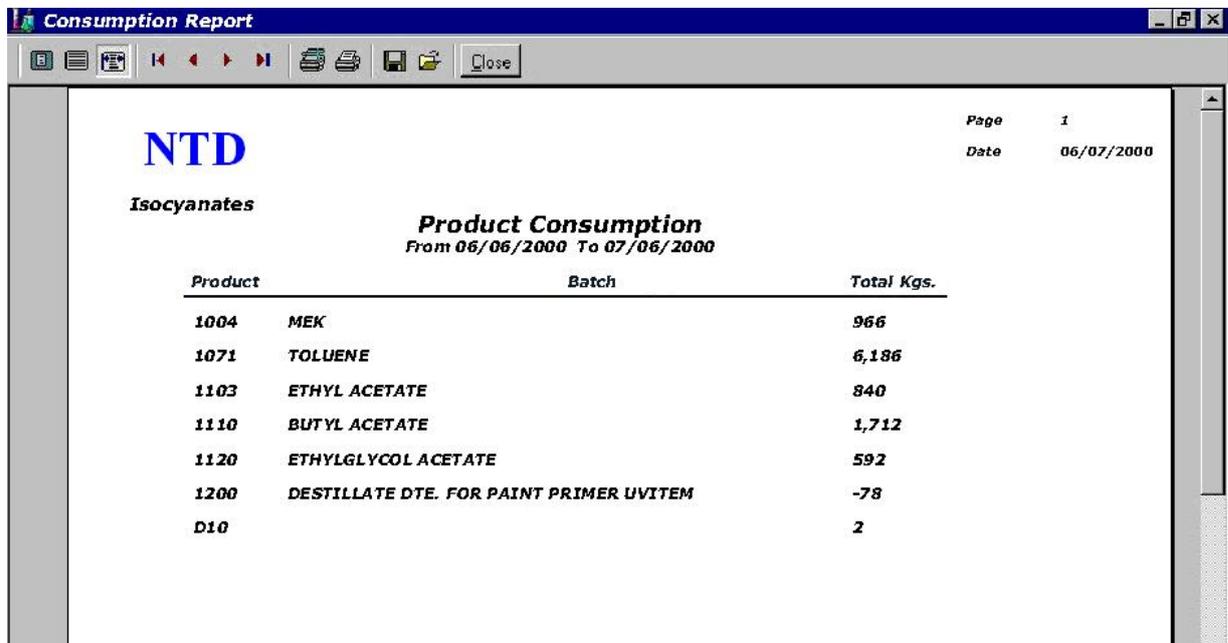
Consumption report

This report details product consumption data. Range of data is selected between dates, which are entered in the appropriate fields. You can request consumption of only one product or consumption of all of them leaving the field empty (blank).



The image shows a dialog box titled "Consumption Report". It contains two date fields: "From" with the value "06/06/2000" and "To" with the value "07/06/2000". Below these is a "Product" label followed by an empty text input field. At the bottom, there are two buttons: "Accept" with a checkmark icon and "Cancel" with a red exclamation mark icon.

The resulting report is below:



The image shows a window titled "Consumption Report" with a toolbar at the top containing icons for back, forward, print, save, and close. The main content area displays the NTD logo and the following text:

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Date 06/07/2000

Isocyanates

Product Consumption
From 06/06/2000 To 07/06/2000

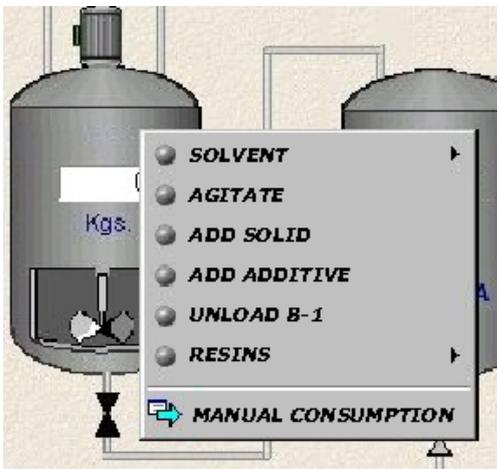
Product	Batch	Total Kgs.
1004	MEK	966
1071	TOLUENE	6,186
1103	ETHYL ACETATE	840
1110	BUTYL ACETATE	1,712
1120	ETHYLGLYCOL ACETATE	592
1200	DESTILLATE DTE. FOR PAINT PRIMER UVITEM	-78
D10		2

