

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant:  شرکت مهندسی مشاور انجی
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 1 of 10

EXTENSION TO NEYRIZ 66/20KVSUBSTATION

SPECIFICATION FOR GROUNDING SYSTEM

Z	Issued For Approval	1405/02/17	M. E.	M. A.	M. A.	M. E.
Rev.	Purpose of Issue	Date	Prepared	Check	Approved	Authorized

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant:  شرکت مهندسی مشاور انجی
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 2 of 10

TABLE OF REVISED PAGES																	
SHEET	REVISION								SHEET	REVISION							
	Z	A	B	C	D	E	F	G		Z	A	B	C	D	E	F	G
1	×								41								
2	×								42								
3	×								43								
4	×								44								
5	×								45								
6	×								46								
7	×								47								
8	×								48								
9	×								49								
10	×								50								
11									51								
12									52								
13									53								
14									54								
15									55								
16									56								
17									57								
18									58								
19									59								
20									60								
21									61								
22									62								
23									63								
24									64								
25									65								
26									66								
27									67								
28									68								
29									69								
30									70								
31									71								
32									72								
33									73								
34									74								
35									75								
36									76								
37									77								
38									78								
39									79								
40									80								

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 3 of 10

TABLE OF CONTENTS

1	Introduction.....	4
1.1	Purpose.....	4
1.2	Definitions.....	4
2	Description.....	5
3	Terminology	5
4	Standards	5
5	Design.....	5
5.1	Detailed Data.....	6
6	Submittals	7
6.1	Calculation Sheets.....	7
6.2	Contractor's Drawing and Design Data	7
6.3	Test Reports	8
7	Fabrication And Manufacture.....	8
8	Inspection And Tests.....	8
9	Supervision Over Installation And Erection.....	9
10	Spare Parts	10
11	Measurement And Payment	10

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION Document Title: Specification For Grounding System Document Number: NRZ-ANJ-SS-SPC-125		Consultant:  Page 4 of 10
		Rev: Z	

1 INTRODUCTION

1.1 Purpose

This document has been prepared to specify and establish the minimum technical requirements for the design, supply, installation, and commissioning of the Extension to Neyriz 66/20 kV Substation.

1.2 Definitions

Within the context of this document, the following definitions will be applicable:

Project:	Extension to Neyriz 66/20 kV Substation
Client:	Petro Kavian Sanat Pars Co.
Owner:	Fars Regional Electric Co.
Consultants:	Aria Niroo Jam Co.
EPC Contractor:	Any firm who is responsible for providing any service and material with respect to detailed engineering, procurement, construction of all items and material in accordance with the contract between the CLIENT and him.
Vendor/Supplier:	The company, which has been selected to supply the equipment and material and products technical documentation mainly, related to the production of the ordered supply.

The word "shall" indicate a requirement. The word "should" indicate a recommendation.
Contractor shall be responsible for vendor goods.

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION Document Title: Specification For Grounding System Document Number: NRZ-ANJ-SS-SPC-125		Consultant:  Page 5 of 10
	Rev: Z		

2 DESCRIPTION

Grounding shall mean grid, ground rods, equipotential mats, connections, equipment and other materials and measures required to complete the grounding of switchyard and indoor switchgear and buildings. Work of this section includes: design, manufacture, testing, transportation and supervision over erection and commissioning of switchyard and indoor switchgear grounding.

3 TERMINOLOGY

Technical terminology is to be as defined in latest edition of IEC 50, I.E.E.E. 100 and / or ANSI C42-100 standards.

4 STANDARDS

Work of this section shall comply with the requirements of latest edition of IEC, BS, DIN, ANSI and NEMA standards within which IEC standard is preferred.

5 DESIGN

The contractor is totally responsible for mutual compatibility and adequacy of all grounding system equipment in any respect.

When designing the grounding system equipment, the contractor should show by carried out calculations according to I.E.E.E. standard No.80 that safety of touch and step potentials, station ground fault, potential rise, conductor diameter and total station ground grid are correct.

Substation ground grid shall be designed to obtain a station ground resistance of less than 0.5 ohm.

The grounding grids shall be effectively protected against corrosion.

The overhead line terminal towers shall be connected directly to the earth system at least in two locations.

The use of earth plates as current carrying electrodes is not acceptable.

It is to be noted that risers or earth conductors are not allowed to come in touch with control cables.

