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

NIOEC SP

NIOEC SPECIFICATION FOR ELECTRICAL NETWORK CONTROL AND MONITORING SYSTEM

FIRST EDITION

JUNE, 2017

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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 complied.

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.

REVISION INDEX

REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5
1						26						51						76					
2						27						52						77					
3						28						53						78					
4						29						54						79					
5						30						55						80					
6						31						56						81					
7						32						57						82					
8						33						58						83					
9						34						59						84					
10						35						60						85					
11						36						61						86					
12						37						62						87					
13						38						63						88					
14						39						64						89					
15						40						65						90					
16						41						66						91					
17						42						67						92					
18						43						68						93					
19						44						69						94					
20						45						70						95					
21						46						71						96					
22						47						72						97					
23						48						73						98					
24						49						74						99					
25						50						75						100					

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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CONTENTS:	PAGE NO.
1. SCOPE.....	2
2. REFERENCES	2
3. UNITS.....	3
4. GENERAL REQUIREMENTS	3
5. SYSTEM ARCHITECTURE	4
6. FUNCTIONAL REQUIREMENTS	8
6.1. General Requirements	8
6.2. Monitoring and Control of Circuit Breakers.....	9
6.3. Monitoring of Electrical Network and Equipment Parameters.....	9
6.4. Communication with Other Systems/Equipment.....	11
6.5. System Functions.....	11
7. CONSTRUCTIONAL REQUIREMENTS.....	12
7.1. General Requirements	12
7.2. Main Components	13
7.3. System Integrity and Capacity	15
8. HMI REQUIREMENTS.....	16
8.1. Hardware and Software.....	16
8.2. Operator Access Levels.....	17
8.3. Display Pages	17
9. TEST AND INSPECTION	20
10. SPARE PARTS.....	21
11. DOCUMENTS.....	21
12. SHIPPING.....	22
13. GUARANTEES	22

1. SCOPE

- 1.1. An industrial power system mainly consists of power supply and power distribution systems. Electrical Network Control and Monitoring System (ENCMS) shall be provided for supervision and control of power distribution system.
- 1.2. Control, monitoring and management of power generation system is not included in this Specification and is covered by NIOEC-SP-60-12.
- 1.3. This Specification defines the minimum requirements for the design, manufacture, materials, software, inspection and test of ENCMS.
- 1.4. Deviations from this Specification will only be permitted on obtaining written approval from NIOEC.
- 1.5. 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)

IEC 60300	Dependability management
IEC 60332	Tests on electric and optical fiber cables under fire conditions
IEC 60364	Low voltage electrical installations
IEC 60445	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60706	Maintainability of equipment
IEC 60793	Optical fibers
IEC 60794	Optical fiber cables
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61131	Programmable controllers
IEC 61850	Communication networks and systems for power utility automation

ITU (INTERNATIONAL TELECOMMUNICATION UNION)

ITU-T G.651.1	Characteristics of a 50/125 μm multimode graded index optical fiber cable for the optical access network
ITU-T G.652	Characteristics of a single-mode optical fiber and cable

NIOEC SPECIFICATIONS

NIOEC-SP-60-00	NIOEC Specification for general design philosophy for electrical system
NIOEC-SP-00-10	NIOEC Specification for Units

NIOEC SHOP INSPECTION PROCEDURE

NIOEC-SIP-60-00	Shop Inspection Procedure for Electrical Equipment
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3. UNITS

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

4. GENERAL REQUIREMENTS

- 4.1. The ENCMS and its components shall be designed in accordance with the applicable IEC publications (in particular IEC 61850).
- 4.2. The design of the ENCMS shall be such as to optimize control and monitoring of the electrical network by means of the implemented functions and shall ensure personnel and operational safety.
- 4.3. The Vendor shall offer hardware and software from his standard range with required modifications to achieve conformity with this specification.
- 4.4. The design and selection of equipment, components and functions shall be based on a lifetime of 20 years. The Vendor shall confirm that replacement components and software support will be available during the lifetime of the system.
- 4.5. The Vendor shall ensure all the required coordination with its sub-vendors and manufacturers of main electrical components and shall be responsible for supplying the system complete in every way.
- 4.6. Although hardware reliability is important, the availability of the whole system (hardware plus software) for critical functions shall be considered as the representative of reliability figures. The availability of the whole ENCMS shall be at least 99.99%.
- 4.7. The ENCMS including all critical components shall have a Mean Time Between Failure (MTBF) of not less than 200,000 hours.
- 4.8. All subsystems shall be designed to achieve a Mean Time To Repair (MTTR) of not more than 4 hours.
- 4.9. Availability, reliability and maintainability requirements shall be in accordance with the definitions of IEC60300 and IEC60706.
- 4.10. System Electromagnetic Compatibility (EMC) shall comply with the requirements of IEC 61000 and also shall be tested in accordance with it.
- 4.11. In order to achieve the specified emission and immunity levels, the specific installation requirements (cabling, earthing, etc.) shall be stated by the Vendor.