Exit

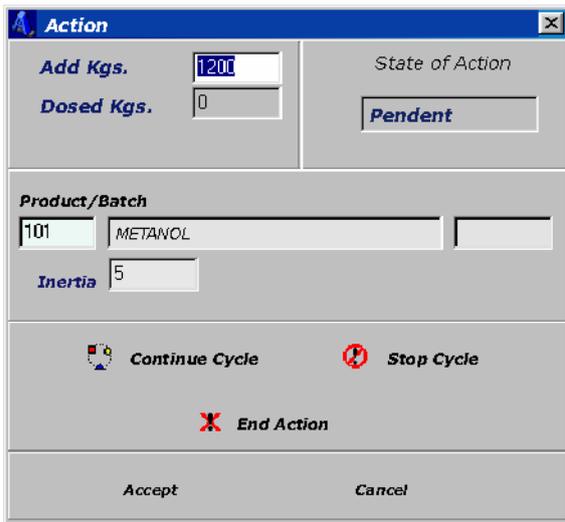
Click Exit to leave the application. Before, a dialogue box pops up to ask confirmation.

WAY OF OPERATION

The system has been developed to execute control actions individually or linked with execution sequences, according to settled formulas. The selector on electrical panel must be in “automatic position”.

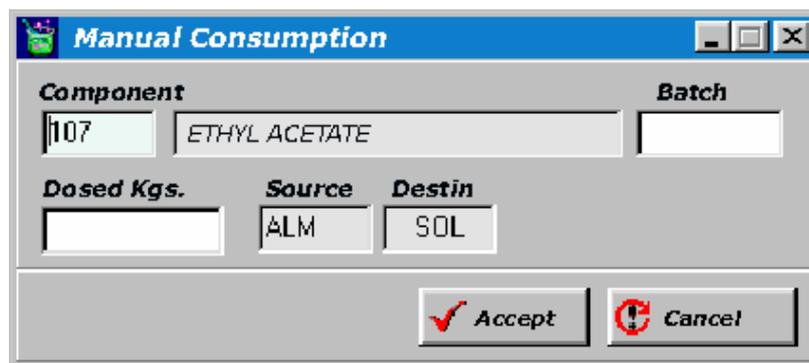


To make an action, right click on appropriate reactor opens a window with different options. Click on action desired to open a new pop-up window to enter conditions of action.



For example, clicking on “Add solvent”, opens a window where amount of product and product data (component, batch, inertia) can be selected. State of action is also indicated: done, in process, interrupted. Likewise, other actions can be selected: Continue process, Stop process, End action.

In actions menu there is another option: *Manual consumption*. Click on this option to open a tab and enter product and kg. This option is helpful to enter data of products consumed in the process and also to control product consumption.



Agitation action

Set time of agitation and agitation order in rpm. If you wants unlimited agitation period, write “0” in the appropriate field.

Action [Close]

Rpm/°C Min	<input type="text" value="300"/>	State of Action	<input type="text" value="Pendent"/>
Time Min	<input type="text" value="0"/>		

 *Continue Cycle*  *Stop Cycle*

X End Action

Accept *Cancel*

FORMULATION

Set formulas automatically following the process described below:

Left mouse click on reactor opens formulation window.

The 'Formulation' window displays the following information:

M.O.: 2000 Batch: 123546 Program. Amount: 1500
Formula: 5000 GENERIC SOLVENT
Com.:
State: Stop Kgs. Comp.: 0
Active Worker: Time: 0

Seq.	Reac	Process	Sour	Dest	Product	Batch	Amount Kgs.	rpm	Min. Agit.	Real Amou.	State
10	1	SOLVENT	D1	B1	2000	TOLUENE 33	150				Pendent
20	1	SOLVENT	D1	B1	2001	ACETATE 1678	450				Pendent
30	1	SOLVENT	D1	B1	2002	ACETATE 2002	150				Pendent
40	1	SOLVENT	D1	B1	2000	TOLUENE 33	675				Pendent
50	1	4 ADD SOLID	B1	B1	S01	SOLID 1	75				Pendent
60	1	2 AGITATE	B1	B1				45	10		Pendent

Buttons: Modify Step, Continue Cycle, Start Formula, Enter M.O., >H Prod<, End Step, Stop Cycle, Stop Formula, End Formula, >H Prod MO<, Print, Exit

This window shows detailed information about process and many actions can be executed.

