E4596 v2

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DEVELOPING A FEASIBILITY STUDY TO SUPPORT THE SECOND PHASE OF THE POWER TRANSMISSION PROJECT (PTP-2)
SELECTION # RFP/MFE/4795/QCBS-15

Environmental Impact Assessment

Prepared for:
Ministry of Fuel and Energy of Ukraine &
World Bank

AF-MERCADOS EMI

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In Collaboration with: **ENCOG**

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Table of contents

Table of contents 2
List of Tables 9
List of Figures 11
Executive Summary 13
1 Introduction 19
2 World Bank's Operational Policy 19
3 Ukrainian Requirements 20
3.1 General Legal Framework 20
4 Evaluation of Impacts 22
4.1 Novokyivska Rehabilitation 22
4.1.1 Project description and actions arising 22
4.1.1.1 Site and locality 22
4.1.1.2 Description of Substations New Configuration 24
4.1.1.3 Description of Rehabilitation Constructive Process and Civil Work 25
4.1.2 World Bank's Operational Policy 29
4.1.3 Evaluation Terminology 29
4.1.4 Summary of the impacts 31
4.1.5 Identification, characterization and evaluation of impacts 34
4.1.5.1 Impact on Geology and Geomorphology 34
4.1.5.2 Impact on the pedology 34
4.1.5.3 Impact on the hydrology 35
4.1.5.4 Impact on the air/atmosphere 36
4.1.5.5 Impact on fauna and flora 39
4.1.5.6 Impacts on the population 40
4.1.5.7 Impacts on the economic sectors 42
4.1.5.8 Impacts on natural sites and other areas of cultural interest 43
4.1.5.9 Impacts on the infrastructure and service roads 43
4.1.5.10 Impacts on the landscape 44
4.1.5.11 Hazards and Hazardous Materials 44
4.1.6 Classification of the Project based on World Bank's Operational Policy 45
4.2 October Rehabilitation 47
4.2.1 Project description and actions arising 47
4.2.1.1 Site and locality 47

4.2.1.2 Description of Substation New Configuration 48
4.2.1.3 Description of Rehabilitation Constructive Process and Civil work 49
4.2.2 Evaluation Terminology 52
4.2.3 Summary of the Impacts 53
4.2.4 Identification, characterization and evaluation of impacts 56
4.2.4.1 Impact on Geology and Geomorphology 56
4.2.4.2 Impact on the pedology 56
4.2.4.3 Impact on the hydrology 57
4.2.4.4 Impact on the air/atmosphere 58
4.2.4.5 Impact on fauna and flora 60
4.2.4.6 Impacts on the population 61
4.2.4.7 Impacts on the economic sectors 63
4.2.4.8 Impacts on natural sites and other areas of cultural interest 64
4.2.4.9 Impacts on the infrastructure and service roads 64
4.2.4.10 Impacts on the landscape 65
4.2.4.11 Hazards and Hazardous Materials 65
4.2.5 Classification of the Project based on World Bank's Operational Policy 66
4.3 Kremenchug Rehabilitation 67
4.3.1 Project description and actions arising 67
4.3.1.1 Site and locality 67
4.3.1.2 Description of Substations New Configuration 68
4.3.1.3 Description of Rehabilitation Constructive Process and Civil Work 69
4.3.2 Evaluation Terminology 72
4.3.3 Summary of the impacts 73
4.3.4 Identification, characterization and evaluation of impacts 76
4.3.4.1 Impact on Geology and Geomorphology 76
4.3.4.2 Impact on the pedology 76
4.3.4.3 Impact on the hydrology 77
4.3.4.4 Impact on the air/atmosphere 78
4.3.4.5 Impact on fauna and flora 80
4.3.4.6 Impacts on the population 82
4.3.4.7 Impacts on the economic sectors 84
4.3.4.8 Impacts on natural sites and other areas of cultural interest 84
4.3.4.9 Impacts on the infrastructure and service roads 84

4.3.4.10 Impacts on the landscape 85
4.3.4.11 Hazards and Hazardous Materials 85
4.3.5 Classification of the Project based on World Bank's Operational Policy 86
4.4 Cherkassy Rehabilitation 88
4.4.1 Project description and actions arising 88
4.4.1.1 Site and locality 88
4.4.1.2 Description of Substation New Configuration 89
4.4.1.3 Description of Rehabilitation Constructive Process and Civil work 90
4.4.2 Evaluation Terminology 92
4.4.3 Summary of the Impacts 93
4.4.4 Identification, characterization and evaluation of impacts 96
4.4.4.1 Impact on Geology and Geomorphology 96
4.4.4.2 Impact on the pedology 96
4.4.4.3 Impact on the hydrology 97
4.4.4.4 Impact on the air/atmosphere 98
4.4.4.5 Impact on fauna and flora 100
4.4.4.6 Impacts on the population 101
4.4.4.7 Impacts on the economic sectors 103
4.4.4.8 Impacts on natural sites and other areas of cultural interest 104
4.4.4.9 Impacts on the infrastructure and service roads 104
4.4.4.10 Impacts on the landscape 105
4.4.4.11 Hazards and Hazardous Materials 106
4.4.5 Classification of the Project based on World Bank's Operational Policy 107
4.5 Zhytomyr Rehabilitation 108
4.5.1 Project description and actions arising 108
4.5.1.1 Site and locality 108
4.5.1.2 Description of Substation New Configuration 109
4.5.1.3 Description of Rehabilitation Constructive Process and Civil work 110
4.5.2 Evaluation Terminology 112
4.5.3 Summary of the Impacts 113
4.5.4 Identification, characterization and evaluation of impacts 116
4.5.4.1 Impact on Geology and Geomorphology 116
4.5.4.2 Impact on the pedology 116
4.5.4.3 Impact on the hydrology 117

4.5.4.4 Impact on the air/atmosphere 118
4.5.4.5 Impact on fauna and flora 120
4.5.4.6 Impacts on the population 121
4.5.4.7 Impacts on the economic sectors 124
4.5.4.8 Impacts on natural sites and other areas of cultural interest 124
4.5.4.9 Impacts on the infrastructure and service roads 124
4.5.4.10 Impacts on the landscape 125
4.5.4.11 Hazards and Hazardous Materials 126
4.5.5 Classification of the Project on World Bank's Operational Policy 127
4.6 Sumy Rehabilitation 128
4.6.1 Project description and actions arising 128
4.6.1.1 Site and locality 128
4.6.1.2 Description of Substation New Configuration 129
4.6.1.3 Description of Rehabilitation Constructive Process 129
4.6.2 Evaluation Terminology 131
4.6.3 Summary of the Impacts 132
4.6.4 Identification, characterization and evaluation of impacts 134
4.6.4.1 Impact on Geology and Geomorphology 134
4.6.4.2 Impact on the pedology 134
4.6.4.3 Impact on the hydrology 135
4.6.4.4 Impact on the air/atmosphere 136
4.6.4.5 Impact on fauna and flora 138
4.6.4.6 Impacts on the population 139
4.6.4.7 Impacts on the economic sectors 140
4.6.4.8 Impacts on natural sites and other areas of cultural interest 141
4.6.4.9 Impacts on the infrastructure and service roads 141
4.6.4.10 Impacts on the landscape 143
4.6.4.11 Hazards and Hazardous Materials 143
4.6.5 Classification of the Project based on World Bank's Operational Policy 144
4.7 Shunt Reactors Installation 145
4.7.1 Project description and actions arising 145
Lutsk Pivdenna Substation 145
4.7.1.1 Site and locality 145
4.7.1.2 Description of Shunt Reactors Installation and Civil work 146

Kovel Substation 147
4.7.1.3 Site and locality 147
4.7.1.4 Description of Shunt Reactors Installation and Civil work 149
Shepetivka Substation 150
4.7.1.5 Site and locality 150
4.7.1.6 Description of Shunt Reactors Installation and Civil work 151
Kamenets-Podilska Substation 153
4.7.1.7 Site and locality 153
4.7.1.8 Description of Shunt Reactors Installation and Civil work 153
Novovolinskaya Substation 154
4.7.1.9 Site and locality 154
4.7.1.10 Description of Shunt Reactors Installation and Civil work 155
4.7.2 Evaluation Terminology 157
4.7.3 Summary of the Impacts 158
4.7.4 Identification, characterization and evaluation of impacts 161
4.7.4.1 Impact on Geology and Geomorphology 161
4.7.4.2 Impact on the pedology 161
4.7.4.3 Impact on the hydrology 162
4.7.4.4 Impact on the air/atmosphere 163
4.7.4.5 Impact on fauna and flora 165
4.7.4.6 Impacts on the population 166
4.7.4.7 Impacts on the economic sectors 167
4.7.4.8 Impacts on natural sites and other areas of cultural interest 168
4.7.4.9 Impacts on the infrastructure and service roads 168
4.7.4.10 Impacts on the landscape 173
4.7.4.11 Hazards and Hazardous Materials 174
4.7.5 Classification of the Project based on World's Bank Operational Policy 174
5 Environmental Management Plan 176
Rehabilitation of Substations 176
5.1 Preventive and corrective measures 176
5.1.1 Preventive measures 176
5.1.1.1 Ground 176
5.1.1.2 Water 176
5.1.1.3 Atmosphere 176

5.1.1.4 Population 177
5.1.1.5 Socioeconomic Sector 177
5.1.1.6 Residuals 178
5.1.1.7 Landscape 178
5.1.1.8 Traffic 178
5.1.2 Corrective measures 178
5.2 Environmental Monitoring Plan 179
5.2.1 Reconstruction phase 179
5.2.2 Operating phase 179
Shunt Reactors Installation 180
5.2.3 Preventive and corrective measures 180
5.2.3.1 Ground 180
5.2.3.2 Water 181
5.2.3.3 Atmosphere 181
5.2.3.4 Population 181
5.2.3.5 Residuals 182
5.2.3.6 Landscape 182
5.2.4 Environmental Monitoring Plan 183
5.2.4.1 Installation phase 183
5.2.4.2 Operating phase 183
6 Cost Estimation 184
6.1 Novokyivska 185
6.1.1 Estimated GANTT 187
6.2 October 192
6.2.1 Estimated GANTT 194
6.3 Kremenchug 198
6.3.1 Estimated GANTT 200
6.4 Cherkassy 204
6.4.1 Estimated GANTT 206
6.5 Zhytomyr 211
6.5.1 Estimated GANTT 213
6.6 Sumy 217
6.6.1 Estimated GANTT 219
6.7 Shunt Reactors Installation 222

6.7.1 Estimated GANTT 222
7 Annexes 225
7.1 Annex 1: Calculation of Costs 225
7.2 Annex 2: Level of Noises 231

List of Tables

Table 1 Classification of the Projects 14
Table 2 Summary of Impacts: Novokyivska 15
Table 3 Total EIA Costs 18
Table 4 Summary of Impacts 31
Table 5 Summary of Impacts 53
Table 6 Summary of Impacts 73
Table 7 Summary of Impacts 93
Table 8 Summary of Impacts 113
Table 9 Summary of Impacts 132
Table 10 Summary of Impacts 158
Table 11 Total EIA Costs 184
Table 12 EIA Cost Estimation 185
Table 13 Estimated GANTT for Novokyivska 187
Table 14 Estimated GANTT: Installation preparatory work 188
Table 15 Estimated GANTT: Supply of Equipment 189
Table 16 Estimated GANTT: Installation of new equipment 189
Table 17 Estimated GANTT: Existing Equipment Dismantling 190
Table 18 EIA Cost Estimation: October SS 192
Table 19 Estimated GANTT for October 194
Table 20 Estimated GANTT: Installation preparatory work 195
Table 21 Estimated GANTT: Supply of Equipment 196
Table 22 Estimated GANTT: Installation of new equipment 196
Table 23 Estimated GANTT: Existing Equipment Dismantling 197
Table 24 EIA Cost Estimation 198
Table 25 Estimated GANTT for Kremenchug 200
Table 26 Estimated GANTT: Installation preparatory work 201
Table 27 Estimated GANTT: Supply of Equipment 202
Table 28 Estimated GANTT: Installation of new equipment 202
Table 29 Estimated GANTT: Existing Equipment Dismantling 203
Table 30 EIA Cost Estimation: October SS 204
Table 31 Estimated GANTT for Cherkassy 206
Table 32 Estimated GANTT: Installation preparatory work 207
Table 33 Estimated GANTT: Supply of Equipment 208
Table 34 Estimated GANTT: Installation of new equipment 208
Table 35 Estimated GANTT: Installation of new equipment 209
Table 36 Estimated GANTT: Existing Equipment Dismantling 210
Table 37 EIA Cost Estimation: October SS 211
Table 38 Estimated GANTT for Zhytomyr 213
Table 39 Estimated GANTT: Installation preparatory work 214
Table 40 Estimated GANTT: Supply of Equipment 215
Table 41 Estimated GANTT: Installation of new equipment 215
Table 42 Estimated GANTT: Existing Equipment Dismantling 216
Table 43 EIA Cost Estimation: October SS 217
Table 44 Estimated GANTT for Sumy 219

