

**SPECIFICATION PREFACE SHEET**

**DEPARTMENT:** Engineering / Instrumentation

SHEET 1 OF 12

AREA: Grundartangi Reduction Plant

SPEC No: 00/07/TS011

REV:C5

**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
  
SCADA systems and HMI's**

**This Standard Technical Specification is subject to change without prior notice. The most current issue will at all times be located on the Nordural web site, [www.nordural.is](http://www.nordural.is).**

REV	BY	DATE	CHK'D	APPROVED	REVISIONS
C1	HRY	08/03/1999	GP	TMS	Issued for Construction
C2	HRY	28/09/1999		TMS	Corrected
C3	SBP	05/07/2000	HRY	TPE	Modified
C4	IMJ	2004-06-07	TDS	ÓJ	Issued for Construction
C5	IMJ/PH	2005-02-04	IMJ	ÓJ	Issued for Construction

NORÐURÁL – ENGINEERING

---

## CONTENTS

<b>SPECIFICATION PREFACE SHEET</b> .....	<b>1</b>
<b>TECHNICAL SPECIFICATION</b> .....	<b>3</b>
<b>1 INTRODUCTION</b> .....	<b>3</b>
<b>1.1 RECOMMENDED EQUIPMENT</b> .....	<b>3</b>
1.1.1 SCADA.....	3
1.1.2 HMI.....	3
1.1.3 MONITORS/SCREENS.....	4
<b>2 ACCESS SECURITY</b> .....	<b>4</b>
<b>3 MAIN MENU AND HIERARCHY</b> .....	<b>5</b>
<b>4 STANDARD SCREEN WINDOWS</b> .....	<b>5</b>
<b>5 PROCESS DISPLAYS</b> .....	<b>6</b>
<b>6 MEASURED AND PRE-SET VALUES</b> .....	<b>7</b>
6.1 EQUIPMENT CONTROL PANELS.....	7
6.2 PID AND OTHER SPECIALISED CONTROLLING DISPLAYS.....	8
6.3 ALARM SETTINGS AND SETTINGS OF PLC PARAMETERS.....	8
6.4 CONTROL AND INDICATION SYMBOLS IN GENERAL.....	9
<b>7 COLOR OF PROCESS MATERIALS</b> .....	<b>9</b>
<b>8 ALARM DISPLAYS</b> .....	<b>10</b>
<b>9 TAG NAMES</b> .....	<b>11</b>
<b>10 HELP</b> .....	<b>11</b>
<b>11 TRENDS</b> .....	<b>11</b>
<b>12 CONNECTION TO THE REAL WORLD</b> .....	<b>11</b>

## **TECHNICAL SPECIFICATION**

### **1 INTRODUCTION**

In this Document the following words and expressions shall have the meaning hereby assigned to them except where the context otherwise requires:

Engineer:

The Owner or any person or organization employed or engaged at any time by the Owner and authorized by the Owner, in writing, from time to time to act on behalf of the Owner in the execution of the items covered by this Document, in whole or in any part, for any or all purposes provided in this Technical Specification.

Owner:

Norðurál hf (Nordic Aluminum Corporation Ltd.), an independent legal entity owned by Century Aluminum.

This document forms a standard of minimum requirements for use by Contractors working on ICA (Industrial Control and Automation) systems at Norðurál. All text used in SCADA designs documentation and SCADA systems code shall be in the English language. All text displayed on the SCADA screens shall be in the Icelandic language. The standard covers engineering, equipment, testing and installation activities through each contract lifecycle from conception through to commissioning. Norðurál shall be informed, as soon as possible if the Contractor cannot follow this standard or has alternatives.

### **1.1 RECOMMENDED EQUIPMENT**

#### **1.1.1 SCADA**

The SCADA (Supervisory Control and Data Acquisition) system enables the plant engineers to have dynamic overview over operating status of all major areas and equipment of the plant.

The recommended SCADA system at Norðurál Reduction Plant is the latest version of the InTouch application from Wonderware Corporation. The system should run on Norðurál Windows 2000 or later PC Operating systems and use a central SQL database for logging data records. The I/O Server should interface the Ethernet TCP/IP PLC network of the plant and will be bridge gatewayed to the Norðurál computer Local Area Network (Ethernet TCP/IP). The Engineering department of Norðurál will host a Development Workstation on the network to Develop, Maintain and administrate the SCADA systems in general.

