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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION
FOR
TRANSFORMER RECTIFIER
FOR
IMPRESSED CURRENT
CATHODIC PROTECTION SYSTEM

SECOND EDITION

DECEMBER, 2015

THIS SPECIFICATION IS THE PROPERTY OF NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED TO THE OWNER. NEITHER WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF THE NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY.

IN THE NAME OF GOD**FOREWORD**

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and compiled.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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1. SCOPE

This Specification covers the minimum technical requirements for design, manufacture, quality control, finishing and testing of indoor or outdoor Transformer Rectifiers for impressed current Cathodic Protection which shall be installed in refineries and pipelines under the service conditions stated in related data sheet which shall comply with NIOEC-SP-00-11.

If another DC power supply (solar, wind, ...) with related switching/pulse type is selected instead of Transformer Rectifier, the designer should replace this Specification with proper related one approved by NIOEC. This Specification is a complimentary document for Cathodic Protection Specification (NIOEC-SP-80-24).

Deviations from this Specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IPS and the international standards, shall be made through written consent and approval of NIOEC.

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor /Contractor.

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

<u>IEC 60051</u>	"Direct acting indicating analogue electrical measuring instruments and their accessories"
<u>IEC 60076</u>	"Power Transformers"
<u>IEC 60146-1-1</u>	"Semiconductor convertors - General requirements and line commutated convertors - Part 1-1: Specifications of basic requirements"
<u>IEC 60146- 2</u>	"Semiconductor convertors - Part 2: Self-commutated semiconductor convertors including direct d.c. convertors".
<u>IEC 60146-3</u>	"Semiconductor convertors. Part 3: Semiconductor direct d.c. convertors (d.c. chopper convertors)"
<u>IEC 60269-1</u>	"Low Voltage Fuses- Part 1: General requirements"
<u>IEC 60296</u>	"Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear"

<u>IEC 60445</u>	"Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors"
<u>IEC 60464</u>	"Specification for Insulating Varnishes Containing Solvent"
<u>IEC 60947</u>	"Low Voltage Switchgear and Controlgear"
<u>IEC 61869-2</u>	"Instrument transformers - Part 2: Additional requirements for current transformers"

NIOEC-SP (NIOEC SPECIFICATIONS)

- NIOEC-SP-00-10 NIOEC Specification for units
- NIOEC-SP-00-11 NIOEC Specification for site conditions
- NIOEC-SP-80-24 NIOEC Specification for cathodic protection

3. UNITS

International system of units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. BASIC DESIGN AND CONSTRUCTION**4.1. General**

- 4.1.1** Environmental conditions shall comply with NIOEC-SP-00-11 requirement.
- 4.1.2** The total required current for cathodic protection which should be provided by rectifier and also the required corresponding voltage shall be calculated by corrosion specialists with regarding to design parameters such as anode type, soil resistance, coating material and etc.
- 4.1.3** The transformer rectifier units shall comprise a main transformer and a rectifier with output regulation equipment. They shall all be installed either in a welded weatherproof steel tank for oil filled or in a standard weather proof steel cabinet, in case of dry type transformers. For Transformer Rectifier Data Sheet see Appendix A .
- 4.1.4** The transformer rectifier unit shall be installed in non hazardous areas.
- 4.1.5** The unit shall be suitable for continuous operation of at least 20 years.
- 4.1.6** The degree of ingress protection of equipment enclosure shall comply with requirement in data sheet in Appendix A.

- 4.1.7 The cathodic protection system shall be compatible with the grounding system as per BS 7430.
- 4.1.8 Available power will be 400 volts, three phase, 50 Hz and/or 230 volts, single phase, 50Hz.
- 4.1.9 The power to the transformer rectifier will be supplied from nearby substation.
- 4.1.10 Free standing, wall or pole mounting are acceptable for Transformer Rectifier.
- 4.1.11 For pipeline projects, a suitable system for monitoring required parameters of all Cathodic Protection Stations shall be considered.