Table 45 Estimated GANTT: Installation preparatory work 220
Table 46 Estimated GANTT: Supply of Equipment 221
Table 47 Estimated GANTT: Installation of new equipment 221
Table 48 EIA Cost Estimation for the Installation of Shunt Reactors in one SS 222
Table 49 Estimated GANTT for Reactors Substation A 223
Table 50 Estimated GANTT: Installation preparatory work 223
Table 51 Estimated GANTT: Supply of Equipment 224
Table 52 Estimated GANTT: Installation of new equipment 224

List of Figures

Figure 1 Novokyivska and Chabany center situation 23
Figure 2 Novokyivska SS-Forest 23
Figure 3 Novokyivska SS 24
Figure 4 Current Novokyivska configuration 27
Figure 5 Novokyievska Rehabilitation 27
Figure 6 Area for the GIS buildings Novokyivska SS 28
Figure 7 Location of October Substation 47
Figure 8 October SS 48
Figure 9 Current October configuration 50
Figure 10 Rehabilitation of October SS 51
Figure 11 Access roads to October SS 64
Figure 12 Kremenchug SS situation 67
Figure 13 Kremenchug SS 68
Figure 14 Kremenchug SS Current Configuration 71
Figure 15 Kremenchug SS rehabilitation 71
Figure 16 Surroundings of Kremenchug SS 81
Figure 17 Location of Cherkassy Substation 88
Figure 18 Cherkassy SS 89
Figure 19 Cherkassy Current configuration 90
Figure 20 Cherkassy current configuration 91
Figure 21 Rehabilitation of October SS 91
Figure 22 Access roads to Cherkassy SS 105
Figure 24 Zhytomyr SS 109
Figure 25 Current Zhytomyr SS configuration 111
Figure 26 Rehabilitation of Zhytomyr SS 111
Figure 27 Access roads to Zhytomyr SS 125
Figure 28 Location of Sumy Substation 128
Figure 29 Summy SS 129
Figure 30 Current Zhytomyr SS configuration 130
Figure 31 Access road to Sumy SS 142
Figure 32 Access road to Sumy SS 142
Figure 33 Location of Lutsk Pivdenna Substation 145
Figure 34 Lutsk Pivdenna SS 146
Figure 35 Lutsk SS configuration 147
Figure 36 Location of Kovel Substation 148
Figure 37 Kovel SS 148
Figure 38 Kovel SS configuration 149
Figure 39 Location of Shepetivka Substation 150
Figure 40 Shepetivka SS 151
Figure 41 Shepetivka SS configuration 152
Figure 42 Location of Kamenets-Podilska Substation 153
Figure 43 Location of Novovolinskaya Substation 154
Figure 44 Novovolinskaya SS 155
Figure 45 Access roads to Lutsk SS 169

Figure 46 Area of work inside the SS..... 169
Figure 47 Access roads to October SS..... 170
Figure 48 Access roads to Shepetivka SS 171
Figure 49 Access roads to Kamenets-Podilska SS..... 172
Figure 50 Access roads to Novovolinskaya SS..... 173

Executive Summary

Since 2004 Ukraine, with the support from the World Bank, is implementing the Energy Sector Reform and Development Program.

The main objective of this document is to analyze the environmental impacts that the second phase of the Power Transmission Project (PTP-2) has. This second phase of the project includes:

- Component A: complex reconstruction of the Substations 330 kV Novokyivska, October, Kremenchug, Cherkassy, Zhytomyr and Sumy.
- Component B: installation of 20 MVA reactive power compensation devices in shunt reactors at 35 kV busbar in: 330/220 Novovoliskya, 220 kV Lutsk-Pivdenna, 330 kV Kovel, 330 kV Shepetivka and 330 kV Kamenets-Podilska.

All works requiring transport, earth movements, dismantling of equipment, etc. have impacts on both the environment of the places where they are performed, as well as the life and health of the people living in them. Therefore, it is necessary to study and asses these impacts in order to analyze the viability of the project and prepare measures to reduce the level of such impacts.

In this document it is shown the Environmental Impact Assessment of all the works in the second phase. It consists of a short analysis of the surroundings of each substation, a detailed project description and actions arising, an evaluation of the impacts, classification of the project according to World's Bank Operational Policy, an Environmental Management Plan for mitigation of the impacts and a estimation of costs of this Plan together with the estimated GANTT for the accomplishment of the measures.

The Bank classifies the projects into one of four categories, depending on the type, location, sensitivity and scale of the project and nature and magnitude of its potential environmental impacts.

- Category A: is likely to have significant adverse environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect and area broader than the sites or facilities subject to physical works.
- Category B: its potential environmental impacts on human populations or environmentally important areas are less adverse tan those of Category A projects. These impacts are site-specific; few if any of them are irreversible and in most cases mitigation measures can be designed more readily than for Category A projects.
- Category C: it is likely to have minimal or no adverse environmental impacts.
- Category FI: it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

According to this classification the proposed components are valued as:

Table 1 Classification of the Projects

	World Bank Category				
	A	B	C	D	FI
Rehabilitation of Substations			X		
Novokyivksa		X			
October			X		
Kremenchug			X		
Zhytomyr			X		
Cherkassy		X			
Sumy			X		
Shunt Reactors Installation					
Lutsk			X		
Kovel			X		
Shepetivka			X		
Kamenets-Podilska			X		
Novovolinskaya			X		

This classification is based on a detailed analysis of the impacts of the works in the different phases. Such impacts are categorized as: Small Beneficial, Beneficial, Small, Null, Not Significant, Small Adverse, Adverse, Severe and Critical. To see an explanation of these terms please refer to section 4.1.3.

In the case of Novokyivska the determination of the impacts is as follows:

Table 2 Summary of Impacts: Novokyivska

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R1	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		R2	**SA**	N/A
Pedology	Destruction and loss of soil quality	R1	**NULL**	N/A
		R2	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R1	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		R2	**SA**	N/A
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R1/R2/O	**NULL**	N/A
	Contamination of groundwater	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R1	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R1/R2/O	**NULL**	N/A
	Elimination of vegetation	R1/R2/O	**NULL**	N/A
	Direct destruction of species	R1/R2/O	**NULL**	N/A
	Degradation of the habitat	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.
Population	Employment generation	R1	**B**	Positive, direct, temporary and short-term.
		R2	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R1	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	R1	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		R2	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		O	**NS**	N/A
	Welfare and life quality	O	**SB**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
Economic Sectors	Economic dynamization	R1	**B**	Positive, direct, temporary and short-term.
		R2	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R1/R2/O	**NULL**	N/A
Infrastructures	Alteration of roads	R1	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R1/R2/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Landscape	Effects on the landscape quality	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	First reconstruction phase	**R1**
Not significant	**NS**	Second reconstruction phase	**R2**
Small Adverse	**SA**	Operating phase	**O**
Adverse	**A**		
Small Beneficial	**SB**		
Beneficial	**B**		
Severe	**S**		
Critic	**C**		

For each substation a similar analysis have been done. Please refer to section "Summary of Impacts" of each substation description chapter. (Sections 4.1.4, 4.2.3, 4.3.3, 4.4.3, 4.5.3, 4.6.3, 4.7.3)

Once the impacts are analyzed and classified the Environmental Management Plan (EMP) is defined. This plan is formed by preventive and corrective measures that reduce or avoid impacts, and by a monitoring plan which purpose is to take control of such measures to be carried out throughout the development of the project.

The Environmental Management and Monitoring Plans entail activities which represent additional material and labor costs. Therefore, a detailed Cost Estimation for each substation is presented in section 6, as well as an estimating implementation schedule of such activities.

The Cost Estimation is broken down according to the tasks and needed material described in the EMP.

The following table shows a summary of the Total Environmental Costs for each work:

Table 3 Total EIA Costs

	Rehabilitation of Substations					
	Novokyivska	**October**	**Kremenchug**	**Zhytomyr**	**Cherkassy**	**Sumy**
Total Costs (USD)	75,381	69,601	66,243	70,130	67,561	73,036

	Installation of Shunt Reactors				
	Lutsk Pivdenna	**Novovolinskaya SS**	**Kovel SS**	**Shepetivka SS**	**Kamenets-Podilska**
Total Costs (USD)	6,174	6,174	6,174	6,174	6,174

1 Introduction

Since 2004 Ukraine, with the support from the World Bank, is implementing the Energy Sector Reform and Development Program.

The main objective of this document is to analyze the environmental impacts that the second phase of the Power Transmission Project (PTP-2) has. This second phase of the project includes:

- Component A: complex reconstruction of the Substations 330 kV Novokyivska, October, Kremenchug, Cherkassy, Zhytomyr and Sumy.
- Component B: installation of 20 MVA reactive power compensation devices in shunt reactors at 35 kV busbar in: 330/220 Novovoliskya, 220 kV Lutsk-Pivdenna, 330 kV Kovel, 330 kV Shepetivka and 330 kV Kamenets-Podilska.

The Environmental Impact Assessment carried out consists of a short analysis of the surroundings of each substation, a detailed project description and actions arising, an evaluation of the impacts, classification of the project according to World's Bank Operational Policy, an Environmental Management Plan for mitigation of the impacts and a estimation of costs of this Plan together with the estimated GANTT for the accomplishment of the measures.

2 World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 this Environmental Impact Assessment takes into account the natural environment; human health and safety; social aspects and transboundary and global environmental aspects. It includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

Depending on the project, a range of instruments can be used to satisfy the Bank's EA requirements. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity and scale of the project and nature and magnitude of its potential environmental impacts.

- Category A: is likely to have significant adverse environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect and area broader than the sites or facilities subject to physical works.
- Category B: its potential environmental impacts on human populations or environmentally important areas are less adverse tan those of Category A projects. These impacts are site-specific; few if any of them are irreversible and in most cases mitigation measures can be designed more readily than for Category A projects.
- Category C: it is likely to have minimal or no adverse environmental impacts.
- Category FI: it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

3 Ukrainian Requirements

3.1 General Legal Framework

The following shows an overview of regulations and standards relevant for preparation of the local EIA, planning of environmental protection measures and implementation of this type of project:

Laws of Ukraine

- "On Protection of Environment" (1991) as amended;
- "On Natural Reserve Fund of Ukraine" (1992);
- "On Environmental Expert Evaluation" (1995); as amended;
- "On Protection of Cultural Heritage" as changed and amended;
- "On Ratification of the Convention on the Environmental Impact Assessment in a Transboundary Context (Espoo Convention)" (1999);
- "On valuation of property, property rights and professional valuation activities in Ukraine" (2001);
- "On valuation of lands" (2003).
-

Regulatory Codices of Ukraine

- Forest Code (1994) as amended;
- Water Code (1995) as amended;
- Land Code (2001) as amended.
-

Binding Decisions and Instructions

- Resolution of the Cabinet of Ministers of Ukraine "0n Approval of the Procedure for Determination of Dimensions and Limits of Water protection Zones and Regime of Economic Activities in Such Zones" of 08.05.1996, No. 486;
- Resolution of the Cabinet of Ministers of Ukraine of 27.07.95 No.554 on "On the List of Activities and Objects that Pose High Environmental Danger";
- Resolution of the Cabinet of Ministers of Ukraine of 17.11.1997 No. 1279 "On Size of and Procedure for Calculation of Agricultural and Forestry Losses Subject to Compensation" and "Procedure for Calculation of Agricultural and Forestry Losses Subject to Compensation";
- Resolution of the Cabinet of Ministers No 483 On the Order of Approval of Investment Programmes and Construction Projects and Their Comprehensive State Review, 2002;
- "Procedure for Calculation and Compensation of Losses to Land Owners and Land Users" approved by Resolution of the Cabinet of Ministers of Ukraine of 19.04.1993 No.284;
- Decree of the Cabinet of Ministers of Ukraine "On methodology for expert valuation of lands" (No 1531 dated 11.10.2002);
- Order of the State Committee on Land Resource "On approval of procedure for expert monetary valuation of the land parcels" (dated 09.01.2003 No.2).

