SPECIFICATION PREFACE SHEET

DEPARTMENT: Engineering / Electrical	SHEET 1 OF 10	
AREA: Norðurál Grundartangi Reduction Plant	SPEC No: 00/07/TS005	REV: C2

STANDARD TECHNICAL SPECIFICATION FOR INSTRUMENTATION

CONTROL SYSTEM INSTRUMENTATION

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.

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C2	IMJ	29.3.2004	TDS	ÓJ	Issued for Construction

NORÐURÁL - ENGINEERING

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TECHNICAL SPECIFICATION

1.0 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.

2.0 GENERAL

In general solid state electronic control equipment shall be provided for all process control functions other than actuation. Actuation may be either electric, pneumatic or hydraulic as appropriate to the duty unless otherwise specified, however a consistent policy of supply and actuator type shall be adopted throughout the project as far as is practically possible.

The system shall be modular in nature and shall contain a minimum of different types of module to ensure minimum spare holding and simplification of maintenance requirements and procedures.

A unified system shall be provided, including compatible measurement transducers, transmitters, control elements, indicators, control initiating devices and recorders, which shall be the standard range offered by a supplier of International standing. The equipment shall be well tried and have had application in similar systems, been available on the open market for at least 2-3 years, be guaranteed support for a minimum of 10 years and be to the approval of the Engineer.

Where equipment of alternative supply is included due to unavailability within proposed major range, this shall be clearly identified and the reasons for its inclusion given.

If the proposed actuation system is not included within the scope of the main control equipment range, the Tenderer shall ensure that the two equipment are fully compatible

and shall include references of similar application in which his control equipment/actuator systems have been used.

All panel and desk mounted instruments/displays and their arrangement shall be to the approval of the Engineer.

The aim of the system design shall be two fold:-

(a) To maximise the safety of plant operation and protection of operating personnel.

(b) To ensure maximum plant availability is obtained within the constraints of safe operation.

Under all conditions of failure, plant regulators shall be moved to or remain at a safe position.

In the context of control instrumentation, not only the requirements for modulating control but also the requirements for sequence and plant protection must be considered. In many major plants these two requirements considerably interact with one another, e.g. a regulator which is used for controlling during normal process operation may have to be shut during start of the fan motor and thus will be under the control of two different systems at different times in its operation.

In the past the two systems have always been completely separate and often supplied by different manufacturers.

This can result in problems of interfacing and also changeover especially from interlock to modulating system. These problems are especially prevalent in the power industry and have been recognised by some of the major international manufacturers. The result is that there are now well-tried systems on the market that combine the functions of modulating and sequence/interlock control. These systems contain both modulating and logic units and there are no problems in changeover. Due to careful design the number of different types of module is minimised and thus spares holding is reduced and maintenance procedures simplified. In addition system tests at works can be much more comprehensive.

It is therefore the aim of these specifications when applied to large systems to obtain a consistent product range throughout both types of control system. Naturally this only applies where fully electronic systems are used and in the case of pneumatic control this is not feasible with available equipment.

The following specifications therefore offer several alternatives to be chosen to suit the application in question.

The alternatives are as follows:-

(a) Large systems with fully electronic control using the modern combined system.

b) All sizes of system using either electronic or pneumatic control but with separate sequence interlock systems in which the logic control may either be solid state or relay type.

(c) Smaller power systems, or possibly some larger petro- chemical or chemical projects, where pneumatic controls are specified possibly for intrinsic safety reasons.

2.0 ELECTRONIC CONTROL SYSTEM

The control system hardware shall have a modular structure consisting of a range of standard plug-in units. The units shall be mounted in 490 mm racks conforming to IEC Standards unless otherwise agreed. The location of the plug-in units within the racks shall follow a logical pattern and all controls and test points for process control and system supervision shall be accessible from the front of the rack not necessitating the removal of the module.

Power regulation within each module shall be provided and adequate power supply redundancy shall be provided to ensure no single fault shall cause total loss of supplies.

A control system offering fully compatible modules for modulating, sequence and interlocking functions within the same range shall be provided.

All control signals for intermodule communication shall be directly wired and conform to a standard signal regime.

The controllers shall have a standard signal interface giving a facility for external guidance adjustment and monitoring of the principal control parameters. These shall include control set point, proportional gain, integral time constants, derivative time constants and any other characteristic variable of the controller requiring on-line adjustment to achieve satisfactory control response.

The signal conditioning of all analogue and switched signal inputs to the system shall monitor open and short circuit fault conditions and incorporate suitable filters and electrical isolation to avoid interference and damage resulting from noise pick-up from external sources and earth loop currents.

The system shall incorporate well-developed fault diagnostic features. These shall flag all common internal system fault conditions to allow the appropriate corrective response to be initiated and to facilitate maintenance.

Auto/manual stations shall be provided with automatic tracking and bumpless transfer facilities.

Apart from transmitters and local amplifiers all electronic equipment shall be located in the equipment rooms, Central Control Room or local control room areas. Exceptions shall require the approval of the Engineer.

The equipment rooms, Central Control Room and local control room areas will be air-conditioned. However, the equipment shall be capable of sensible drift-free operation throughout an ambient temperature range between 0°C to 50°C and relative humidity range 15% to 85% and under the most onerous site conditions in the event of air-conditioning failure.

Field mounted equipment shall be protected against moisture and dust by strong and robust cases and where possible be hermetically sealed. It shall be capable of operating throughout an ambient temperature range between –10°C and 55°C and relative humidity range of 5% to 95%.