4.2 Main Transformer

- 4.2.1 The main transformer shall be a double wound type in accordance with IEC 60076, suitable for connection to a supply system rated at voltage and current given in data sheet .
- 4.2.2 The primary and secondary windings of the transformer shall be separated by an earthed metallic shield.
- 4.2.3 Suitable surge protectors shall be provided at the input of transformer
- 4.2.4 The Oil immersed type transformer shall be supplied with the first complete filling of oil which shall comply with the requirements of IEC 60296.
- 4.2.5 The Oil immersed type transformer shall be supplied complete with silicagel breather, steel channel under base, oil sight gauge, oil filler with cap, oil drain cock and suitable lifting lugs.

4.3 Rectifier

- 4.3.1 Unless otherwise specified, suitable surge protection shall be provided at input and output of the Rectifier.
- 4.3.2 The rectifier shall be full wave according to IEC 60146, complete with necessary filters and smoothing devices. The output RMS ripple shall not exceed 1% of the DC output current between 5 % and 100 % of the rated current output.
- 4.3.3 Unless otherwise specified, three phase rectifiers shall be used. Using of Switched Mode Converters is also acceptable.
- 4.3.4 The output voltage shall be adjustable from zero to the maximum rated output when on load.
- 4.3.5 The transformer/rectifier shall be provided with meters to read the input and output voltage and current. The measuring accuracy shall be better than 2 % of full scale.
- 4.3.6 The DC output voltage for each rectifier shall not exceed 50V and the rated output current shall be at least 25% greater than required under normal operating condition.

4.3.7 AC and DC cables and terminals shall be physically separated inside the Transformer Rectifier unit.

4.4 Cables

4.4.1 The cables feeding transformer rectifier units shall be three or four core 600/1000 volts, copper conductors, with PVC/XLPE insulation lead covered, single wire armored with black PVC oversheath.

4.4.2 AC and DC cables shall be physically separated e.g. by an insulating panel.

4.5 Input Circuit Breaker

4.5.1 A suitable molded case circuit breaker shall be provided with the transformer rectifier unit. It shall be possible to switch off the unit for inspection and/or maintenance. Provisions shall be included to lock the disconnection means in closed or open position.

4.5.2 The bottom entry on the switch shall be provided with a cable gland suitable for the required cable.

4.6 Time Switch

4.6.1 A built-in timer unit may be required. The timer unit may be mechanical or electronic and shall be capable of switching the full output current in a sequence of 4 s on and 1 s off. All transformer/rectifier timer units should be provided with a facility for synchronous switching. During normal operation, the timer shall be bypassed.

4.6.2 A double pole selector switch shall be provided to enable a selection to be made for either continuous operation or time switch controlled operation of the unit.

4.7. Control Box

4.7.1 A control box shall be installed on the outside of the tank of transformer rectifier and shall be provided with a hinged lockable door, suitably stiffened to prevent distortion and provided with a reinforced glass for viewing the meters. The box enclosure protection shall be at least IP55.

4.7.2 The control box shall house the following:

- a) The manual control of the output regulation device.
- b) The time/continuous control switch.
- c) Suitable voltmeter and ammeter.

4.7.3 The instrument cases shall be earthed unless manufactured of insulating materials.

4.7.4 The voltmeter shall be protected by a fuse in each lead of the instrument.

4.7.5 There shall be a schematic circuit diagram on the inside of control box door of the transformer rectifier. This diagram shall be engraved on non corrosive and non deteriorating material.

4.7.6 Three positive and three negative output terminals shall be provided in a suitable location for easy access and cable connection.

4.8. Enclosure

4.8.1 The enclosure shall be metal enclosed type, self supporting and shall consist structure(s) enclosed by steel sheet with minimum thickness of 3mm .

4.8.2 The enclosure protection shall be at least IP54.

4.8.3 A shelter to be considered for the enclosure as sun shade and rain shelter.

4.9. Nameplates, Labels and marking

4.9.1 The nameplates, labels and their fixing materials shall be proven durable under service conditions specified for the transformer .