Standards and Rules

- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), 1999;

- Ministry of Environment Guidelines for Public Participation in Environmental Decision-Making, 2004;
- State Construction Standard DBN A.2.2-1-2003 Structure and Contents of Materials of the Environmental Impact Assessment (EIA) in Designing and Construction of Production Facilities, Buildings and Structures;
- Rules for Guarding of Electricity Transmission Lines (1997) [Resolution of the Cabinet of Ministers of Ukraine of 04.03.97];
- Rules for Set-Up of Electric Equipment (2006);
- State Sanitary Regulations and Norms for Protection of Population against EMR, Order of Ministry of Health of Ukraine, No. 239, August 1, 1996;
- GOST 12.4.154-85 "Shielding Devices for Protection from Industrial Frequency Electric Fields";
- SNiP 3.05.06-85 "Electrotechnical Devices";
- SNiP 2.01.01-82 "Construction Climatology and Geophysics";
- SNiP II-12-77 "Noise Protection" (amended 2003);
- "Technical Operation of Power Stations and Networks. Guidelines." GKD 34.20.507-2003;
- "Guidelines for Safe Use of Consumer Power Appliances" DNAOP 0.00-1.21-98);
- Sanitary Norms and Regulations (DSTU) approved by the Ministry of Health Protection of Ukraine (Order No. 476 of 18.12.2002);
- DBN 360-92** "City Development. Planning of Cities and Villages";
- "Norms for Technological Design of 6-750 kV AC Substations" (GKD 341.004.001-94), which had been approved by the Ministry of Energy of Ukraine on 5 September 1994 and came into force on 1 January 1995;
- GOST 12.1.019-79* "Electrical Safety. General Requirements and Protection Types";
- SNiP III-4-80* "Construction Safety";
- "Guidelines for Lightning Protection of Buildings and Installations" RD 34.21.122-87;
- SNiP 2.01.07-85* "Loads and Impacts";
- SNiP 2.03.01-84* "Concrete and Armoured Concrete Structures";
- SNiP II.7-81* "Construction in Seismic Areas";
- SNiP II.23-81* "Steel Structures";
- DBN B.2.3-4-2000 „Automobile Roads";
- Fire Safety Rules of Ukraine" (NAPB A.01.001-2004);
- GOST 12.4.009-83 "Fire Equipment for Protection of Installations";
- "Fire Safety Guideline" GKD 343.000.004.003.001-2001;
- Guideline for Operation of SF6 Switchgear (GND 34.47.503-2004).

4 Evaluation of Impacts

4.1 Novokyivska Rehabilitation

4.1.1 Project description and actions arising

4.1.1.1 Site and locality

Novokyivska substation is located to the south of Kiev city, at a distance of 1.5 km from the closest urban core that is Chabany Township. The total area of the substation is 13.6 hectares.

Lands surrounding Novokyivska have been used originally as potato plantations. However, this location is becoming a potential residential area, and construction companies that have already developed plans to urbanize have acquired these parcels. Land prices have therefore risen far above economical values for transmission assets expansion. This is one of the main reasons for which the rehabilitation plan shall not involve expansion of the current area of the substation.
Novokyivska is close to a forest area, located at its south (see Figure 2). This area is known as the forest-steppe province. It stretches from the south-west to the north-east of the country. Typical of this area are the following species: snake, steppe viper, gopher, partridge, hawk, fox, lark, badger, polecat, marten, wild bore, bat, muskrat, roe, deer, etc.

Air quality in Kiev city is very deteriorated due to atmospheric pollution. General perception of pollution in the air by citizens and visitors is 81.82 out of 100. Noise and light pollution perception is 40.91 out of 100. Consequently, air quality perception reaches only 18.18 out of 100. Chabany is located 12 km away from the urban core, therefore, air quality is similar to Kiev's.

Figure 1 Novokyivska and Chabany center situation

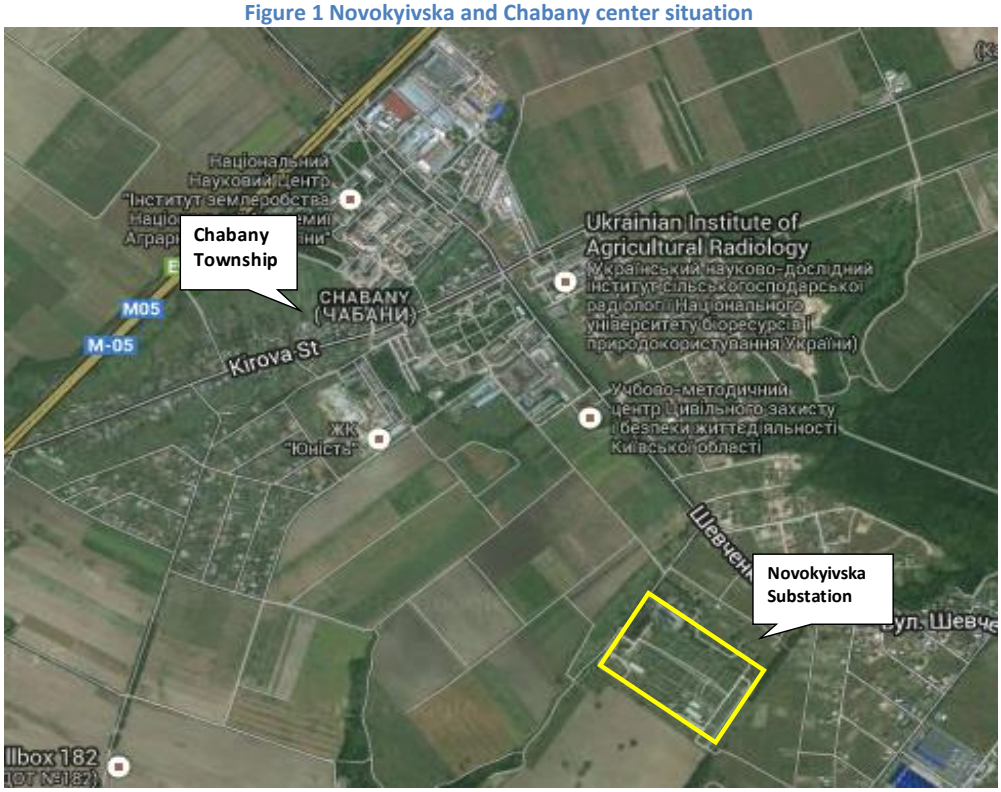


Figure 2 Novokyivska SS-Forest

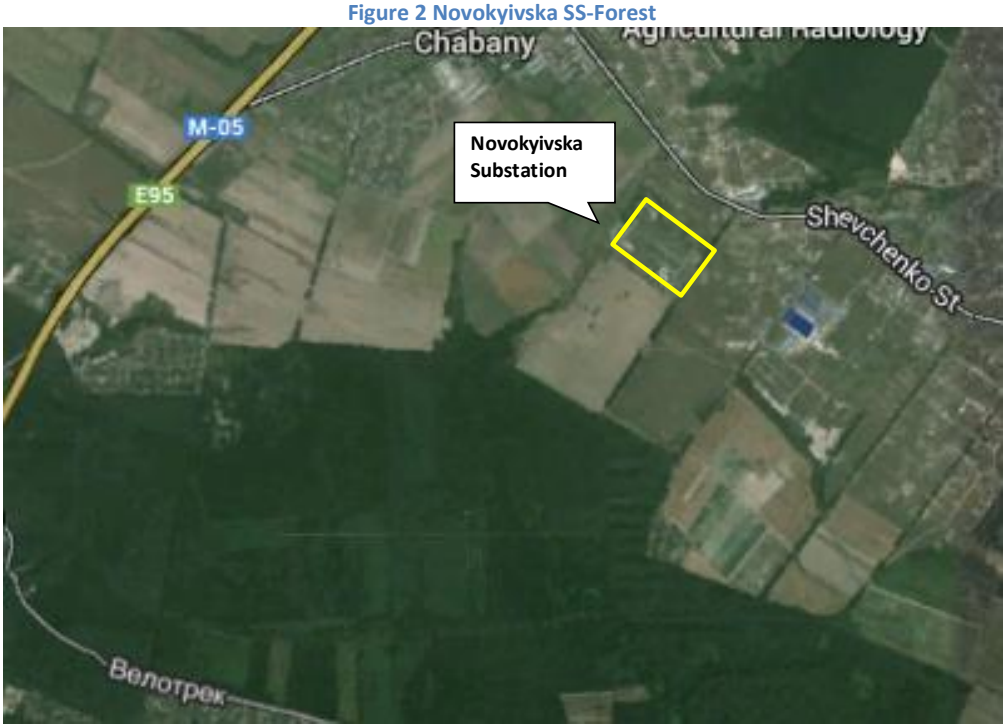
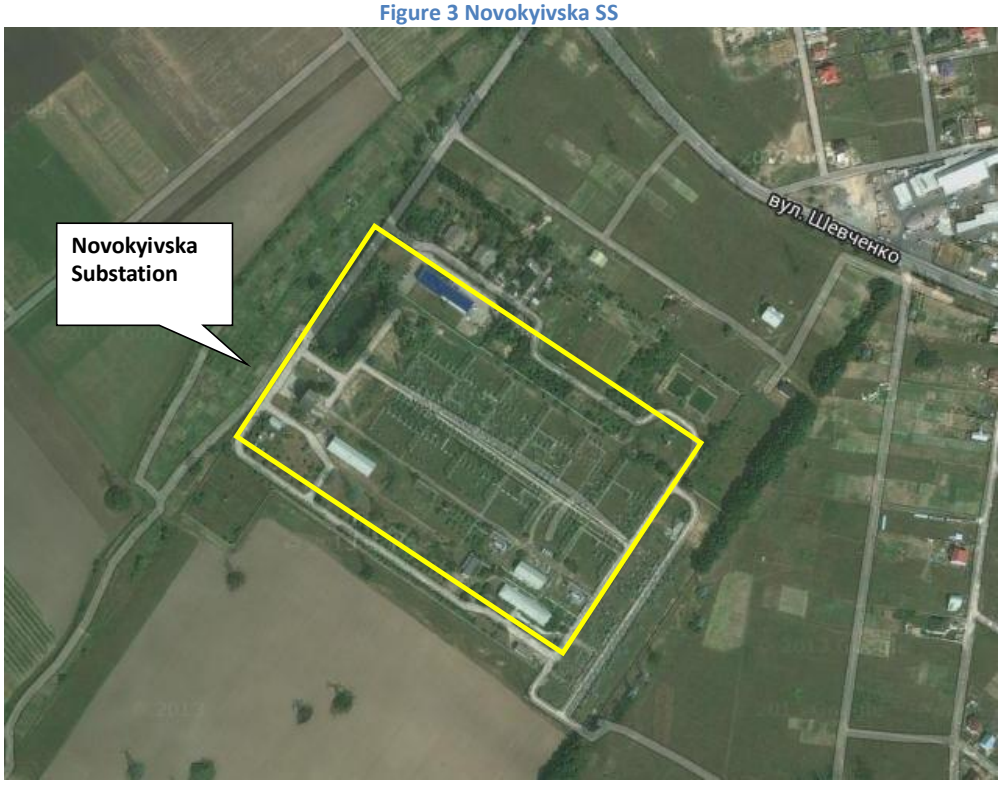


Figure 3 Novokyivska SS



4.1.1.2 Description of Substations New Configuration

At 330kV level

The project foresees the construction of a GIS 330kV substation under the "one-and-a-half-breaker" scheme to enable connection of five 330kV OTLs feeders and installation of four ATs feeders.