#### **1.1.2 HMI**

The HMI (Human Machine Interface Systems) enables the operator to perform start up and shut down of plant and equipment, operator interaction during normal operation and during upset conditions.

The HMI should provide alarming, trending, logging and maintenance information. Information should be capable of being generated automatically or on demand.

HMI features are to include:

- Dynamic color displays.
- Alarm windows.
- Message displays.
- Function keys.
- Numeric keys.
- Special keys.

The recommended HMI at Norðurál is the Allen Bradley Panelview, Color TFT touch-screen. The TFT screens may be replaced with other technologies if the other is equally immune to strong magnetic fields as the TFT.

### 1.1.3 MONITORS/SCREENS

Wherever SCADA displays and pictures are distributed along the network, to be viewed by PC-based workstations, they have to be capable of being viewed by computer screens in the resolution of 1280x1024 pixels, using 32.768 colors. .

## 2 ACCESS SECURITY

The system is to include access protection on a structured level of privilege. Facilities shall be provided against loss of system data. The access protection is to be developed in four levels of privilege. The levels configured will be capable of being modified in the future.

- Monitor access** allows the user to view process screens without being able to make any changes except setting up historical- and real time trends.
- Operator access** allows the user to view all process screens, change the state of equipment, and change the set point for controlled values and to set up historical and real-time trends.
- Engineer access** includes operator access and in addition, the right to change PID controller variables, process control parameters and system alarm settings.
- Supervisory access** the access level is used on a network level to allow access to what the operator and the engineer allow plus the InTouch network related matters. When logging on as a supervisor, an operator can get access to various keyboard functions such as windows button and ctrl-alt-del.

The current access level and/or user name shall be indicated with color and text with an indicator in the alarm and indicator window at the bottom of the screen.

Access level (a) shall be default unless otherwise specified. The operator must log in by typing his user name and password in order to gain access to the system. The system shall automatically return to default access level, 10 minutes after the last operator action.

### **3 MAIN MENU AND HIERARCHY**

The SCADA system shall contain a main menu system, with sub-menus for each production area of the plant, and further sub-menus for every equipment visible from the production area menu.

The hierarchy of the SCADA system shall be in structured way and shall be approved by the Engineer and be consistent with the HMI displays at all possible extents. The HMI system shall have a main menu that covers the machinery that the HMI controls. From the main menu and the relevant equipment control desk, there shall be sub-menus for all visible equipment. The hierarchy of the HMI system shall be the same whenever it is possible and use the same hierarchy and appearance as the SCADA system to all possible extents.

### **4 STANDARD SCREEN WINDOWS**

A standard screen consists of four windows visible at the same time. There shall be a main window or process window, with a display window visible on top, an indicator and alarm window and a button window.

The main purpose of this set-up is to have on each screen, access to all major parts of the processes in the plant, by selecting one button and within each process display, be able to select every available display within that group using easy accessible display drop down menus. Buttons can be of the nature of active icons, displaying the individual parts on the layout of the plant / process areas and operate as buttons on the display to jump to the relevant process display behind that plant icon.

- a) **The top window** is a single line window that identifies the process of equipment being controlled. This window is divided into three parts. The left part indicates where the equipment is located, e.g. **“NORÐURÁL RODDING SHOP”**. The middle part shall include the equipment being controlled, e.g. **“ANODE SHOT BLASTER”**. The right part shall display time and date on the format: **hh.mm.ss – dd.mm.yyyy**.  
The font used shall be Arial bold letters size 18 with the Norðurál blue (black) color.
- b) **The button window**, located under the top window makes it possible to select individual processes within the equipment group, a help button. The buttons for alarms and individual processes may be equipped with drop-down menus if the selection options exceed five options. Their name shall appear in letters using Arial bold and black colored font size 12.
- c) **Main process window** is used for graphical display of the process or equipment.
- d) **The indicator and alarm window** shall consist of equipment status and alarm for major processes and an overall alarm indicator. A Distributed alarm system shall show unacknowledged alarms in the system.

If an alarm occurs in any of the processes the alarm indicator will change color according to the severity of the alarm, and flash until the alarm is acknowledged.

