ELECTRO EYE-HYE SYSTEM

LOW WATER LEVEL LIMIT CONTROLS

from

CLARK-RELIANCE CORP.

16633 FOLTZ INDUSTRIAL PARKWAY

STRONGSVILLE, OHIO 44136

J.I. 2N2A5.AF
(7710)

JULY 20, 1989

Factory Mutual Research

1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, Massachusetts 02062

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I INTRODUCTION

1.1 Clark-Reliance Corp. requested approval of their Electro Eye-Hye System for low water level limit control. The system may be used to activate alarms, fuel cutout systems and/or pumps when liquid levels in boilers or tanks reach a predetermined level.

1.2 These limit controls will appear in the Fuel and Combustion Controls section of the Factory Mutual Research Approval Guide under the heading, Boiler Water-Level Controls, as follows:

Models ELxxxx-10,-12,-20 Electrolev water columns.
x = Pressure rating 450 to 3000 psi (3.1 to 20.7 MPa) WSP
Models ECIL-10,-12,-20 control units with auxiliary dry contacts rated at 5 amps.

1.3 Examination and tests were in accordance with the requirements of Factory Mutual Research Class 7710, Standard for Low Water Level Limit Controls for Boilers.

II DESCRIPTION

2.1 General - The Electro Eye-Hye System is an all electric liquid level gage. It is used to activate or deactivate alarms, fuel cutout circuits and feed water pumps when liquid levels reach pre-determined limits. Level is sensed by conductivity type probes in the water column which in turn actuate control relays thereby changing the state of the relay load contacts and the state of the indicator lights. The indicator lights are either single color, illuminated red for water, or bi-color, illuminated red for steam and green for water. Standard offerings are columns with 10, 12 or 20 probes along with a corresponding number of control relays and indicator lights.

2.2 Probes - Four probe models are available, T, V, ZG and FG. Pressure ratings for these probes are 450 psi (2.7 MPa), 1000 psi (6.9 MPa), 1800 psi (12.4 MPa) and 3000 psi (20.7 MPa), respectively. The body of the probe is

constructed of stainless steel. The center electrode is of stainless steel for Models T and V, inconel for Models ZG and FG. Wetted insulating material is Teflon for Models T and V, zirconium oxide for Models ZG and FG.

2.3 Water Columns - The water columns are constructed of seamless steel pipe and can be supplied with any number of probes from 1 to 20. Standard offerings are 10, 12 or 20 probe columns. Probe spacing, steam and water centers and column length are specified by the end user.

2.4 Control Units - Each probe is connected to a separate Model ECID solid state control unit. The control unit provides a nominal 12 Vac to the probes from a nominal 115 Vac supply. In addition, the control unit provides two sets of normally open and normally closed, non-powered contacts with a load rating of 5 A. One set of contacts is used to operate the level indicator lamps, the other set is used for auxiliary functions such as alarms or fuel cut-off. These controls plug into eleven pin sockets mounted on a circuit board. A transformer, wired into the circuit board, provides a nominal 24 Vac, through the control unit, to the indicator lamps. The circuit board, transformer and terminal strips for probes, indicator lamps and auxiliary functions are mounted in either metallic or non-metallic enclosures with various environmental protection ratings. Three sensitivites are avalable, 26K, 50K and 100K ohms (38, 20 and 10 micro-mho conductivity).

2.5 Indicators - Indicator panels containing 10, 12 or 20 lamps are available in three basic types; standard, miniature and subminiature. The standard type utilizes tungsten wire lamps whereas the other two types utilize LED lamps. The single color indicators are illuminated red at and below the actual water level. Miniature and sub-miniature panels are available with bi-color lamps that are illuminated green for water and red for steam. Numbers are engraved into the indicator faceplates, corresponding to probe location in plus or minus inches from normal liquid level.

III MARKINGS

3.1 A metal nameplate permanently attached to each water column denotes the manufacturer's name and address, model number, serial number and pressure rating.

3.2 A metal nameplate, permanently attached to the cover of the control unit housing, denotes the manufacturer's name and address, trademark, model number, serial number, voltage, current and power consumption.

3.3 An adhesive backed vinyl coated aluminum foil label depicting the FM APPROVFD diamond is attached to the cover of the control unit enclosure.

IV EXAMINATION AND TESTS

Note: The applicable section of FMRC Class 7710, standard for Low Water Level Limit Controls is referenced at the end of each paragraph.