GIS option covers the full-scale development of the substation. The GIS 330kV with a "one-and-a-half-breaker" configuration enables further expansion of 330kV switchgear (installation of 4 AT) without dispatch constraints during the work.

- Rehabilitation of 330kV switchgear and construction of indoor GIS 330kV, construction of a new substation control building combined with the GIS 330kV building.
- Moving the AT-1 and AT-2 to a new location with their connection to GIS 330kV of the "air – SF6" type.
- Installation and connection of additional AT-3 with "air-SF6" type connections.
- Reconnection of OTL 330kV to the new portals with oil filled cable inserts.
- Dismantling of all outdoor switchyard 330kV.

At 110kV level

The project foresees construction of GIS 110kV under "two main and one transfer busbar" scheme. Busbars are segmented with bus tie circuit breakers. GIS will provide 23 feeders to enable connection of the following elements:

- 3 Autotransformer feeders (2 existing and 1 additional in the scope of the rehabilitation.(There is one future Autotransformer out of the scope of this

rehabilitation). The ATs feeders will be spread between the two busbars. The 2nd and 3rd Autotransformers will be connected to busbar 2 while AT-1 and the future AT-4 will be connected to the other busbar (busbar 1). This ATs connection ensures greater safety and operational flexibility with respect to the current situation, and provides the uninterrupted energy supply in the case of a busbar affected by a failure.

- 15 transmission lines feeders (11 OTLs and 4CL – future connections which should be included in the scope of equipment, since 2 of them («Novokyivska-Chabany-1» and «Novokyivska-Chabany-2») are already built and connected in temporary manner, and another 2 («Novokyivska-Odeska-1» and «Novokyivska-Odeska-2») are in the design stage and will be connected by the time of completion of rehabilitation.)
- 2 bus coupler feeders
- 2 bus tie feeders.

GIS option covers the full-scale development of the substation and enables further expansion thanks to liberated space without dispatch constraints during the work.

The main scope of work includes:

- Rehabilitation of 110kV switchgear by construction of indoor GIS 110kV under "two main sectionalized busbars with two bus couplers without transfer" busbar scheme on the free space within the existing substation site.
- Dismantling of all outdoor switchyard 110kV.
- Connecting of 3 Autotransformers with the "air – SF6" type connections. The ATs feeders will be distributed between two busbars. The 2nd and 3rd Autotransformers will be connected to busbar 2, while AT-1 and the future AT-4 will be connected to the other busbar (busbar 1).
- Reconnection of 11OTL 110kV to the new portals and their connection to GIS 110kV with gas-insulated bus ducts.
- Connection of 2 underground cable lines by cable terminal modules.

4.1.1.3 Description of Rehabilitation Constructive Process and Civil Work

Rehabilitation of SS Novokyivska with construction of GIS 330kV and 110kV is feasible in conditions of live substation and requires minimum time of equipment outages.

In general, the rehabilitation of switchgear 330kV at SS Novokyivska includes:

a) Construction of the new building to accommodate GIS 330kV equipment («one-and-a-half circuit breaker» scheme) and Substation Control Building (SCB) for relay protection and automation panels in the free space within the existing substation site. Combination of GIS and SCB in the same building is explained by the close process relationship.
b) AT1 and AT2 are moved to a new place, followed by connecting them and AT3 to GIS 330kV. It is assumed that the autotransformer AT3 is already installed. AT1 and AT2 movement to a new location will be made only after the transfer of all consumers 10kV from buses 10kV of SS Novokyivska to buses 10kV of substation 110/10kV Chabany, which was built and commissioned in 2012.
c) Re-connection of OTL 330kV to the new portals. Connection of GIS 330kV to autotransformers (AT1, AT3, etc.) and the existing diversions of OTL 330kV (5 lines) are made by the enclosed SF6 insulated bus ducts.

d) Demolition of existing equipment in outdoor switchyard 330kV and the existing oil sump tank.

Given that all building and electrical connection/wiring work shall be carried out under live substation conditions, connection of GIS 330kV is made in two phases, namely:

First phase of reconstruction:

- Construction of new line portals 22.5 m high, which will reduce the electromagnetic field strength to the normal (safe) values (below 5.0kV/m) and provide the following construction work on live equipment without disconnection of transmission line.
- Re-connection of busbars to connect OTL 330kV to the new portals. In this case only connections of OTL 330kV are sequentially disconnected (the AT connections are remained), line disconnectors, RF line traps and coupling capacitors are dismantled and moved to the new locations.
- Removal of transfer bus system and the relevant disconnectors;
- Construction of a new building GIS 330kV and SCB and installation of equipment are performed. At the ground floor of SCB AC and DC auxiliary boards room and a new DC source - two batteries are located, as well as personnel workstations, server and heating unit.

Second phase of reconstruction:

- Sequential disconnection of OTL 330kV from the existing outdoor switchyard 330kV and autotransformers is made and their connection to GIS 330kV, namely:
    - OTL 330kV "Severna" is disconnected and re-connected to gas-insulated bushings of GIS 330kV, the existing line portal is dismantled, a temporary "bridge" of gas-insulated busbars to supply AT1 is installed, a temporary relay protection and automation of this connection is installed using protection terminals of AT. Then this part is energized from the outdoor switchyard 330kV and OTL 330kV "Severna" is switched on;
    - OTL 330kV "Zhovtneva" is disconnected and re-connected to the gas-insulated bushings of GIS 330kV and put into operation;
    - AT3 and OTL 330kV to CHP-5 are disconnected. Gas-insulated busbars are built to transfer AT3 and OTL 330kV "CPP-5" to GIS 330kV. AT3 and OTL 330kV "CHP-5" are put into operation;
    - OTL 330kV "Trypilska TPP-1" is disconnected and transferred to GIS 330kV;
- Second busbar system of outdoor switchyard 330kV is disconnected and partially dismantled;
- AT2 is disconnected and towed to the new location under the conductors of bay for the line 330kV "Trypilska TPP-2" (which is disconnected). Installation and connection of AT2 and re-connection of OTL 330kV "Trypilska TPP-2" into GIS 330kV is made;
- AT1 is disconnected and a temporary "bridge" dismantled. AT1 is rolled on tracks to its place and connected to GIS 330kV;
- A complete dismantling of equipment and supporting structures in the outdoor switchyard 330kV is made and the works on site improvement and landscaping are performed.
- Construction of the 110kV GIS building at the location of the 330 kV current configuration.
- Reconnection of the Autotransformers.
- Dismantling of the 110 kV current configuration.

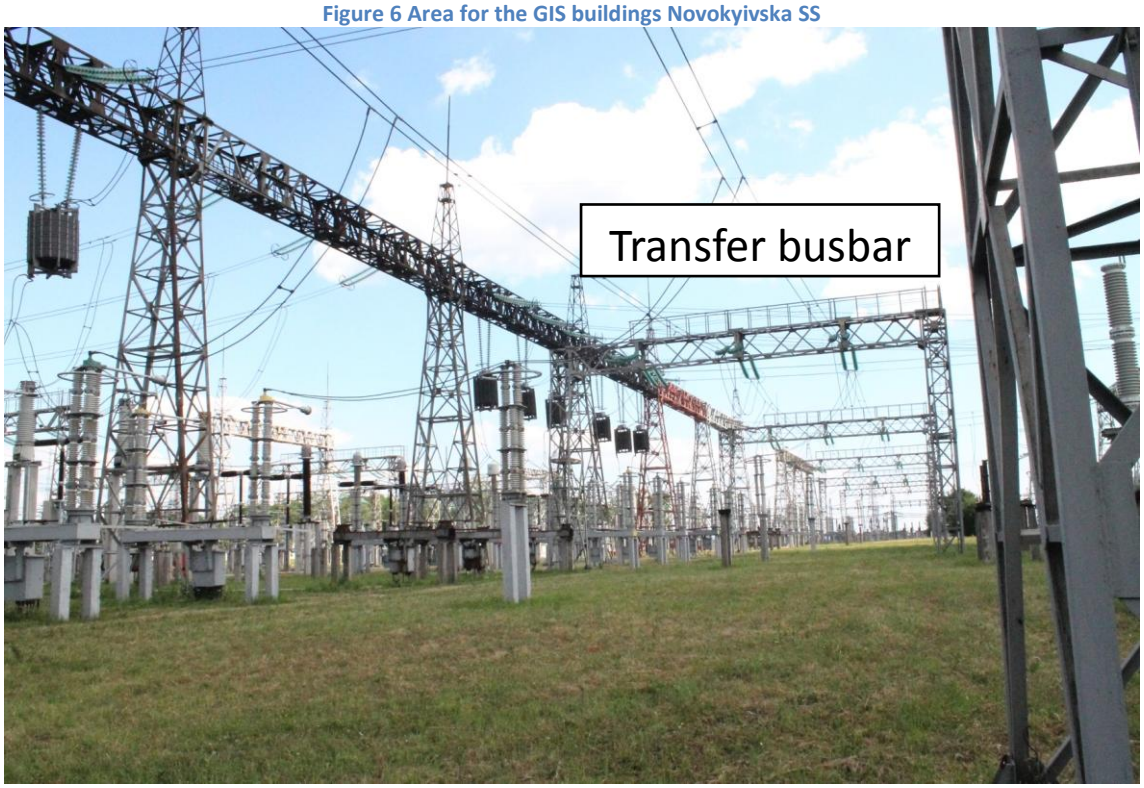
The construction of the GIS 330kV and SCB will be made with the existing outdoor switchyard 330 kV **at the location of transfer busbar system**, after removal of main busbar system and its disconnectors. The current configuration of the substation and the expected rehabilitation is shown in the following figures.

Figure 4 Current Novokyivska configuration

Figure 5 Novokyievska Rehabilitation

The area of the substation where the GIS buildings will be built is shown in the following picture, which was taken in the visit of the Consultant to the substation.

Figure 6 Area for the GIS buildings Novokyivska SS



Civil Work

Following civil work is considered for this project:

- Levelling (excavation and backfills)
- Drainage works
- Retaining, grading and surrounding Walls
- 330kV and 110kV CVT, lightning arrester, line trap, bus duct supports, bus duct insulators and supporting insulator foundations
- Pylon foundations
- Autotransformer foundation (including Loading platforms and railways)
- Concrete fire wall
- Completion of Earthing System
- Gates for vehicles and pedestrian
- Concrete roads and site concrete covering works
- Outdoor lighting poles
- GIS Building Works (Cable gallery + Ground level + Floor(s) 330kV GIS Building (GIS hall, control room, relay room, HF room, battery rooms, office room, toilets, kitchen, workshop, cable gallery, floors, sewer system and clean water system pipe lines between building and main systems, etc.)
- Completion of the electrical works
- Completion of the plumbing works
- Completion of the air conditioned system
- Completion of Guardian house (including sewer system and clean water system pipe lines between building and main systems.)
- Trenches for power cables and fibre optic cables with pipes for Power cable connection

4.1.2 World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Novokyivska Rehabilitation, the project can be classified between Categories B and C. The proposed project has some site-specific adverse impacts, although in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.