After the acknowledgement, the alarm indicator will show its color steadily until the alarm condition returns to normal state. The color of the alarm indicator signals the highest severity of the alarm in the system at each time and when alarm signal disappears, the color shall change to other color than red/yellow.

Alarm colors are two, red that indicates severe alarm or dangerous condition, and yellow which indicates abnormal condition. In the left part of the indicator window the login privilege level is to be indicated as stated above using following statements:






- i) Monitor – with a black colored font on a white background.
- ii) Operator – with a white colored font on a green background.
- iii) Engineer – with a black colored font on a yellow background.
- iv) Supervisory – with a white colored font on a red background.

## 5 PROCESS DISPLAYS







Process display background color shall be light Grey. The process display name shall be positioned in the middle of the top window, in black Arial bold font, using letters.

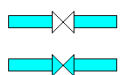
Symbol colors shall be consistent from one display to another. Green shall be used to indicate security and that equipment is running properly. Yellow and red shall indicate severity of alarms, as stated above. Symbols of white or dark Grey colors shall indicate that equipment is not running or operational.

The color of the font of the equipment ID or its outline indicates its control status. Operational status of equipment is indicated below and this shall be the color fill of the symbol:

Color of symbol	Operational status of equipment
 Green	Equipment is running properly
 White	Equipment is at standstill, but ready for operation
 Dark Grey	Equipment is not available for operation
 Yellow	Equipment is in abnormal condition
 Red	Equipment is in Alarm State

The control status of equipment is indicated as below, this shall be the outline and font of the symbol:

Font/Outline color	Operational status of equipment
  Black	Equipment is in normal automatic mode
  Blue	Equipment is in manual mode
  Red	Equipment is in test or unprotected mode

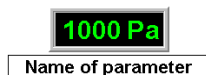
 If equipment is a part of process line/flow it will take the color of the same process line to indicate that the equipment is an active part of that process. Otherwise, its color will be white if the equipment is not active.

Where possible, use text to indicate failure of object like overheat, tripped, etc. Use red or yellow text to indicate to fault conditions for the device being indicated for. Where text is used on process displays, its font shall always be Arial, with its color in relation to the above. Normally black colored fonts on a white background shall be used in inactive text windows like comments and tag names. All text fonts shall be Arial regular or bold as best suitable. Bold has proved to be more legible.

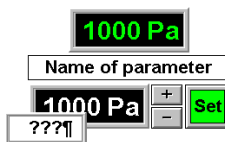
## 6 MEASURED AND PRE-SET VALUES



Measured value and its unit shall be displayed in a box. The box frame shall be a Gray colored 3-D button type. The value shall be indicated with a white font on a black background for a normal state, black font on a yellow background for warning state, and white font on a red background for Alarm State.



Pre-set value and its unit shall be displayed in a box. The box frame shall be a Gray colored 3-D button type. The value shall be indicated with a green font on a black background.



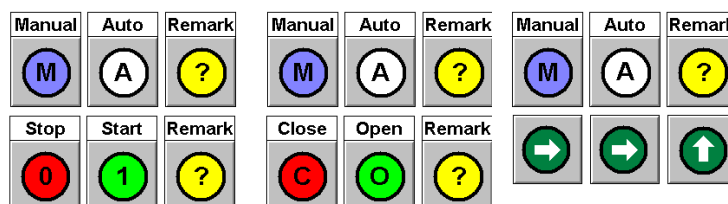
If the user has the privilege to change its settings, an adjustment pop-up screen will appear when the pre-set value window is clicked on. Then the pre-set value can be changed in another window displaying the new value with white font on a black background or directly typed in by clicking directly on the value.

When selection has been made, a green set button is required to make the changes take place.

### 6.1 EQUIPMENT CONTROL PANELS

Each individual equipment that requires more than one control button to ensure full control of it, shall be provided with it's own control panel. That control panel shall pop up by clicking on the equipment.