4.1 One sample each of a Model ELF3000-12 water column, Model ECIL-12 control unit, Model STI-12 indicator and a Model MTI-12B indicator were submitted for examination and tests at the Factory Mutual Research facilities in Norwood, MA. Examination showed that the samples were constructed in accordance with the manufacturer's drawings and specifications. (Section 2.3)

4.2 Operational and accuracy tests were conducted by measuring the actual trip level for each of the 12 probes in the sample water column. The results were compared with the specified trip levels from normal water level. Trip point deviations, from specified levels, ranged fom 0 to 1/8 in. There was no detectable difference in trip points with increasing or decreasing water level nor was there any detectable non-repeatability. These results comply with the requirement that a limit control will operate within $\pm$ 1/4 in. of the specified trip point. (Section 5.8)

4.3 Control unit sensitivity was checked by connecting a resistance decade box in series with a sample probe. The resistance was decreased until the control unit actuated. The sensitivity was found to be 61.6K ohms (16.2 micro-mho conductivity), showing greater sensitivity than the nominal 50K ohm specification. (Section 5.1)

4.4 The Models STI-12 and MTI-12B indicator panels were operationally tested in conjunction with the water column and the control unit. Both panels operated satisfactorily in accordance with the manufacturer's specifications. (Section 5.1)

4.5 The auxiliary contacts, in the control units, operated properly and in accordance with contact status markings. Contact status changed in accordance with specifications when the associated probes were activated. (Section 5.1)

4.6 The control unit, water column, indicator panel system operated properly at 85% and 110% of nominal supply voltage. (Section 5.9)

4.7 The control unit, water column, indicator panel system was subjected to at least 5000 operational cycles. There was no failure of the system nor was there any significant change in operating characteristics. (Section 5.7)

4.8 The ECIL-12 control unit was conditioned for at least four hours each at temperatures of 35°F (2°C) and 140°F (60°C). The unit functioned properly at each temperature and upon return to normal room temperature. (Section 5.3)

4.9 A dielectric breakdown test was conducted by applying 1240 Vac, for 1 minute, between the shorted input terminals and ground. There was no evidence of arcing or breakdown. (Section 5.5)

4.10 The ELF3000-12 water column was pressurized to 150% of its rated operating pressure for 10 minutes. There was no failure nor was there any evidence of leakage. (Section 5.4)

4.11 A sample of an ECID-18 transformer was subjected to a transformer fault test by short circuiting the secondary windings and then applying 120 Vac to the primary windings. A circuit breaker, protecting the transformer, opened 5.7 seconds after energization. There was no emission of flame or molten particles, no explosion causing enclosure rupture and no infringement of protection against electrical shock. (Section 7.0, FMR Class 3820, Standard for Electrical Utilization Equipment.)

V REMARKS

5.1 This equipment shall be installed, operated and maintained only in accordance with the manufacturer's instructions.

5.2 Factory Mutual Research Approval applies only to the low water level limit function of this system. Accordingly, the control units must be supplied with a terminal strip connected to the auxiliary dry contacts.

5.3 As a low water limit, this system shall be used only in conjunction with fuel safety shutoff valves that require manual reset.

VI FACILITIES AND PROCEDURES AUDIT

The low water level limit controls listed in Paragraph 1.2 of this report are manufactured in Strongsville, Ohio. An audit of this facility was conducted on Janaury 18, 1988 under J.I. 2N7M9.AF. The results of this audit were satisfactory.

VII MANUFACTURER'S RESPONSIBLITY

As part of the listing requirements, Factory Mutual Research requires assurance that subsequent units produced will present the same quality and reliability as previously examined. The manufacturer shall maintain a Quality Assurance Program which includes as a minimum: incoming inspection and testing, in-process inspection and testing, final inspection and testing, equipment calibration, and drawing change control. The specific procedures used to control quality are best determined by the manufacturer.

VIII DOCUMENTATION FILE

A documentation file is attached.

IX CONCLUSION

The low water level limit controls listed in Paragraph 1.2 of this report meet Factory Mutual Research Corporation approval requirements. Approval is effective when the Approval Agreement is signed and received by Factory Mutual Research Corporation.

ATTACHMENTS: Documentation File
Electro Eye-Hye System Brochure

ORIGINAL DATA: Test Notebook No. 87-456

EXAMINATION AND TESTS BY: J. A. Gutauskas and J. R. Qualey

REPORT BY:

J. A. Gutauskas
Project Engineer, Fuels Section

REVIEWED BY:

D. R. Knight
Manager, Fuels Section

JAC/mg

DOCUMENTATION FILE

The following documents/information are on file at Factory Mutual Reearch Corporation. No change to this information is permitted without prior written consent of FMRC. Requests for changes must be submitted to FMRC on Form 797, Approved Product-Revision Report. Unauthorized changes may result in withdrawal of Approval.

1. Drawings

Description	Number	Rev.	Date
ECIL-10 Control Unit	EC-1314-B	1	6/8/89
ECIL-12 Control Unit	EC-1320-B	1	5/31/89
ECIL-20 Control Unit	EC-1341-C	1	6/8/89
Electrolev Assy.	B-9043	11	12/12/85
Electrolev Assy.	B-9122	7	5/20/86
FM Label	MS-7047-A	-	6/29/89
Type V Electrode Assy.	B-8903	22	1/28/88
Type T Electrode Assy.	EA-1000-B	1	1/28/88
Type ZG Electrode Assy.	AB-18600	9	1/27/88
Type FG Electrode Assy.	AB-18603	9	1/27/88
MTI-10B Indicator Assy.	EI-1035-A	1	7/12/88
STI-20 Indicator Assy.	EI-1042-B	-	7/15/87
MTI-12B Indicator Assy.	EI-1036-A	1	7/12/88
SMI-20B Indicator Assy.	EI-1030-A	-	8/28/86
Field Wiring, Standard Indicators	EI-7031-A	-	7/16/87
Field Wiring, Miniature Indicators	EI-7025-A	-	11/17/86
Field Wiring, Sub-miniature Indicators	EI-7017-B	1	8/22/88