The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.1.3 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.1.4 Summary of the impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 4 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R1	**SA**	Negative, direct, permanent, short-term, and irreversible.
		R2	**SA**	N/A
Pedology	Destruction and loss of soil quality	R1	**NULL**	N/A
		R2	**NULL**	N/A
		O	**NULL**	N/A
	Soil pollution by discharges and waste	R1	**SA**	Negative, direct, permanent, short-term and irreversible. .
		R2	**SA**	N/A
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R1/R2/O	**NULL**	N/A
	Contamination of groundwater	R1	**SA**	Negative, direct, temporary, short-term and reversible.
		R2	**SA**	Negative, direct, temporary, short-term and reversible .
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R1	**A**	Negative, direct, temporary, short-term and reversible .
		R2	**A**	Negative, direct, temporary, short-term and reversible .
		O	**SA**	Negative, direct, temporary, short-term and reversible .
	Increase of the noise level	R1	**SA**	Negative, direct, temporary, short-term and reversible .
		R2	**SA**	Negative, direct, temporary, short-term and reversible .
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Fauna and Flora	Degradation of vegetation	R1/R2/O	**NULL**	N/A
	Elimination of vegetation	R1/R2/O	**NULL**	N/A
	Direct destruction of species	R1/R2/O	**NULL**	N/A
	Degradation of the habitat	R1	**SA**	Negative, direct, temporary, short-term and reversible .
		R2	**SA**	Negative, direct, temporary, short-term and reversible .
	Alteration in animal behaviour	R1	**SA**	Negative, direct, temporary, short-term and reversible .
		R2	**SA**	Negative, direct, temporary, short-term and reversible .
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.
Population	Employment generation	R1	**B**	Positive, direct, temporary and short-term.
		R2	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R1	**A**	Negative, direct, temporary, short-term and reversible .
		R2	**A**	Negative, direct, temporary, short-term and reversible .
	Risk of fire	R1	**SA**	Negative, indirect, temporary, short-term and reversible.
		R2	**SA**	Negative, indirect, temporary, short-term and reversible..
		O	**NS**	N/A
	Welfare and life quality	O	**SB**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R1	**B**	Positive, direct, temporary and short-term.
		R2	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R1/R2/O	**NULL**	N/A

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Infrastructures	Alteration of roads	R1	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R1/R2/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.
Landscape	Effects on the landscape quality	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R1	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		R2	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	First reconstruction phase	**R1**
Not significant	**NS**	Second reconstruction phase	**R2**
Small Adverse	**SA**	Operating phase	**O**
Adverse	**A**		
Small Beneficial	**SB**		
Beneficial	**B**		
Severe	**S**		
Critic	**C**		

4.1.5 Identification, characterization and evaluation of impacts

4.1.5.1 Impact on Geology and Geomorphology

- First reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the preparation of land in the area where the GIS building will be constructed and for the dismantling of the current substation.

The construction of the building entails excavations and land levelling, nevertheless as the GIS building will be placed at the location of the former transfer busbar system and as the topography of the parcel is essentially flat, earthmoving is expected to be minimized. Consequently, there will be no significant alteration in the relief due to the project.

The dismantling of the substation requires removing the foundations of the support structure, which involves earthmoving and conforming terrain. This terrain will remain part of the substation area and it is not expected to use it for another purpose. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.
The impact is characterized as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

In the second reconstruction the dismantling works are finished. As in the previous phase, corrective measures shall be implemented after the earthworks. Therefore the impact relief changes is valued as SMALL ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.1.5.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.
The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- First reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, the area where the GIS building will be built has no agricultural or urban purposes and it is currently used for the same activity as it will be after the execution of the reconstruction activities. Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

These discharges are unlikely to happen due to the existence of specific preventive measures for handling these substances, and the maintenance of machinery and equipment assembly. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Therefore, and because the probability of occurrence is low, the impact is described as negative, direct, temporary, short term, irreversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

The same conditions as in the first reconstruction phase are given. Consequently there is a NULL impact of destruction and loss of soil quality, and a SMALL ADVERSE impact of soil pollution by discharges and waste.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.1.5.3 Impact on the hydrology

- First reconstruction phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented

establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered negative, direct, temporary, reversible and recoverable, and valued as SMALL ADVERSE.

- Second reconstruction phase:

The same conditions as in the first reconstruction phase are given. Consequently there is a NULL impact of interruption or alteration of surface hydrology and a SMALL ADVERSE impact of contamination of groundwater.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket will be dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. As the area was already part of the former substation, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.1.5.4 Impact on the air/atmosphere

The construction and commissioning of the new GIS substation will produce changes in its surroundings regarding the air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for each stage of the reconstruction and operation.

- First reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

Moreover, the occurrence of fire would also have an impact on the quality of the air. Insulating oils used in transformers are flammable, consequently preventive measures should be implemented while removing and inserting the oils in the transformers.

The area surrounding the substation is considered as a potential residential zone, and for the years of the substation reconstruction, urbanization plans in these parcels is expected. In this sense, the magnitude of the civil work carried out in the substation is can be considered small compared to that in urbanization plans, and so the impact on the air quality derived from it. However, bearing in mind that the impact is cumulative, alteration of the air quality is considered as a negative, direct, temporary, short term, reversible and recoverable impact, valued as ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures can be found in Section 5.1.

During the first reconstruction phase an increase of the noise levels will be produced by the operation of machinery when performing excavation, earthwork, installation of equipment, etc.

In any case, the equipment and machinery used for the civil works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection"). In this case the urbanization works in the surrounding area is also considered, but expected to comply with the noise regulations as well.

All this, together with the temporary nature of the works and the implementation of preventive and protective measures, makes the impact increase of the noise levels be considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

During this phase the main part of the substation is dismantled which entails a greater use of cranes and adequate transport, however the excavation and movement of earth is reduced. Therefore the alteration of the air quality will be produced in a similar scale than in the first phase. Consequently, this is impact is valued as ADVERSE.

Regarding the increase of the noise levels the magnitude of the impact is similar to the previous phase as well and thus, considered as SMALL ADVERSE.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric system cells.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this

gas represent a product of decomposition, which otherwise involves no greater risk. However, SF6 is a strong greenhouse gas and there are strict regulations which must be complied. In Section 5.2.2 is explained the monitoring plan to deal with any leakage of this gas.

Despite the low probability of existence of these products, the few manoeuvres this equipment requires along its lifespan and the minimal risk that their presence represents, when maintenance operations that may involve some manipulation of gas are required they shall be conducted by qualified personnel and complying the appropriate preventive measures for this type of work. In case this works entailed the gas evacuation from its compartments, it would be collected by the empting and filling staff preventing this way a free discharge to the atmosphere.

On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

Therefore, the alteration of the air quality impact is valued at SMALL ADVERSE.
With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. During the operation of an AIS substation there are two main sources of noise: the one produced by the vibrations of the transformers windings, and the one produced by the actuations of the switches.

In the case of the new Novokyivska GIS substation, noise produced by the vibration of the transformers windings will remain the same as transformer will not be encapsulated. On the contrary, noise from the actuation of the switches will be attenuated to a very low level. It should also be noted that in GIS substations another source of noise appears, however it is given only in the full load time: noise characteristic of the operation of exhaust fans in the GIS room and the climate control in the system control room.

Taking into account everything said so far, it can be said that the reduction of the switches noise is an improvement that not only compensates for the noise produced by the fans, but it also reduces the overall operation noise level of the substation. Therefore this impact is considered as positive, direct and long-term, and valued as BENEFITIAL.

The operation of the substation entails the generation of an electromagnetic field in the surroundings. The project consists in a rehabilitation of the current substation, thus there was already an electromagnetic field cause by the operation of this substation. In any case, this impact is mitigated to the normal/safe values (below 5

kV/m) thanks to the construction of new line portals. Consequently this impact is valued as NOT SIGNIFICANT.

4.1.5.5 Impact on fauna and flora

Flora

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and therefore there will be no need to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, this parcels are considered as residential zones, thus the impact degradation of vegetation is valued as NULL for every phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- First reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the construction of the GIS building is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

The area of the rehabilitation works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term, reversible and recoverable, valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.
Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

Similar conditions as in the previous phase are given, and therefore direct destruction impact is valued as NULL, alteration in the animal behaviour is defined as SMALL ADVERSE, and degradation of the habitat is considered as SMALL ADVERSE.

- Operating phase:

The transformation of the AIS substations into a GIS substation entails an improvement in the impact of danger for the avifauna. This danger is reduced to null as the electric equipment is encapsulated inside the GIS building avoiding the electrocution of any bird species. Thus, this impact is considered as positive, direct, permanent and short-term, valued as BENEFICIAL.

It might be said that power lines that comes in and out of the substation have impacts on bird's behaviour. However, these lines are not going to be modified and its impact is outside of the scope of this assessment.

The regular operation of the substation does not involve any other impact on the fauna.

4.1.5.6 Impacts on the population

- First reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the first and second reconstruction phases, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the first reconstruction phase excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will be carried out within the confines of the substation, and therefore, the size of the trucks required does not cause any inconvenience regarding the entrance to the site or the damage of infrastructures. On the contrary, if a transformer in-out movement was necessary, special trucks would be required that may not fit into the roads or entrance to the SS.

As explained above in this document, the area where the substation is placed is surrounded by plain parcels were there is a low number of usual residents and industrial or agricultural areas.

Taking into account the information given above together with the temporary nature of the effect and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact be considered as negative, direct, temporary, short term, reversible and recoverable, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable, consequently, preventive measures shall be

implemented when removing and inserting them from the transformers, trying to avoid any action that may cause the fire.
In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term, reversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

Employment generation would be produced in this phase as well. As previous this effect is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

In this second reconstruction phase the main part of the dismantling work will be carried out. This entails earth works, movement of equipment and the use of large-sized trucks, which have a direct impact on the noise produced, pollution and traffic in the area.

As considered for the first reconstruction phase, given the characteristics of the area and the mitigation measures that shall be implemented, the discomfort to the population is an effect considered as negative, direct, temporary, short term, reversible and recoverable, valued as ADVERSE.

The risk of fire is equally considered as in the first reconstruction phase: negative, indirect, temporary, short-term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase the substation will need certain maintenance work; however, since these jobs are intermittent and the new configuration of the substation involves the automation of the operation, there would be a decrease of the current number of employees working at the substation. As Ukrenergo is growing as a company it should be able to relocate these job positions that might be lost. Consequently, the impact employment generation is considered as negative, indirect and permanent, valued as ADVERSE.

Regarding effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply. It should be borne in mind that the former operating conditions of the substation allowed a normal operation. Consequently this impact is considered as positive, direct, permanent and short-term, valued as SMALL BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in Novokyivska SS. However, as explained in the Section 4.1.5.4 in this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection

systems causing its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.
In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained in Section 4.1.5.4 this impact is mitigated to the normal/safe values (below 5 kV/m) thanks to the construction of new line portals. The substation is placed in a populated area but outside of a residential zone, consequently it is complying with the regulation. Thus this impact is valued as NOT SIGNIFICANT.
During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). In any case, the change of the SS configuration, from AIS to GIS, improves the security of insulation reducing the possibilities of electrocution of external people. Consequently this impact is considered as positive, indirect, permanent and short-term, valued as SMALL BENEFICIAL.

Furthermore, the introduction of GIS technology into the country can be considered as an improvement of the national technological advance, apart from encourage the creation of trained workers in this area. Therefore, introduction of new technology can be seen as an impact considered positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.1.5.7 Impacts on the economic sectors

- First reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.
Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a

temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Second reconstruction phase:

Same conditions as in the previous phase occur in the second reconstruction phase. Economic dynamization impact is considered as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.1.5.8 Impacts on natural sites and other areas of cultural interest

- First reconstruction phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Second reconstruction phase:

There are not any protected natural sites or any other area of cultural interest in the surroundings of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.1.5.9 Impacts on the infrastructure and service roads

- First reconstruction phase:

Access to the site of Novokyivska SS will be made through roads whose width and preservation is sufficient to perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment. Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and thus the impact is NULL.

- Second reconstruction phase:

The same conditions given in the first reconstruction phase are considered for the second, and in consequence the alteration or modification of national or local roads impact is valued as SMALL ADVERSE and the effects on the rainwater evacuation network are NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.
However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.1.5.10 Impacts on the landscape

- First reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Second reconstruction phase:

The same considerations as in the first reconstruction phase are given for the second stage; consequently the loss of landscape quality impact is valued as SMALL ADVERSE.

- Operating phase:

In this phase the impacts on the landscape caused after the rehabilitation of the SS are assess. In this case, the impact shall be analyzed as the improvement or aggravation of the visual impact of the SS before the rehabilitation. GIS configurations reduce the size of the substations about a 40% and in the same way the height is reduced. Consequently, the impact landscape quality is considered as positive, permanent and short-term, valued as BENEFITIAL.

4.1.5.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- First reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Transformers are not transported from outside the substation as the current one will be use for the new configuration. Therefore, mineral oil would only be

transported small distances inside of the SS area. Necessary measures described in Section 4.1.5.3 shall be implemented when handling the oils.
Thus, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old Novokyivska configuration. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Second reconstruction phase:

In this phase the conditions given are the same than in the first one, and consequently the two possible impacts are valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in Section 4.1.5.2.