The control panel will first show the controls for the control status of the equipment, e.g. if it is in manual or automatic mode. In addition, certain parameters can be changed for that equipment, regardless of its control mode



If the control mode is changed, e.g. from auto to manual, the additional and exclusive manual parameters will then appear on the control panel and disappear if automatic mode is selected again. When Touchscreens are used or by other reasons necessary, a provision for acknowledgement button for the action selected might be necessary to prevent accidental selection and action. The above samples can be used as guidelines where the lower button row indicates the additional manual mode. If value of parameters needs to be changed in those pop-up control panels, the same format shall be used as stated before regarding adjustable parameters.

The color of manual buttons will be as follows:

Red	Stop/Off/Shut
Green	Start/Run/On/Open
Yellow	Abnormal condition/action
White	Automatic mode
Blue	Manual mode
Green with symbols	All other activity/action and movement of machinery

Nature of action/movement shall be indicated with the symbol and the symbol shall be according to European standards.

## 6.2 PID AND OTHER SPECIALISED CONTROLLING DISPLAYS

Where a PID or a specialized controller is displayed, it shall be explicitly indicated as a Grey box with a clear outline to distinguish it from the background. The box shall contain all the most relevant data available like the actual value, set point and output value. In the box the state of the controller shall be clearly indicated i.e. auto, manual cascaded Symbol at the top of the box will indicate by its appearance that further information is available. When it is selected, a pop-up window will appear indicating the controller's function and description of its use. In that window all alarm values and controlling parameters like e.g. proportional gain, integration time and derivative time and related adjustments shall be displayed. In addition, bar graphs showing the measured value, set point, output value with a real-time trend displaying the changes of those three values over a selected period of time.

## 6.3 ALARM SETTINGS AND SETTINGS OF PLC PARAMETERS

Where alarm settings or PLC parameters are displayed, it shall be explicitly indicated as a Grey box with a clear outline to distinguish it from the background. The box shall contain all the most relevant data available like the actual value and set point of each parameter to be set. A symbol at the top of the box will indicate by its appearance that further information is available. When it is selected, a pop-up window will appear, describing its use. The settings adjusted in such boxes will be forwarded to the relevant PLC and the requested changes reflected in the PLC source code.

## 6.4 CONTROL AND INDICATION SYMBOLS IN GENERAL








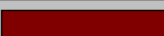
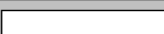
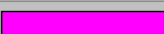
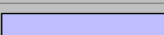
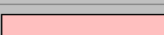
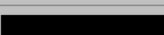
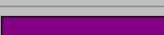

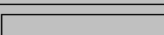
All control provisions on the process display in the form of symbols, buttons or icons shall reflect their nature as control provisions with feedback. The feedback can be in the form of minor changes of the appearance of that symbol, and ScreenTips shall be displayed where possible.

All symbols shall be made of sensible combination of preferred drawing symbols by the standard ISA 5.1, generally recognized drawing symbol standards and real-world symbolic approach. Usage of symbols is to be agreed on by the Engineer.

All process lines shall indicate their relative transport capacity e.g. a pipe of half the capacity compared to another pipe, shall appear with process line half of the wider pipe's line width. All control system lines can be displayed with single lines. All process lines shall, by their color, indicate the material they contain, as stated in the following section.

## 7 COLOR OF PROCESS MATERIALS

The following table shows standard colors for process materials and refers to color positions in InTouch color palettes.

No	Material / item	Color (Standard)	Sample	InTouch Color Palette	
				Standard Palette	Classic Colors
1	Compressed air	Gray		7,2	4,5
2	Fluidizing Air	Chyan		5,4	1,6
3	Air slide	Blue-Green		5,2	3,8
4	Potable water	Blue		3,4	1,5
5	Process/cooling water	Green		2,4	1,3
6	Diesel Fuel	Orange		–	2,4
7	LPG Fuel	Yellow		4,4	1,4
8	Hydrolic	Brown		1,2	2,1
9	Virgin Alumina	White		7,6	1,8
10	Reacted Alumina	Violet (Magenta)		–	1,7
11	Alumina Fluoride	Light Blue		3,6	–
12	Crushed Bath	Pink		1,6	–
13	Carbon dust	Black		7,1	–
14	Carbon classified	Purple		6,2	4,4
15	Fire hydrants and equipm.	Red		1,4	1,2
16	Main window background	Light Gray		7,4	4,2

## 8 ALARM DISPLAYS

When a process enters into an alarm state, an alarm indicator lamp in the lower right hand corner indicates the severity of the alarm. The appropriate equipment symbol shall change its color too, and start flashing, and a written description of the alarm appear in the alarm window in the lower right corner of the screen.