4.12. ENCMS equipment shall be normally installed inside air conditioned electrical or control rooms with 20 ~ 25 °C normal temperature, nevertheless, unless otherwise specified, the equipment shall be capable of operating at the following conditions:

- maximum ambient temperature: 40 °C
- minimum ambient temperature: 5 °C
- maximum relative humidity: 90 %
- maximum altitude: 1000 m

4.13. Available supply voltage will be single phase 230VAC or three phase 400VAC with the following variations:

- steady state voltage variation: ±10%
- transient voltage variation (max. 0.5 sec): -20%
- frequency variation: ±5%

4.14. The ENCMS shall be connected to two independent sources of supply. At least one of these sources shall be an AC UPS.

4.15. The Vendor shall advise the power requirements of the hardware per location and also his preferred supply configuration. The configuration shall be approved by NIOEC.

4.16. The Vendor shall be responsible for the power distribution within the ENCMS (including AC/DC converters).

5. SYSTEM ARCHITECTURE

5.1. ENCMS shall communicate with all electrical substations and shall be interfaced with the following system/equipment for data acquisition and control purposes:

- switchgears
- protective relays
- AC/DCUPSs
- Emergency diesel generators
- Process Control System (PCS or DCS)
- HVAC (Heating, Ventilation and Air Conditioning) system
- VFDs (Variable Frequency Drives) and Soft Starters
- Other packages
- PMS (Power Management System)

5.2. The ENCMS shall generally be configured so that the following levels can be distinguished:

- level1 (acquisition/command)
- level2(automation)
- level3 (supervision)

5.3. All level1 equipment shall be dedicated to a part of the electrical network and shall be located nearby relevant equipment. This level includes protective relays, transducers, circuit breaker auxiliary contacts, etc.

5.4. AC/DC UPSs, emergency diesel generators, DCS and other packages are generally connected to the ENCMS through I/O modules. These I/O modules shall also be considered as level1 equipment.

- 5.5. Level2 consists of redundant controllers (typically PLCs) that shall be installed in each substation. Monitoring and control of level1 systems/equipment shall be implemented at this level.
- 5.6. Level1 equipment will communicate with level2 by means of hardwired connections, serial links or other communication protocols. Level1 shall be self-supporting i.e. all control and protection equipment on this level shall support the primary function of this network part without communication to other levels.
- 5.7. Supply of level1 components is not generally in the scope of ENCMS Vendor and will be supplied by other equipment vendors (switchgear, etc.).
- 5.8. Protective relays shall be interfaced with the ENCMS using IEC 61850 based network and protocol. Other protocols such as Mod bus with RS485 serial link are allowed upon NIOEC approval.
- 5.9. Transducers and circuit breaker auxiliary contacts shall be interfaced to the ENCMS by hardwired connections.
- 5.10. Other system/equipment such as AC/DC UPSs, emergency diesel generators, DCS and third party packages, etc. shall be interfaced with the ENCMS using RS 485 serial link and Mod bus protocol. These interfaces are generally used for monitoring purposes. The required data shall be defined by coordination with relevant system/equipment vendor.
- 5.11. A facility shall be provided for connecting a temporary engineering workstation using laptop at level2 for commissioning and troubleshooting purposes. No permanent operator/engineering workstation shall be implemented at this level.
- 5.12. Level3 consists of main system controllers (typically redundant PLCs), redundant servers, workstations (HMI) and other operational facilities. The monitoring and control of the level1 and level2 systems shall be implemented at this level. This is the highest level of ENCMS. Main controllers shall generally be installed in power station auxiliary room.
- 5.13. A full graphical HMI shall be provided at level3 and shall be connected to the controllers through the redundant TCP/IP network. Data servers, workstations, printers, etc. shall also be connected to this network so that Multi-station configuration is possible.
- 5.14. Minimum two operator workstations, one engineering workstation and two printers shall be installed in main control room and shall be connected to the main network by means of redundant optical fibers. One operator/engineering workstation shall also be installed in power station control room. Redundant servers shall be provided for overall data acquisition, data storage and data management.
- 5.15. An appropriate communication network (typically Ethernet TCP/IP) shall be provided for interconnection of all level3 equipment. Level2 equipment shall communicate with level3 by means of this communication network. Level2 shall be self-supporting even in case of communication failure with upper level.
- 5.16. Dedicated optical fiber links shall be used for connection of all substations controllers to the main controllers. As a general rule, such links shall be redundant and run on separate cable routings from end to end in order to avoid common mode faults.
- 5.17. ENCMS communication network shall be connected to PMS communication network for data exchange. List of required parameters shall be coordinated with the PMS Vendor.
- 5.18. The PMS includes a GPS or equivalent system for time synchronization of PMS equipment. For time synchronization between PMS and ENCMS, the ENCMS shall use this system for