4.9.2 The nameplates, labels and their fixing materials shall be corrosion and moisture resistant and provided with indelible inscription in English.

4.9.3 Stainless steel nameplates and trifoliate labels are acceptable.

4.9.4 Holes for fixing of nameplate or labels shall not influence in any way the IP degree of enclosure.

4.9.5 Each transformer rectifier shall bear the following marking:

- 1) Purchaser's name, order number and date of order.
- 2) The manufacturer's name and trade mark.
- 3) Identification reference/serial No.
- 4) Year of manufacture.
- 5) Number of input phases and neutral.
- 6) Rated input voltage, current and frequency.
- 7) Rectifier materials.
- 8) Rated output DC current and voltage.
- 9) Range of output voltage.
- 10) Type of voltage control.
- 11) IEC standard publications Number(s).
- 12) Dimensions.
- 13) Weight (with oil/without oil In case of oil immersed type).

5.0 Documentation

A complete set of manufacturer documents and drawings shall be supplied.

6.0 TEST & INSPECTION

6.1 All materials and equipment shall be factory tested according to IEC 60146, IEC 60076, NIOEC-SIP-60-00 and witnessed by NIOEC representative.

6.2 NIOEC and/or appointed inspectors reserve the right for inspection at any stage of manufacturing, testing or preparation for shipment.

7. SHIPPING

Preparation for shipment shall be in accordance with Manufacturer's standards, unless otherwise noted on the Request for Quotation and/or Purchase Order. The Manufacturer shall be solely responsible for the adequacy of the Preparation for Shipment.

8. SPARE PARTS

8.1 Together with the supply of all equipment, a complete set of spare parts for Commissioning shall be supplied for every and each equipment, and also recommended spare parts list for two years of operation shall be included.

8.2 All the spare parts shall comply with the same standards and specifications of the original equipment and shall be full interchangeable without any modifications at site.

9. GUARANTEES

9.1. The Transformer Rectifier unit shall be guaranteed, and the supplier shall replace any damaged equipment resulting from faulty design, defective materials, and/or poor workmanship.

9.2. The supplier shall also replace any equipment failed under the following conditions:

- a) Failure under start-up and commissioning tests.
- b) Failure under normal usage for a minimum of 12 months after being placed in the specified service, or 24 month after shipment whichever occurs earlier.

APPENDIX ATYPICAL DATA SHEET FOR TRANSFORMER RECTIFIER

1	Project name	
2	Area classification	
3	Location	
	Indoor. Required IP	
	Outdoor. Required IP	
4	Transformer Type	
	Dry type	
	Oil immersed	
5	Transformer Rating	
	Phase(s) / Frequency / cos Φ :	
	Rating (kVA):	
	Primary voltage (V, \pm %V):	
	Secondary voltage (V, \pm %V):	
	Primary current (A, \pm %A):	
	Efficiency:	
	Vector group:	
	Neutral earthing:	
	Insulation temp. class:	
	Type of cooling:	
6	Rectifier	
	Output DC voltage (V):	
	Max voltage ripple (mV):	
	Output current (A):	
7	Accessories	
	Lifting lugs	
	Oil level gauge	
	Oil drain cock with blocking plug	
	Dial type thermometer	
	Oil breather	
	Sun shade	

	Provision for remote alarm	
	Schematic circuit diagram plate	
	Rating plate	
	Padlock for isolating means	
8	Measuring instruments	
8-1	A) AC Input	
	Input AC voltmeter :	
	scaled (V) (from/to)	
	Rectifier Input AC voltmeter :	
	scaled (V) (from/to)	
	Rectifier Input AC ammeter :	
	scaled (A) (from/to)	
8-2	B) DC Output:	
	Output DC voltmeter:	
	scaled (V) (from/to)	
	Output DC ammeter:	
	scaled (A) (from/to)	
9	Cables/Conduit type and size	
	AC incoming side : (mm ²)	
	DC outgoing side : (mm ²)	