In the event of equipment structure or system malfunction, there might be a loss of SF6 from the electric system cells. As explained in Section 4.1.5.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. Regarding the greenhouse effects a leakage might have, a monitoring plan explained in Section 5.2.2 is carried out, avoiding further consequences.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.1.6 Classification of the Project based on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Novokyivska Rehabilitation, the project can be classified between Categories B and C. The proposed project has some site-specific adverse impacts, although in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.

The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring

and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.2 October Rehabilitation

4.2.1 Project description and actions arising

4.2.1.1 Site and locality

Substation 330/110/35/10kV October, which belongs to Central Power System (CPS) of IPS of Ukraine, is located in the residential area almost in the centre of Kiev and covers an area of 3.9 hectares. The substation was commissioned in 1958 as a step-down substation 110/35/10kV, and since 1961, after the construction of OTL 330kV Novokyivska - October and installation of Autotransformers AT-1 and AT-2, was converted to the voltage 330/110/35/10kV.

Given the locality of the SS, close to the centre of the Kiev and in a residential area, in order to minimize the impact the rehabilitation plan shall not involve expansion of the current area of the substation.

The fact that the substation is located in this area also entails that the fauna and flora around it is limited.

Air quality in Kiev city is very deteriorated due to atmospheric pollution. General perception of pollution in the air by citizens and visitors is 81.82 out of 100. Noise and light pollution perception is 40.91 out of 100. Consequently, air quality perception reaches only 18.18 out of 100.

Figure 7 Location of October Substation

Figure 8 October SS

Accesses to the Substation are described in detail in Section 4.2.4.9.

4.2.1.2 Description of Substation New Configuration

At 330 kV level

The project foresees construction of GIS 330kV under the "one-and-a-half-breaker" scheme. Within the scope of the rehabilitation there will be provided and installed only two modules, which are enough for the existing and ongoing connections, and there will be spare places for other two diameters in both the switchgear field and the control room. It is expected that the procurement and implementation of the futures bays becomes part of the contract of each of the additional elements (transformers or lines).

- The connections considered for the rehabilitation are two 330kV line feeders (one existing overhead transmission line Novokyivska-October and one projected cable line Zakhidna-October), and 2 AT feeders.
- The spare places for two future diameters are considering the connection of the third transformer AT3 and two additional spare places required by Ukrainian standard.

This change of SS configuration and connection of a second 330kV feeding line Zakhidna-October will solve the problem of the reliable power supply to the consumers fed by SS October, which is now connected to 330kV grid by only one OTL 330kV Novokyivska – October. Switchgear 330kV scheme at SS October will be brought in compliance with applicable regulations with the possibility of further extension.

Given the location of SS October (near the centre of Kyiv, in residential area) and limited site area, a new 330kV line Zakhidna-October can be considered only as a

cable option with partial use of the existing route of 330kV transmission line Novokyivska - October, while reconstruction of 330kV switchgear is made by installation of GIS 330kV.

The main scope of work includes:

- Construction of indoor GIS 330kV;
- Construction of a new substation control building combined with the GIS 330kV building for relay protection and automation panels in the free space within the existing substation site;
- Installing two Autotransformers feeders with Autotransformers connection to GIS 330kV of the "air – SF6" type;
- Reconnection of the AT-1 and AT-2 to the "air-SF6" type connection; Reconnection of OTL 330kV to the new portals and its connection to GIS by enclosed SF6 insulated bus ducts;
- Dismantling of all outdoor switchyard 330kV.

At 110 kV level

The project foresees construction of GIS 110kV under "two main busbars without transfer busbar" scheme. The busbars are segmented with bus tie circuit breakers. Even though the total technical solution, the one analyzed in the chapter of selection of alternatives, foreseen a switchgear of 24 bays, within the scope of the rehabilitation there will be provided and installed only 16 bays, which are enough for the existing and ongoing connections, and there will be spare places for the other eight bays in both the switchgear field and the control room. It is expected that the procurement and implementation of the futures bays becomes part of the contract of each of the additional elements (transformers or lines).

- The connections considered for the rehabilitation are:
  - 2 Autotransformer feeders (for the two existing AT)
  - 10 bays for the existing feeders, 6 OTLs + 4 underground cables
  - 2 bus coupler bays
  - 2 bus tie feeders.

- The spare places for eight future bays are considering the following connections:
  - 1 Spare places for autotransformer feeder (for the additional AT3)
  - 3 Spare places for future lines feeders in the midterm (Polytecnichna 3 and Lukianivska 1,2)
  - 4 Spare places for future lines feeders in the long term (reconnection from 35 kV into 110 kV - Kievenergo)

4.2.1.3 Description of Rehabilitation Constructive Process and Civil work

The proposed solution for SS October rehabilitation can be easily implemented in live substation conditions. The work sequence is as follows:

- GIS building for 330kV switchgear is built at the selected location which is shown in Figure 10
- New cable line Zakhidna-October is connected to GIS by cable termination kit.
- Existing AT-1 and AT-2 connected to GIS 330kV by connection of "air-SF6" type.
- 330kV feeding line at SS October is old and will need some rehabilitation: about 50 towers have to be replaced, when finally the line is out of service. Now an outage of 330kV OTL Novokyivska-October for any considerable time is practically impossible.

- 330kV OTL Novokyivska-October is reconnected to new portal and connected to GIS by enclosed SF6 insulated bus duct.
- Dismantling of existing 330 kV switchgear.
- GIS building for 110kV switchgear is built at the current location of the 330 kV switchgear.
- Existing AT-1 and AT-2 connected to GIS 110kV by connection of "air-SF6" type.
- 110kV OTL line is connected to new 110kV GIS by enclosed SF6 insulated bus duct.

The addition of the bus circuit breakers, and therefore the bus tie feeders on the two main busbars makes it necessary to add one new bay. This bay shall be assembled nearby the existing ones, and one of the current lines will be transferred to it. The selected area for it is show in Figure 10.

The bay left shall be used for the circuit breakers need to sectionalizing the main busbars. In Figure 9 and Figure 10 the current configuration and the rehabilitation of the SS are shown.

Figure 9 Current October configuration

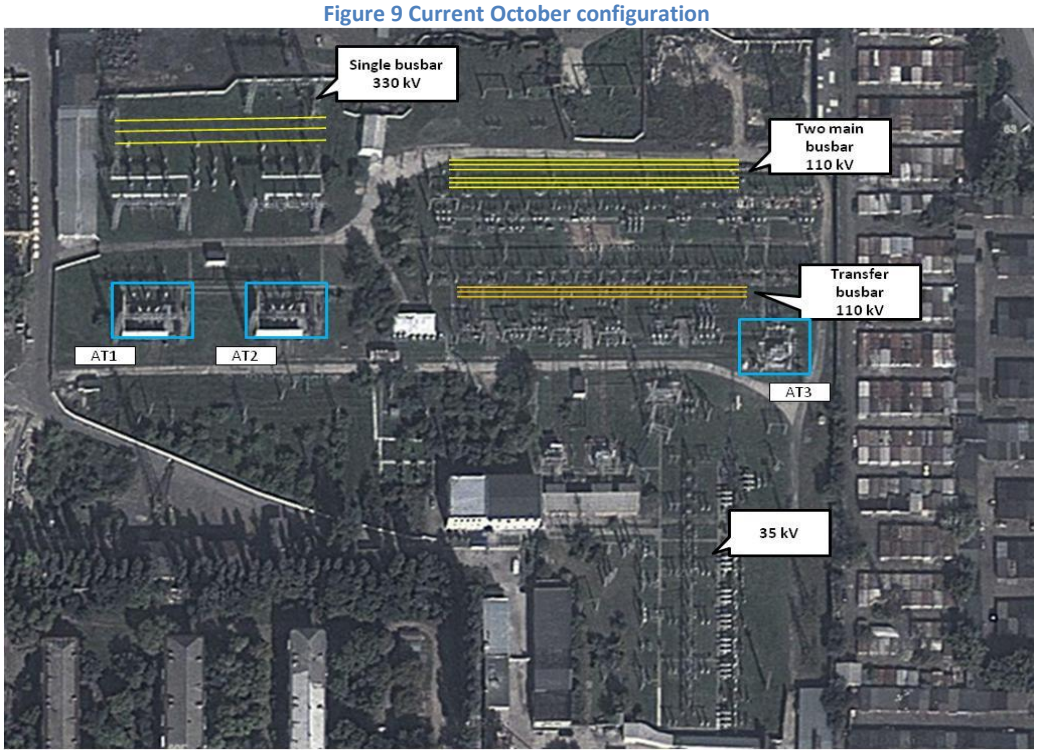
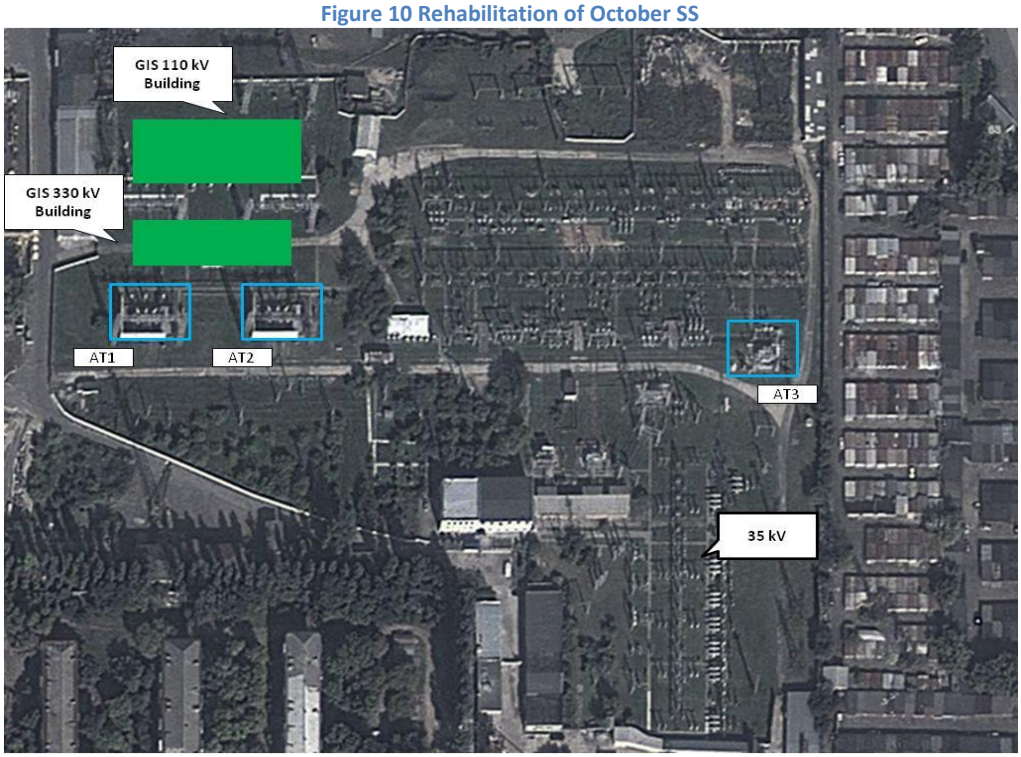


Figure 10 Rehabilitation of October SS



Civil Work

Following civil work is considered for this project:

- Leveling (excavation and backfills)
- Drainage works
- Retaining, grading and surrounding Walls
- 330kV and 110kV CVT, lightning arrester, line trap, bus duct supports, bus duct insulators and supporting insulator foundations
- Pylon foundations
- Concrete fire wall
- Completion of Earthing System
- Gates for vehicles and pedestrian
- Concrete roads and site concrete covering works
- Outdoor lighting poles
- GIS Building Works (Cable gallery + Ground level + Floor(s))
- 330kV and 110 kV GIS Building (GIS hall, control room, relay room, HF room, battery rooms, office room, toilets, kitchen, workshop, cable gallery, floors, sewer system and clean water system pipe lines between building and main systems, etc.)
- Completion of the electrical works
- Completion of the plumbing works
- Completion of the air conditioned system
- Completion of Guardian house (including sewer system and clean water system pipe lines between building and main systems.)
- Trenches for power cables and fibre optic cables with pipes for Power cable connection

4.2.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.2.3 Summary of the Impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 5 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
Pedology	Destruction and loss of soil quality	R	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R/O	**NULL**	N/A
	Contamination of groundwater	R	**NS**	N/A
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R/O	**NULL**	N/A
	Elimination of vegetation	R/O	**NULL**	N/A
	Direct destruction of species	R/O	**NULL**	N/A
	Degradation of the habitat	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Population	Employment generation	R	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	R	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		O	**NS**	N/A
	Welfare and life quality	O	**B**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, indirect, permanent and short-term.
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R/O	**NULL**	N/A
Infrastructures	Alteration of roads	R	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Landscape	Effects on the landscape quality	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	Reconstruction phase	R
Not significant	**NS**	Operating hase	O
Small Adverse	**SA**		
Adverse	**A**		
Small Benefitial	**SB**		
Benefitial	**B**		
Severe	**S**		
Critic	**C**		

4.2.4 Identification, characterization and evaluation of impacts

4.2.4.1 Impact on Geology and Geomorphology

- Reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the preparation of land in the area where the 330 and 110 kV GIS buildings will be constructed and for the dismantling of the current configurations.