When no formula is registered, formulation window appears empty. Therefore, the first action is *Enter M.O.* clicking on the appropriate button.

The 'Enter Manufacturing Order' dialog box contains the following fields:

M.O.: 2000 Batch: 1234 Amount: 1500
Formula: 5000 GENERIC SOLVENT
Comments:
Buttons: Accept, Cancel

After clicking, the window above comes out. Go to MO field and press enter or double click to access to Master of Manufacturing Order. Select the manufacturing order and upload indicating Batch No. and pressing Enter. In this moment, the tab is filled with formula data and a calculation in Kg for each product.

You can access from the same tab to reactor and auxiliary tank formulation. Click on appropriate figure on the upper side of the screen.

On top of the tab, there are other fields:

State. Shows state of formula: stop or executing

Kg. Indicates the amount in kg of dosage product.

Time. Indicates the remaining time in agitation processes.

At the right end of every line, there is a description of states:

Pending. Not executed yet

In process. Executing

Interrupted. The step is interrupted

Finished. The step is already done

Likewise, at the lower side of the tab there are different buttons for different actions:

Step Modification. Modify a step, select the step and then click button “Order modification”. A display comes out to change data.

End. Finish a step in process.

Continue. Continue the formula after an interruption (voluntary interruption or due to safety conditions)

Stop. Interrupt the process.

Stop Formula. Interrupt the formula. Finish step in process and do not start the following step.

Start Formula. This option starts the execution of a formula from beginning or after another step if the process was stopped.

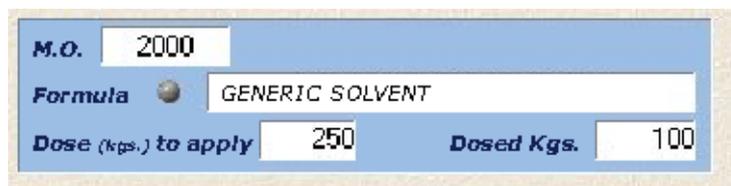


End Formula. This option ends formula in process. Clicking this button, data disappear from the screen and is registered in database of process history.

Print. Print formulation tab.

Exit. Close the window

When a reactor has a formula unloaded, a description appears on the lower side of the screen. In addition, it shows planned Kg and Real Kg of product which is being dosed.



During the process, some messages or alarms may pop up.

If an action has a message assigned, you may be prompted with it. To continue the process press Accept.



Alarms can also come out. Some of them inform and others stop or act over the process.

When an alarm goes off visual and acoustic signal are activated. You can stop them either pressing reset at electrical panel or clicking on “register” button on computer.

When a formula is in execution and the process stops –it stops when reaches a step when worker must perform an action (unload product)-, the step is marked like “In process”. It will not continue until worker gives the order. Actions to add products manually are divided in two types:

- ADD SOLIDS
- ADD ADDITIVES

On the lower side of reactor and auxiliary tank, there is an electrical panel with scales indicators and a green pilot light and a push button.

When process reaches a manual step, pilot light is switched on to indicate a worker must perform the unloading of product. As it is done, the worker must indicate it to the system. To do it, press push-button or finish the process from computer.

The criterion to register dosed kg is:

- ADD SOLID. Kg recorded are those the scale registers by difference of weight
- ADD ADDITIVE. “Planned” kg are registered by default. This data can be changed in “step modification” option in formulation tab.

To make an action (dosing) during an automatic formula, the formula must be stopped. Right click opens a window with different options; when the formula is in process, you cannot click on any options. However, you can choose any option when the formula is stopped.

You can only act over agitation process in automatic formulations. You can stop or start an agitation process clicking on motor (on computer screen).

GENERAL CONDITIONS

Here below are described detailed general conditions of system operation and other points to be considered.

Way of operation

There are two ways of operation:

Remote: Control from computer.