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 6 of 10

5.1 Detailed Data

ITEM	DESCRIPTION	UNIT	REQUIREMENT
1	<u>General characteristics:</u>		
1.1	Implementation standard		IEEE
1.2	Nominal system voltage	kV	400/230/132/63/20
1.3	Maximum fault current	kA	Acc. To SLD
1.4	Peak of fault current and X/R of the grid		Acc. To Power system Study
1.5	Maximum fault current duration for HV side	Sec	1
1.6	Maximum fault current duration for MV side	Sec	3
1.7	Fault clearing time	Sec	0.6
1.8	Depth of ground grid	m	≥0.5
1.9	Maximum ground resistance	Ω	0.5
1.10	Soil resistant	Ω.m	min 150 *
2	<u>Earthing grid conductors:</u>		
2.1	Type		Stranded
2.2	Material		Copper annealed soft-drawn.
2.3	Minimum area cross section	mm ²	185/185/150/150
3	<u>Riser conductors:</u>		
3.1	Type		Stranded
3.2	Material		Copper annealed soft-drawn.
3.3	Minimum area cross section	mm ²	240/240/185/185
4	<u>Earthing Rod:</u>		
4.1	Material		Copper Clad Steel
4.2	Minimum diameter	mm	19
4.3	Length of each rod	m	3
4.4	Rods connection method		Exothermic weld

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 7 of 10

Page 7 of 10

ITEM	DESCRIPTION	UNIT	REQUIREMENT
5	<u>Surface layer:</u>	Yes/No	Yes
5.1	Resistivity	$\Omega.m$	2500
5.2	Thickness	mm	100
5.3	Assumption for calculation of step and touch voltage:		
	a) Step length	m	1
	b) Body resistance	Ω	1000
	c) Weight (approximately)	kg	50

* The correct value of earth resistivity will be measured during engineering stage based on Wenner method by contractor and contractor must calculate the grounding system and supply equipment according to approved measured value, minimum soil resistance 150 $\Omega.m$ acceptable. The earth resistivity shall be measured by contractor as a part of this tender.

** The earth conductor cross section are preliminary. The maximum allowable temperature for calculation of copper conductor cross section should be considered 450°C for mesh and 250°C for riser.

6 SUBMITTALS

6.1 Calculation Sheets

Submit five (5) copies of all calculations to prove adequacy of the grounding system equipment selected, in any respect, for the specified duties under all power system operation conditions (from normal to the most severe fault conditions envisaged) in accordance with submittals Document.

6.2 Contractor's Drawing and Design Data

Submit electrical design, fabrication and erection drawings for this section in accordance with the submittals Document.

The following shall be included:

- (1) Layout drawings of overall grounding grid.
- (2) Detailed drawings showing all equipment and equipotential mats.
- (3) Detailed description of various connectors and connecting processes used to form the grounding system.
- (4) Shipping and packing details.
- (5) Diagrams of expected voltage rise in the grounding grid.
- (6) Calculated potential gradient between the high voltage and other sections of the grid.

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 8 of 10

6.3 Test Reports

Submit six (6) copies of all testing procedure and final type test and routine test reports together with the certification of compliance of the equipment with the type and routine tests stipulated in the applicable standards.

7 FABRICATION AND MANUFACTURE

The materials used shall be as follows:

- (1) The conductor for connections between structures, equipment etc., and main grid shall be of the same current carrying capacity as the main grid conductor and shall be of stranded soft drawn annealed copper.
 - (2) Ground rods shall be with minimum diameter of 1.75 cm, and minimum length of 3 meters.
 - (3) Grounding conductor shall be connected to equipment and to galvanized steel structures by bolted connectors. The connectors shall be tinned copper where fitted to aluminium.
 - (4) Minimum contact area of the conductor to the connector shall be 10sq.cm.
- All jointing of conductor to conductor or conductor to ground rods shall be effected by an endothermic welding process.
- (6) The equipotential mats shall be prefabricated type.
 - (7) Insulated cable or copper ground bus supported on insulators shall be used for connecting lightning arresters to lightning arrester's counters and hence to the ground grid.
 - (8) Transformer tanks shall be connected with two risers according to the same principles as for steel structure.
 - (9) The neutral terminals of the transformers should be connected to the grounding grid by means of a bus conductor isolated from the tank. The neutral connection to the grounding grid shall be in one point only, via two separate risers. Each properly dimensioned for the earth fault current, but not less than 180 sq.mm copper.
 - (10) Temporary grounding devices:
 - (10-1) Earthing for working shall normally be achieved with the help of both fixed grounding switches and portable grounding equipment. where portable grounding equipment is used, phase conductors and steel supports shall both be equipped with fixed contacts to which the portable equipment shall be connected.
 - (10-2) The method of using the portable grounding equipment shall be subject to Engineer's approval.
 - (10-3) If different portable devices are used in different sections of the switchyard, the marking must be so clear that no inter-mixing is possible. Only one type of portable devices should be used within one section.