The construction of the GIS building entails excavations and land levelling. The parcel where the substation is located is essentially flat, and the buildings shall be place inside the area of the substation, in the 330 kV switchyard. Therefore, earthworks needed for the construction of the building are expected to be minimized.

The dismantling of the current configurations requires removing the foundations of the support structure, which involves earthmoving and conforming terrain. In part of this area the GIS buildings will be built, and the rest of the terrain will remain part of the substation area and it is not expected to be used for another purpose. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.

Taken into account all above, and since the area affected is wholly inside the area of the substation and it will not be used for any other purposed, this impact is considered as negative, direct, permanent and short-term, valued as SMALL ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.2.4.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.

The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, as mentioned above, the area where the earthworks shall be carried out is inside the substation, and thus it has no agricultural or urban purposed and it is currently used for the same activity as it will be after the rehabilitation.

Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

In the case of October rehabilitation, transformers will not be moved avoiding this risk. All machinery used in the civil works shall have passed all relevant inspections and be in good condition to perform the work, minimizing, in this way, any risk of leakage. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Due to the small possibility of these discharges to happen, and the fast measured that would be develop if it did, this impact is considered as NOT SIGNIFICANT.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.2.4.3 Impact on the hydrology

- Reconstruction phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered NOT SIGNIFICANT.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket will be dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. As the area was already part of the former substation, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.2.4.4 Impact on the air/atmosphere

The rehabilitation of the substation and construction and commissioning of the new GIS building, will produce changes in its surroundings regarding air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for the stages of reconstruction and operation.

- Reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

The area surrounding the substation is a residential zone, and thus population will be directly affected. The impact alteration of the air quality is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures are shown in Section 5.1.

During the reconstruction phase an increase of the noise level will be produced by the operation of machinery when performing the excavation, earthwork, installation of equipment, etc. In any case, the equipment and machinery used for the civil

works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection"). However, even though civil works are expected to comply with the noise regulations, since the substation is located in a residential area, the impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some corrective measures shall be performed, as strictly complying with schedules in order to minimize the working time and reduce the inconvenience to the population living or working in the surroundings.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric system cells in the 330 and 110 kV switchyard.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. Despite the low probability of existence of these products, the few manoeuvres this equipment requires along its lifespan and the minimal risk that their presence represents, when maintenance operations that may involve some manipulation of gas are required they shall be conducted by qualified personnel and complying the appropriate preventive measures for this type of work. In case this works entailed the gas evacuation from its compartments, it would be collected by the empting and filling staff preventing this way a free discharge to the atmosphere.

On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

On the 35 kV switchyard, it should be noticed the possibility of ozone production due to corona. The target of this assessment is to analyze the impact produced by the rehabilitation. In this case, the substation is already operating, and thus this is not an impact produced by the operation after the rehabilitation. Anyway, the ozone production in a high voltage line ranges between 0.5 and 5 g per kW/h due corona, depending on the weather conditions. Even under the worse conditions, this amount of ozone is insignificant and it is immediately dissipated to the atmosphere. The alteration of the air quality impact is considered as negative, direct, permanent and reversible, valued as SMALL ADVERSE.

With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. During the operation of an AIS substation there are two main sources of noise: the one produced by the vibrations of the transformers windings, and the one produced by the actuations of the switches.

In the case of October SS, the 330 and 110 kV configurations will be modified to a GIS building. However, transformers will not be replaced, and thus the noise produced by the vibration of the windings will remain the same. On the contrary, noise from the actuation of the switches will be attenuated to a very low level. It should be noted that in GIS substations another source of noise appears, however it is given only in the full load time: noise characteristic of the operation of exhaust fans in the GIS room and the climate control in the system control room.

Taking into account everything said so far, it can be said that the reduction of the switches noise is an improvement that not only compensates for the noise produced by the fans, but it also reduces the overall operation noise level of the substation. Therefore this impact is considered as positive, direct and long-term, and valued as BENEFITIAL.

The generation of an electromagnetic field does not change from the former operation of the substation, in which the limits set by the regulation were respected. Therefore this impact is considered as NOT SIGNIFICANT.

4.2.4.5 Impact on fauna and flora

Flora

- Reconstruction phase:

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and mostly it will not be necessary to eliminate vegetation.
Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, this parcels are considered as residential zones, thus the impact degradation of vegetation is valued as NULL.

- Operating phase:

No impact on the flora is considered in this phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the performance of the works is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

The area of the rehabilitation works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term and reversible valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.

Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

The transformation of the AIS substations into a GIS substation (in the 330 and 110 kV switchyards) entails an improvement in the impact of danger for the avifauna. This danger is reduced to null as the electric equipment is encapsulated inside the GIS building avoiding the electrocution of any bird species. Thus, this impact is considered as positive, direct, permanent and short-term, valued as BENEFICIAL.

It might be said that power lines that comes in and out of the substation have impacts on bird's behaviour. However, these lines are not going to be modified and its impact is outside of the scope of this assessment.

The regular operation of the substation does not involve any other impact on the fauna.

4.2.4.6 Impacts on the population

- Reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the reconstruction phase, excavations and movement of equipment will be carried out. This involves the use of cranes,

affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will not be necessary, and therefore, regular trucks can be used. On the contrary, if a transformer in-out movement was necessary, normal size trucks are not valid and special ones would be required.

Taking into account this information together with the temporary nature of the effects and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact to be considered as negative, direct, temporary, shor-term and reversible, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, works near transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable; consequently, preventive measures shall be implemented when performing works near them, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase the substation will need certain maintenance work; however, the new GIS configurations in the 330 and 110 kV switchyards involve the automation of the operation and there would be a decrease of the current number of employees. Ukrenergo is a growing and strong company and should be able to relocate these job positions that might be lost. Consequently, the impact employment generation is considered as negative, indirect and permanent, valued as ADVERSE.

With regard to the effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply of the customers fed by the SS October. It should be borne in mind that the former operating conditions of the substation allowed a normal operation although it had a low reliability. Consequently this impact is considered as positive, direct, permanent and short-term, valued as BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in October SS. However, as explained in the Section 4.2.4.4 in this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection systems causing

its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.

In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained before, the rehabilitation will not change the values of the electromagnetic fields produced by the operation of October SS. These values will remain under the maximum valued allowed for a residential area, which is 1 kV/m.
During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). In any case, the change of the SS configuration in the 330 and 110 kV switchyard, from AIS to GIS, improves the security of insulation reducing the possibilities of electrocution of external people. Consequently this impact is considered as positive, indirect, permanent and short-term, valued as SMALL BENEFICIAL.

Furthermore, the introduction of GIS technology into the country can be considered as an improvement of the national technological advance, apart from encourage the creation of trained workers in this area. Therefore, introduction of new technology can be seen as an impact considered positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.2.4.7 Impacts on the economic sectors

- Reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.
Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a

temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.2.4.8 Impacts on natural sites and other areas of cultural interest

- Reconstruction phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.2.4.9 Impacts on the infrastructure and service roads

- Reconstruction phase:

Access to October SS will be made through roads whose width and preservation is sufficient to perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment. The entrance to the substation shall not be made through the regular one as it would be blocked. Instead the access to the site will be made directly to the area where the equipment and machinery will be placed. This access requires the demolition of a small brick wall which belongs to the substation and shall not have any secondary impact.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 11 the roads used for the access to the substation are shown.

Figure 11 Access roads to October SS

Regarding the possible effects en the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.2.4.10 Impacts on the landscape

- Reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

In this phase the impacts on the landscape caused after the rehabilitation of the SS are assess. In this case, the impact shall be analyzed as the improvement or aggravation of the visual impact of the SS before the rehabilitation. GIS configurations reduce the size of the substations about a 40% and in the same way the height is reduced. Consequently, the impact landscape quality is considered as positive, permanent and short-term, valued as BENEFITIAL.

4.2.4.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Movements of transformers are not necessary in this rehabilitation and thus the risk of possible mineral oil discharges is avoided. Therefore, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.
As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old October 330 and 110 kV configurations. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in Section 4.2.4.2.

In the event of equipment structure or system malfunction, there might be a loss of SF6 from the electric system cells. As explained in Section 4.2.4.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.2.5 Classification of the Project based on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 October Rehabilitation, given the urban nature of the area where it is located, the project can be classified as Category B. The proposed project has some site-specific adverse impacts, although they are not critical and can be mitigated or avoided with the implementation of corrective or protective measures. Besides, it also entails beneficial impacts.

The necessary EA for this kind of projects depends on the specific characteristics of each one. In any case, it examines the porject's potential negative and positive environmental impacts and recommends any measured needed to prevent, minimize, mitigate or compensate for adverse repercussions and improve environmental performance.

The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.3 Kremenchug Rehabilitation

4.3.1 Project description and actions arising

4.3.1.1 Site and locality

Substation 330/150/10kV "Kremenchug" is located on the northern outskirts of the city of Kremenchug, Poltava region, at a 2 km distance from the city line in the industrial area at Kremenchug.

Kremenchug substation is not placed in an urban area, and the surrounding land is uninhabited and not used for agriculture purposes.

Kremenchug is the centre of an industrial complex based on a hydroelectric plant; construction of the plant created the large Kremenchug Reservoir nearby. Kremenchug has a heavy machine industry and a small oil refinery. The presence of these industries affects directly to the air quality of the location. In 2011 Kremenchug was one of the three cities in Ukraine which high rates of pollution exceeded 5 maximum acceptable concentration rates.

Lands surrounding Kremenchug SS are not inhabited and in general are not used for agricultural or animal husbandry. The substation has a large empty territory around it, and thus, it could be used for the rehabilitation works and future configuration in case it is necessary.