Local: Control from electrical panel

Use the **L/R 1** selector in control panel to select the mode. On screen will appear:

AUTOMATIC- Remote control

MANUAL- Local control

Apart from this selector (L/R 1) there are other selectors which are described below:

L/R Agitator: This selector sets agitator operational mode. In remote mode, you can control the unit from computer. In local mode, you can control the unit from potentiometer in panel next to reactor.

A/M valves/pumps: Control panel contains some selectors to start and stop the pumps. Automatic position means, the system opens the valve and then starts the pump. Manual position means that first, you must open the valve with the appropriate selector and then start the pump also by means of the appropriate selector.

A/M resin valves floor agitator. The function is set the operational mode of manual resin valves, for dosage in floor agitator. Position A (automatic) means the pump will start as valve is open and touch limit switch device. Position M means, the pump will not start even if the valve is open.

Action over components will be possible depending on Local/remote selector. Only resin pumps work separately to ease simultaneous unloading and dosage.

Valves VTR1 and VTR2 are close under normal conditions. Their operation is related to valves VR1, VR2 and VR1M, VR2M. In any of those (VR1, VR1M) or (VR2, VR2M) is open because of dosages reasons, VTR1 or VTR2 are closed.

A circuit must be open to make possible the starting of pumps,

Alarms

Alarms are visual (light) and acoustic. Acoustic signal can be stopped either pressing reset in electrical panel or clicking “register” button on computer. Visual signal remains until alarm conditions disappear.

Minimum weight security system for variator.

Load on reactor must be controlled during agitator operation as blades can be damage if agitator starts being empty. You can set weight from computer.

If you try to start the agitation, breaking the previous conditions, an alarm will go off and agitator will not start. Besides, if agitator is working and the product is being unloaded, the agitator will stop and an alarm will pop up on screen if weight drops down under minimum allowed.

Weigh variation security system

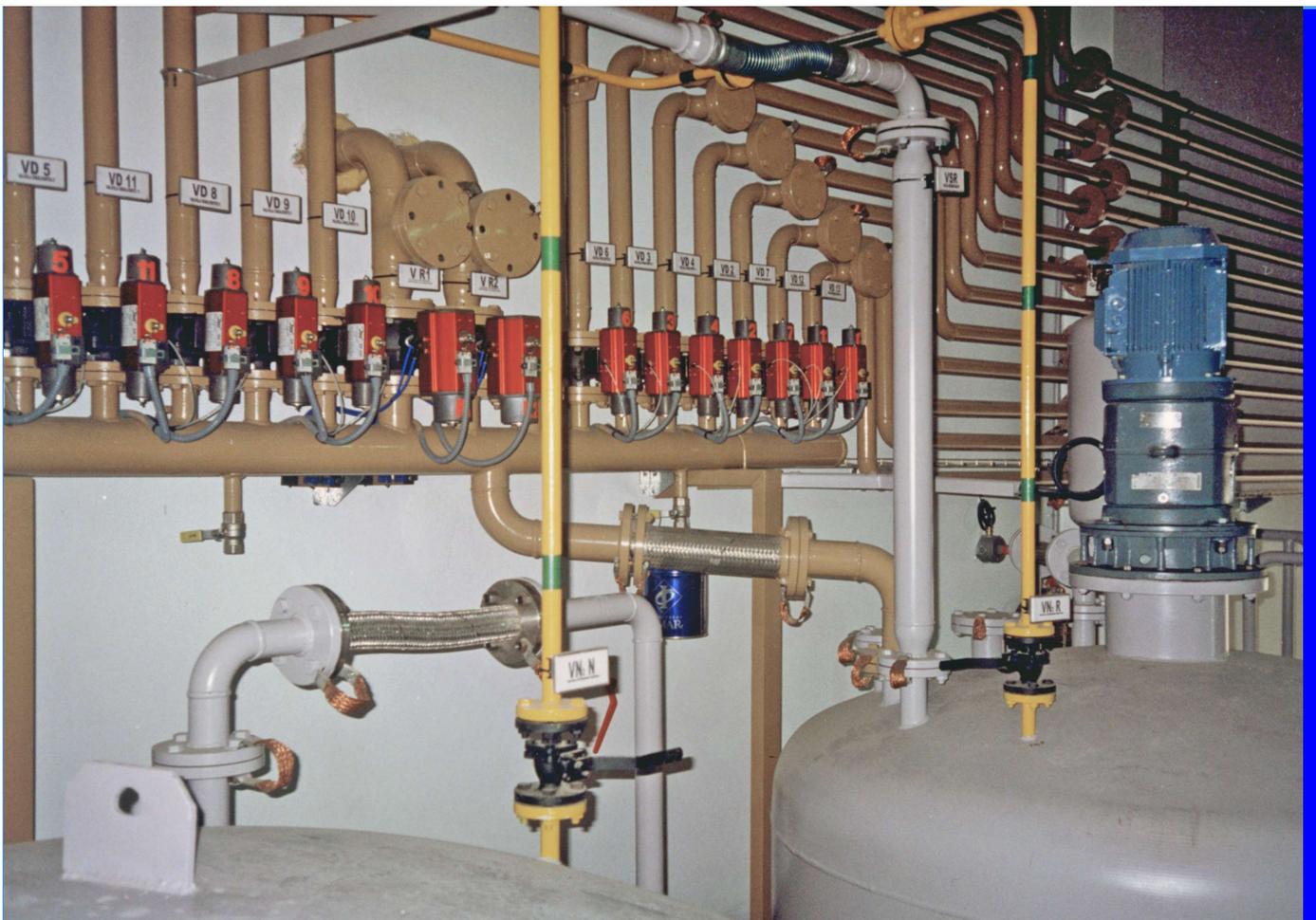
The system controls variations on weigh during dosage. When weigh does not change the process stops. Security system acts when weigh does not change within a minute.