8 INSPECTION AND TESTS

Perform all inspection, routine tests and type tests stipulated in applicable standards to ensure that the material and workmanship conform to the specification and drawings.

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 9 of 10

Give Engineer access to the works for determination or assessment of compliance with the provision of this specification or to witness the contractor's inspection or tests.

Produce a certificate of compliance of the equipment with the design, routine and type tests stipulated in the applicable standards.

Owner reserves the right to have representative present during final shop and functional testing. The contractor shall advise the date of test at least sixty (60) days in advance.

9 SUPERVISION OVER INSTALLATION AND ERECTION

Perform visual inspection before installation to ensure that there is no damage resulting from shipment.

Supervise over installation, erection and commissioning of grounding systems to ensure satisfactory and proper operation in every respect.

The supervision shall cover but not be limited to the following:

- (1) Burying of the main ground grid at depth of 50-70 cm below site finished level.
- (2) Connecting of the new grounding to the existing ground grid where applicable.
- (3) Placing the metal grating on top of finish level and directly below the operator's normal standing position when manually operating disconnect switches.

Connection of each mat should be only to the disconnect switch control mechanism.

- (4) Grounding each structure column by direct connection to main ground grid.
- (5) Grounding the overhead shield wires through removable links.
- (6) connecting all equipment frames to the main ground grid.
- (7) Grounding point of the lightning arresters should not be ground connection for the other equipment.
- (8) Grounding connections to lightning arresters should be short and straight.
- (9) Grounding the frames of disconnect switches by direct connection to main ground grid except where switches are mounted on metal structures in which case the continuity across structural joints should be assured.
- (10) Grounding the hinge end of ground switches by direct connection to main ground grid and ground rod which is located adjacent to each ground switch.
- (11) Using bolted connections for the connection of equipment frames and galvanized steel structures to ground grid. All other connections should be by an endothermic welding process.
- (12) All connections to equipment should be by mechanical connectors bolted or clamped to a vertical face with sufficient pressure and contact area for prevention of burning due to fault currents.
- (13) Bending electrically the metallic cable trays and conduits at all mechanical joints and connecting them at intervals to ground grid.
- (14) Providing a separate ground grid for the steel associated with site walls and gates.
- (15) Earthing the metal substation fence immediately below any overhead line entering or leaving the site.

Client:  Petro Kavian Sanat Pars Co.	EXTENSION TO NEYRIZ 66/20 KV SUBSTATION		Consultant: 
	Document Title: Specification For Grounding System		
	Document Number: NRZ-ANJ-SS-SPC-125	Rev: Z	Page 10 of 10

(16) Grounding high frequency coupling equipment and lightning arresters via a copper rod driven directly in the ground at a position immediately adjacent to the equipment being earthed in addition to the normal earth connection.

(17) Earth terminals of low voltage equipment shall be earthed by wires designed for the actual earth fault current and 150 A/mm². The minimum area for buried conductors shall be 35 mm².

(18) All earthing units (including portable grounding devices) intended for connection to the conductor shall as a rule be capable of carrying the specified full fault current of the system for three seconds.

(19) Performing field tests and inspections including but not be limited to the following:

- (a) Measuring of the switchyard grounding and resistance independent of any other grounds, e.g.: transmission line structure. If the grounding resistance of the grid is greater than 0.5 ohm additional ground rods should be used or an auxiliary ground grid may be installed to reduce the grounding resistance.
- (b) Measuring touch, step and mesh potentials.
- (c) Checking the continuity of earthing.

10 SPARE PARTS

An additional quantity representing ten percent of the total quantity of all material required for the completion of this section of the works shall be included in the shipment to cover possible damage or loss during shipment or erection. At the completion of the project the balance of material will be turned over to Owner as spare parts and the cost shall be included in the tender amount of the contract for grounding.

11 MEASUREMENT AND PAYMENT

Payment for work of this section will be a lump sum and will be made in accordance with the schedule of prices.