The identification of components in boards shall comply with an approved International Standard and the Engineer shall approve the identification of individual boards.

3.0 PNEUMATIC CONTROL SYSTEMS

Pneumatic control equipment shall be of modern design, built on a modular basis with front presentation units suitable for mounting directly on an operator's control panel or alternatively supplied with separate presentation unit with control generation and signal conditioning equipment suitable for separate rack mounting.

The system supplied shall contain within its range at least modules for two or three term control, addition and subtraction of signals, signal selection, ratio manipulation of signals, multiplication of signals, master and slave automated stations, recorders,

integrators, indicators and square root extractors. Systems exhibiting bumpless transfer from manual to automatic and vice versa should be used.

Where pneumatic controls are provided two sets of air filter and pressure-reducing equipment shall be provided to supply air to a header on which valves shall be fitted to enable individual instruments to be isolated. Headers/systems supplying air at reduced pressure directly to instruments shall be provided with a safety relief valve of appropriate set pressure. Header air supply "take-off" connections shall be from the top of the pipework. Lower elevation points shall be fitted with drain valves.

All instrument air supply piping shall be of N.B. seamless steel electro-galvanized construction as a minimum requirement, and a ring main system should be used.

Piping fittings shall also be of steel and electro-galvanized.

For reasons of mechanical strength, the air supply ring main and headers on pipe tracks shall have a minimum size of 2 inches N.B. or equivalent.

For connections of pipe sizes less than 2" N.B. screwed taper threads are acceptable. For larger sizes flanged type of connections should be used.

The size of the distribution pipes shall depend on the number of users along with their individual consumption and shall conform to the following as a general requirement.

Number of Users	**Pipe Sizes**
1 - 5	1/2 in. N.B.
6 - 20	1 in. N.B.
21 - 50	1 1/2 in. N.B.
51 - 100	2 in. N.B.
101 - 200	3 in. N.B.

Pipe sizes of metric equivalent are acceptable.

At least 15% spare branches 1/2 in. N.B. or equal shall be provided, evenly distributed through the plant area.

All distribution valves and individual isolating valves should be of bronze or brass construction globe type.

Use of underground air supply lines shall only be by agreement and discretion of the Engineer.

The route(s) selected for pneumatic signal lines shall be as short as possible.

Pneumatic signal lines shall be connected as soon as feasible to multi-tube bundles via marshalling boxes of approved design.

A spare capacity of approximately 10% for multi-tube bundle and marshalling boxes shall be catered for in all cases.

Pneumatic signal tubing shall be of 6,0 mm (metric) or 0,25 in. (Imperial) minimum O.D. with wall thickness of 20 SWG or equivalent.

Tubing to individual instruments, in the field, shall be in copper and sheathed in PVC, unless otherwise agreed.

Multi-tube bundles, where applicable, should have individual tubes of copper with PVC sheath overall, and where installation runs are exposed to conditions of likely damage it shall also be served with SWA/PVC overall. Multi-bundles of plastic tubes shall be considered an acceptable alternative providing they are in all cases served PVC/SWA/PVC overall.

All compression fittings shall be of an approved manufacture.

All tubing shall be adequately supported on brackets and tray runs.

All tubing shell be rated for higher ambient temperatures then might be expected in worst case along their conduit route and approved by the engineer prior to installation.

4.0 GENERAL REQUIREMENTS FOR PROTECTION AND SEQUENCE INTERLOCK CONTROLS

Although these two systems may be considered separately during engineering, it is a requirement of this specification that a consistent design approach is maintained on both systems with respect to failure philosophy, signal levels and equipment used.

Unless otherwise specified the equipment offered shall either be solid state electronics or relay based and its design shall comply with the following general requirements:

(a) Suitable measuring devices shall be installed on all plant to give warning of all abnormal conditions and in addition suitable status indications shall be made available on all plant connected with sequence control systems.

(b) A common signal level for plant status signals, tripping and start signals shall be used throughout the plant. The signal level chosen shall be a single voltage within the range of 22 to 50 V dc.

(c) As well as automatic action to safeguard plant in abnormal conditions suitable visual and/or audible warning shall be given to the operator.

(d) Generally the presence of a signal shall represent a healthy state of the parameter.

(e) In cases where a system may assume two healthy states each state shall be represented by a signal and the absence of one shall not be taken to indicate the presence of the second.

(f) Systems protecting the safety of the plant by causing tripping action shall always be arranged on a de-energise to trip basis.

(g) In sequential control operation, the initiation of an operating command shall not be taken as evidence that the command is completed. The result of the action shall be suitably monitored before further progression of the sequence is allowed to occur.

(h) When an overall trip of the plant may occur following the detection of a certain plant state, three independent and separate measurements of the plant state shall be made and tripping action shall occur when at least two out of three measurements indicate a trip.

(i) The design of the system on safety protection systems shall incorporate sufficient redundancy or alternatively circuit monitoring to ensure high reliability and to reduce the likelihood of spurious trips. This shall apply to both relay and solid state systems.

(j) Where initiating contacts are provided to signal the state of any parameter these shall be volt-free changeover contacts and wired to a local terminal block or marshalling box.

(k) Where initiating contacts are power operated they shall be arranged to fail to the fault conditions on loss of power.

Emergency shutdown functions shall be in all cases hardwired and shall not under any circumstances rely on software derived interlocking for the safe shutdown of equipment. Interfacing to electronic systems shall be for alarm/monitoring purposes only.

Where hardwired interlocks are considered necessary for safety reasons or to prevent mechanical damage to machinery, they should be installed.