Emergency button.

The activation of this button stops actions in process and stops/closes all components of the system



Detail of manufacturing plant



Detail of manufacturing plant



Detail of manufacturing plant



Detail of tank

Detail of Nitrogen pressurization



Isocyanate circulation



EExd control panels

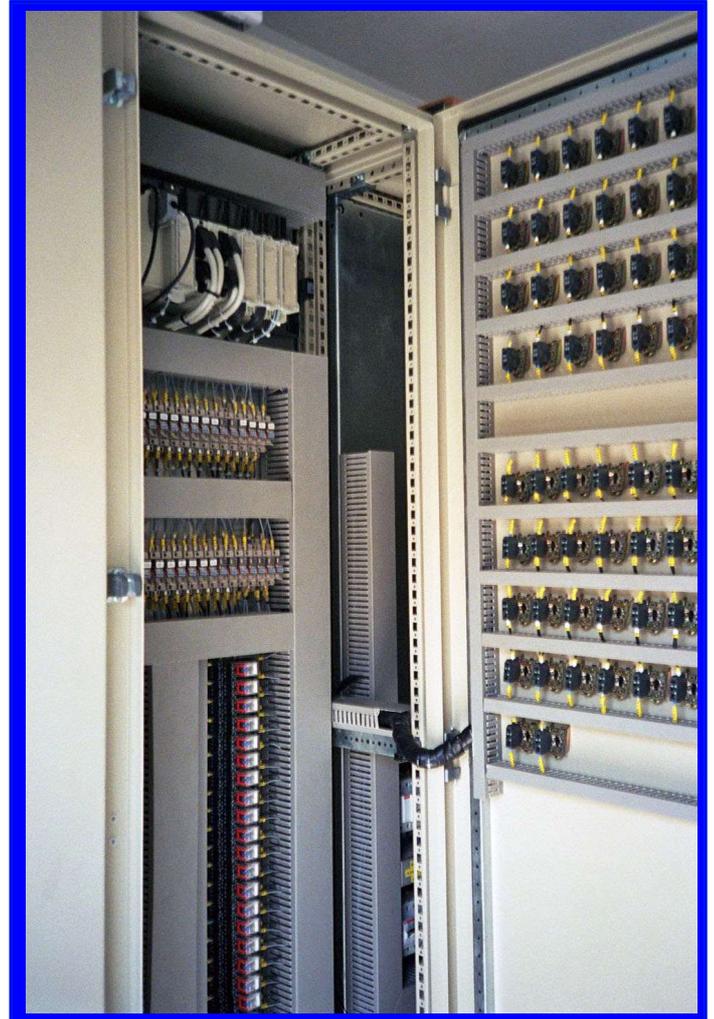


Isocyanates storage tanks

Detail of PLC panel



Detail of variator and control panel



*Detail of electrical panel
and manual setting*