When an alarm occurs, the drop down menu or button for selection of the different plant display pages, or the page selection buttons will start to flash to enable the operator to select the correct graphic page where the alarm occurred.

All alarms shall be given a priority number on a three digit numerical format where the first digit indicates the severity of the alarm the next digit indicates the Plant Area, and the last digit indicates the engineering disciplines of the nature of the alarm. The numbers are given below:

Digit	First Digit "Severity"	Second Digit "Area"	Third Digit "Discipline"
1	Call back Message	Plant Utilities	Project
2		Administration	Civil
3		Material Handling	Structural
4		Power Electrical area	Piping
5		Reduction area	Mechanical
6		Anode Production	Electrical
7	Alarm state. Stand By	Metal Casting	Instrumentation
8	Alarm state yellow Warning	Environmental	Building services
9	Alarm state red. Severe.	New Projects	Architectural
0	Test	General	Process

Example: Number 936 reads as Severe Alarm state at the Material Handling area and the problem is of an Electrical Nature. It is admitted that some items at the list above, look absurd from the ICA point of view but this coding is intended to serve as a general Paging system for the Norðurál and the SCADA system must comply to that.

Upon selecting the alarm button the alarm log window shall appear. From this window the operator will be able to acknowledge a selected alarm. The alarm window shall show the state of every alarm in the system or predefined groups of alarm. The selection of alarm groups shall reflect the functional structure of the plant and is to be approved by the Engineer.

All alarms shall be logged in a special alarm log file, in a chronological order. It is required to save the Alarm Log file to the local (plant's) SQL database so it can be retrieved if the system fails to save this log file. The system time shall be synchronized with a master clock and it shall be possible to resynchronize system time without a total system shut down. Automatic time resynchronization at operator set periods is required.

## **9 TAG NAMES**

Tag names shall describe the measured value in the best suitable way. Each tag name shall be structured with a facility code and a process code as described in the Norðurál Standard Technical Specification NA-00-07-TS009.

## **10 HELP**

If “on screen help” is needed to indicate purpose and type of equipment, or where applicable, use balloon help text. A help button “F1” shall be included for each application. It must be easy to add more help text into the available “on screen help”.

The Help section describes the system controlled by the SCADA system. This help shall be configured by using the well-recognized HTML language with links to easily maintainable text files containing the help texts.

## **11 TRENDS**

The SCADA system shall have one main historical trend screen page and smaller pop up windows showing trends where appropriate to display trends and in appropriate time scale. All information and data to be displayed by the main Trend display shall be recorded to the SQL database and read from there when the data is requested by the Trend display.

On the main historical trend screen the operator shall be able of selecting the parameter(s) to be displayed on the trend, the units and range and the time span. It shall be made easy for the operator to zoom in on narrow time frames and zoom out to wide time frames on the screen, and in addition, for the operator to go back in time and look up previous measurements.

## **12 CONNECTION TO THE REAL WORLD**

The SCADA system will use TCP/IP protocol carried by an Ethernet network with 10 base T (CAT 5) and 10 base FL optic (fibre optic) methods. Norðurál uses a fibre optic star configured network and will provide transceivers to make conversion to 10 base T cables where needed. The HMIs will generally be connected directly to the PLCs using a serial connection. Communication to the PLCs should be set up carefully to make the best use of the communication link. The connection between every PLC and the SCADA system has to be monitored.

The SCADA and the HMI shall read their data from data file tables, specially configured in the PLCs for exclusive use of the systems. This provision is to be made so the SCADA system can transfer the data of the requested tags from one data table per block request instead of looking up the tags in two tables with two block requests.

Those data tables shall reflect the status of the actual working data tables of the PLC. All provisions must be made to filter the data as necessary in those tables by sending average values over a period of time to the SCADA system instead of a continuous stream of the same data. Filtering of abnormal transient changes of data shall be provided with respect to normal

rate of changes of that same data. Methods of filtering shall be submitted to the engineer for approval before any decision is made. All configurations of the above mentioned data tables and filtering must comply with Norðurál Standard Technical Specification NA-00-07-TS009.