2. Documentation

Electro Eye-Hye System Brochure
Electro Eye-Hye Installation and Maintenance Instructions, Form 539B
Water Column Nameplate Sample
Probe Installation Instructions, Form E-101-A
Hydrostatic Test Procedure, MPS-1001, 2/18/80
ZG and FG Probe Test Procedure, Form TP-114, 1/4/82
Installation and Specifications, Model ECID Controls, Form E-137-A, 11/88
U.L. Listing, Model ECID Controls, File No. E121297, 10/4/88
Stancor Transformer Specifications
Water Column Model No. Code
Control Unit Housing Mat'l, Modor Products
Buss Fuseblocks, Series 8000, Catalog Cut
Reed Devices Inc., Relay Socket and Terminal Strip Specifications

Factory Mutual System

Factory Mutual Research

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APPROVAL AGREEMENT

The Agreement is made by and between Factory Mutual Research Corporation, (herein called FMRC), and Clark-Reliance Corp., Strongsville, OH 44136 (herein called the Client). The Client is making a product or providing a service known and described as:

Addition of ECIL-10R & ECIL12R

Control Units

to Current Listings

This product or service has been examined by FMRC as described in the report bearing Job Identification 1Z0A1.AF , dated June 28, 1995

In consideration of FMRC Approval of the product or service the Client is authorized to indicate such approval, as stated by the above report, and agrees to the following and terms stated on the reverse side of this Agreement:

1. The Client shall place a unique identification mark (i.e. model or type number) on the product as stated in the above report and shall not place this mark on any other product unless covered by separate agreement with FMRC.

2. The Client shall use the FMRC Approval mark on the product, but shall not use this mark on any other product unless such other product is covered by separate agreement with FMRC.

3. The Client shall not use, reproduce or distribute the above referenced report by FMRC except in its entirety without any change, deletion or addition thereto. The Client agrees that FMRC may distribute the referenced report and related information within the Factory Mutual System.

(SEE OVER)

CLARK RELIANCE CORPORATION
Client

Allan R Goellner
Signature

ALLAN GOELLNER
Name

VICE PRESIDENT
Title

16633 FOLTZ INDUSTRIAL PKWY.
Address

STRONGSVILLE, OH. 44136
Date

FACTORY MUTUAL RESEARCH CORPORATION

R. L. Martell
Signature

R. L. Martell
Name

Asst. V. P. - Approvals Division
Title

July 26, 1995
Date

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4. The Client shall assume full responsibility for the design, material, workmanship and operation of the product or the quality of the service rendered and agrees to hold harmless and indemnify FMRC from any claims and liability to the Client or others for any kind or type of injury or damage, including without limitation, loss of earnings or profits, caused by or in any way connected with any of the services rendered by FMRC, or arising out of any defect, accident, damage or injury related to the product or service referenced herein.

5. The Client shall manufacture the product or provide the service as approved by FMRC and no changes of any nature shall be made in the product or service unless notice of the proposed change has been given and written authorization obtained from FMRC. Client agrees to make full and immediate written disclosure to FMRC of all information concerning any defect in or potential hazard of the product or service referenced herein. Failure to provide such notification of changes or defects may result in suspension or withdrawal of FMRC Approval.

6. The Client shall (1) provide the user with adequate instructions for the proper installation, maintenance, and operation of the product; (2) provide adequate facilities for repair of the product and supply replacement parts; (3) provide services to ensure proper installation, inspection or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection or maintenance.

7. The Client shall permit periodic unannounced audits of the manufacturing facilities and quality control procedures for the approved product or unannounced audits of the service locations by FMRC or its representative and shall furnish samples of the approved product for re-examination on request.

8. The Client shall manufacture the product or provide the service only at locations audited by FMRC or its representative and manufacture of products bearing the Factory Mutual Approval mark shall not be done at any other location without prior written authorization by FMRC.

9. The Client shall pay within 30 days after date of invoice the costs of Approval, audit, and subsequent re-inspection, re-examination and listing as a condition of continued Approval.

10. FMRC Approval does not imply or express any warranty of any kind with respect to the Client's product or service, and FMRC assumes no responsibility for defects, failure in service or patent infringement.

11. FMRC reserves the right in its sole judgment to change or revise its standards, criteria, methods or procedures.

12. Approval may be withdrawn by FMRC due to unsatisfactory performance, unsatisfactory results in meeting requirements of re-examination, unsatisfactory quality control, or for violation of or non-compliance with any part of this Agreement. The Client may at any time withdraw from the terms of this Agreement by so notifying FMRC in writing. Regardless of whether withdrawal is made by FMRC or the Client all activities that would indicate or imply Approval shall be immediately discontinued by the Client unless otherwise agreed to in writing by FMRC. FMRC reserves the right to notify the public in general and/or any appropriate party if in its sole judgment the product or service is found to present an unusual danger or hazard.

13. This Agreement is not transferable to another party without prior written authorization by FMRC.