Figure 12 Kremenchug SS situation

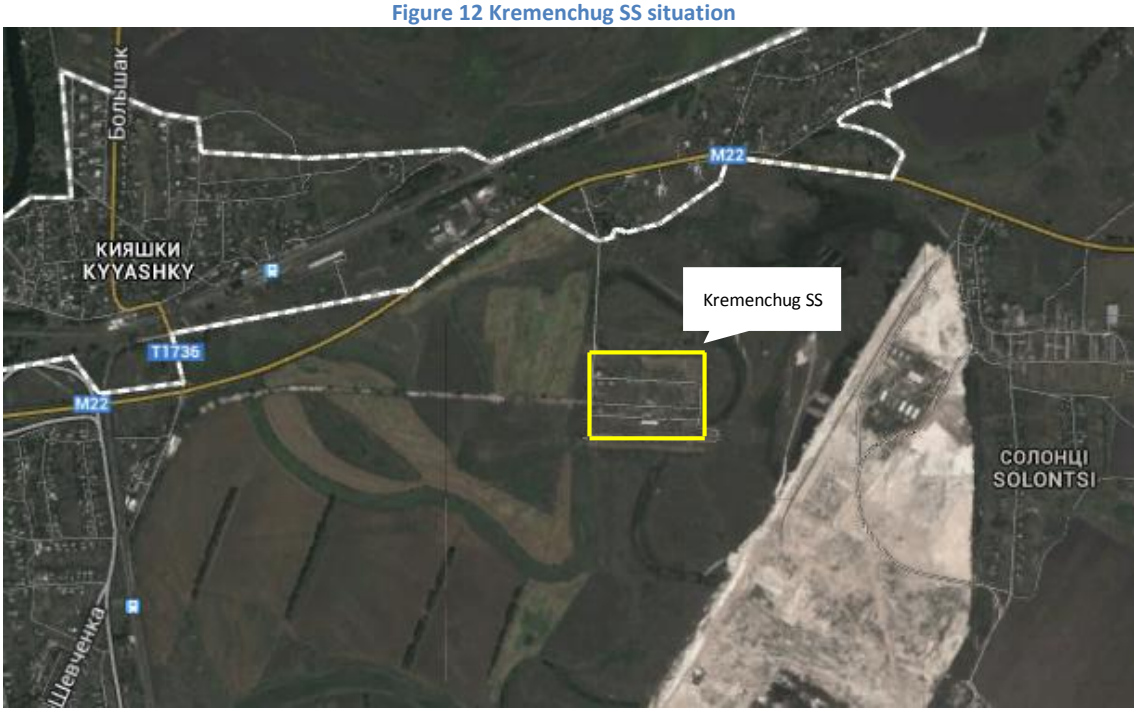


Figure 13 Kremenchug SS

4.3.1.2 Description of Substations New Configuration

The 330kV and 150 kV switchyards will be reconstructed as indoor GIS.
After rehabilitation Kremenchug SS will present the following configuration.
330kV level switchyard will be transferred to one-and-a-half-breaker scheme, organized in four modules providing eight bays for the following connections:

- 4 OTLs feeders
- 4 Autotransformer feeders
- Indoor GIS system

Future expansion on 330 kV switchyard with space for an arrangement of the fifth diameter (two bays) to accommodate two 330 kV OTL will be envisaged.

- Autotransformer AT4 is installed and commissioned

150kV switchyard will be reconstructed maintaining the wiring scheme "two main busbars without transfer busbar". The busbars are segmented with bus tie circuit breakers. The total technical solution foresees a switchgear of 25 bays, within the scope of the rehabilitation there will be provided and installed only 21 bays (25 circuit breaker modules), which are enough for the existing and ongoing connections, and there will be spare places for the other four bays in both the switchgear field and the control room. It is expected that the procurement and implementation of the future bays becomes part of the contract of each of the additional elements (transformers or lines).

- The connections considered for the rehabilitation are:
  - 4 Autotransformer feeders (for the three AT into operation and the fourth AT to be connected)
  - 17 bays for OTLs
  - 2 bus coupler bays

- 2 bus tie feeders.

Totaling 21 connections (25 CB modules).

- The spare places for four future bays.

The outdoor switchyard 330kV at SS Kremenchug needs to be converted to the "one-and-a-half-breaker" scheme, which corresponds to the requirements of Ukrainian technical standards.

To increase a supplied load of the SS and thus ensure a reliable supply to the existing and prospective customers it is envisaged to connect the AT-4 330/150kV of 250 MVA capacity at SS "Kremenchug", which is already installed on site (placed on foundation in 1993, completion degree is about 60%), but not connected to the network 150kV and 330kV.

The connection of AT-4 will increase the levels of short-circuit currents to a value that exceeds the breaking current-carrying capacity of 150kV circuit breakers installed at outdoor switchyard 150kV, therefore connection to the 330/150kV grid of 4AT and reconstruction of the 330kV and 150kV switchgear at SS "Kremenchug" must be carried out in parallel.

The scope of work includes as follows:

- Commissioning of the fourth Autotransformer;
- Replacement of the outdoor switchyard 330kV with indoor GIS under "one-and-a-half breaker" scheme;
- Replacement of the outdoor switchyard 150kV with indoor GIS under "two main segmented with bus tie circuit breakers busbars without transfer busbar" scheme;
- Connecting of 3 Autotransformers with the "air – SF6" type connections.
- Reconnection of 330 kV and 150 kV OTLs to the new portals and their connection correspondingly to GIS 330 kV and 150kV with gas-insulated bus ducts;
- Dismantling of the existing outdoor AIS switchyards 330 kV and 150 kV;
- Dismantling of the existing substation control building;
- Presently, at Kremenchug SS there are two compressor stations for compressed air for air circuit breakers 330kV and 150kV. After reconstruction the compressor stations have to be dismantled.

4.3.1.3 Description of Rehabilitation Constructive Process and Civil Work

The rehabilitation of 330 kV switchyard will be performed in two stages:

First phase

Construction of a new building to accommodate GIS 330kV equipment («one-and-a-half circuit breaker» scheme) and Substation Control Building (SCB) for relay protection and automation panels in the free space within the existing substation site. Combination of GIS and SCB in the same building is explained by the close process relationship. As an initial suggestion, the new building can be placed on the spare area in the northern part of the SS land plot.

Installation of equipment is performed: GIS and measurement, control and protection equipment, as well as auxiliary services.

Second phase

Sequential disconnection of OTL 330kV and autotransformers from the existing outdoor switchyard 330kV and their connection to GIS 330kV, namely:

- OTL 330kV "Kremenchug HPP" and AT3 are disconnected and re-connected to gas-insulated bushings of GIS 330kV, temporary relay protection and automation of this connection is installed using protection terminals of AT. Then all parts are energized from the switchyard 330kV and 150kV and put into operation.
- In the same manner next diameter formed by OTL 330kV "Myrgorod" and AT1 is disconnected and re-connected to the gas-insulated bushings of GIS 330kV and put into operation;
- After that, we proceed to disconnect and re-connect to gas-insulated bushings of GIS 330kV OTL "Poltava" and "Dneprovska" in the same diameter (and disconnect and reconnect AT2 in the next (fourth) diameter.
- Finally will proceed to connection of AT4 and to the same diameter as AT2 (fourth).

Disconnections and reconnections will be conducted in short intervals, coinciding with weekends.

Before connecting AT to GIS it is necessary to move them, bringing them closer to the 330kV GIS.

The connection of AT4 should be made after finishing the reconstruction of 150kV switchyard as it would cause short-circuit currents exceeding the breaking current-carrying capacity of the old 150kV circuit breakers of switchyard 150kV.

The sequence of works for GIS 150kV is the same as for GIS 330kV.
The ATs feeders will be spread between the two busbars. The 2nd and 3rd Autotransformers will be connected to busbar 2 while AT-1 and the future AT-4 will be connected to the other busbar (busbar 1). This ATs connection ensures greater safety and operational flexibility with respect to the current situation, and provides the uninterrupted energy supply in the case of a busbar affected by a failure.

Location of Autotransformers, GIS building 330kV and substation control building is performed in coordination with GIS 150kV.

Construction of both 330 kV and 150 kV GIS can be performed in parallel.

Final phase

- Complete dismantling of equipment and supporting structures in the outdoor switchyards 330kV and 150 kV.
- Complete dismantling of equipment of the air compressor stations for air circuit breakers 330kV and 150kV.
- Carrying out the works of site improvement and landscaping at an important free area left.
- Works of dismantling of the switchyard 330kV may be performed in parallel with the reconstruction of 150kV switchyard, because it will take longer duration and mark, by far the total time of the reconstruction of the SS Kremenchug, on condition that the equipment of both switchyards will be available for the same dates.

The current configuration of Kremenchug SS is shown in Figure 14.

Figure 14 Kremenchug SS Current Configuration

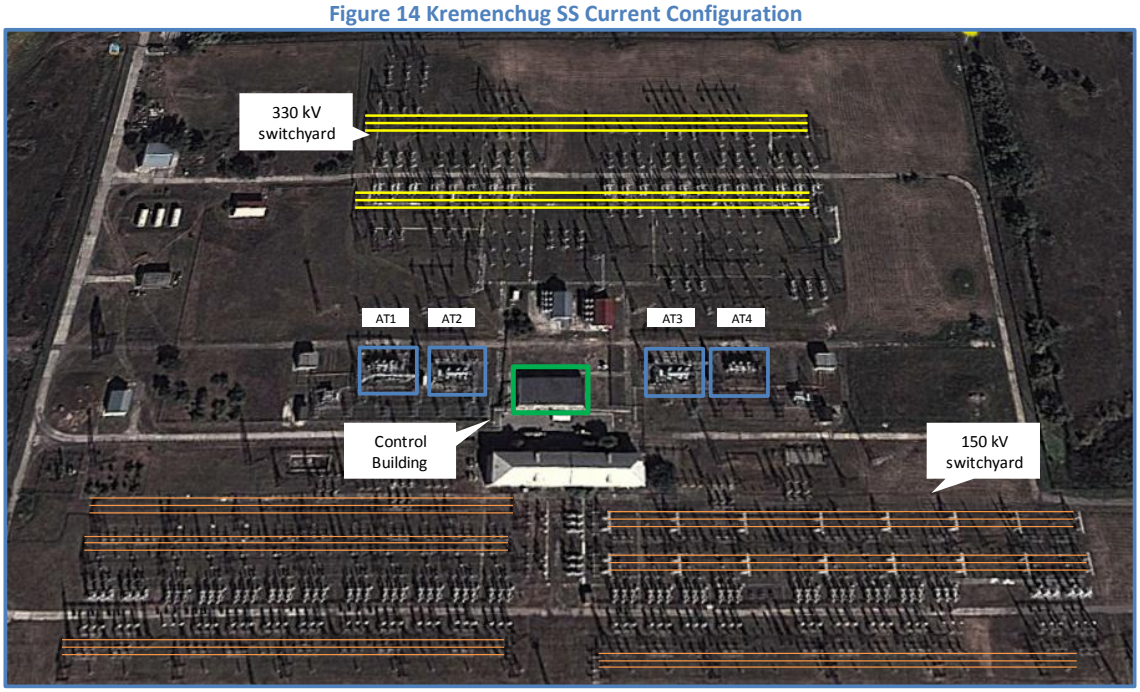


Figure 15 Kremenchug SS rehabilitation

Civil Works of covers followings: leveling (excavation and backfills), drainage works, retaining, grading and surrounding walls, foundations of all equipment (including loading platforms and railways), concrete fire wall, grounding system, gates for vehicles and pedestrian, concrete roads and site concrete covering works, outdoor lighting poles, building works, air conditioned system and guardian house.

4.3.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.3.3 Summary of the impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 6 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R	**A**	Negative, direct, permanent, short-term and irreversible
Pedology	Destruction and loss of soil quality	R	**SA**	Negative, direct, permanent, short-term and irreversible
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R	**SA**	Negative, direct, permanent, short-term and irreversible
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R/O	**NULL**	N/A
	Contamination of groundwater	R	**NS**	N/A
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**SA**	Negative, direct, permanent, short-term and irreversible
Atmosphere	Alteration of the air quality	R	**A**	Negative, direct, temporary, short-term and reversible
		O	**SA**	Negative, direct, temporary, short-term and reversible
	Increase of the noise level	R	**SA**	Negative, direct, temporary, short-term and reversible
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R/O	**NULL**	N/A
	Elimination of vegetation	R/O	**NULL**	N/A
	Direct destruction of species	R/O	**NULL**	N/A
	Degradation of the habitat	R	**SA**	Negative, direct, temporary, short-term and reversible
	Alteration in animal behaviour	R	**SA**	Negative, direct, temporary, short-term and reversible
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Population	Employment generation	R	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R	**A**	Negative, direct, temporary, short-term and reversible.
	Risk of fire	R	**SA**	Negative, indirect, temporary, short-term and reversible
		O	**NS**	N/A
	Welfare and life quality	O	**B**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, indirect, permanent and short-term.
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R/O	**NULL**	N/A
Infrastructures	Alteration of roads	R	**SA**	Negative, direct, permanent, short-term and reversible
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.
Landscape	Effects on the landscape quality	R	**SA**	Negative, direct, permanent, short-term and reversible
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R	**SA**	Negative, direct, temporary, short-term and reversible
		O	**NS**	N/A
	Hazardous materials due to dismantling	R	**SA**	Negative, direct, temporary, short-term and reversible

Legend			
Null	**NULL**	First reconstruction phase	**R1**
Not significant	**NS**	Second reconstruction phase	**R2**
Small Adverse	**SA**	Operating phase	**O**
Adverse	**A**		
Small Beneficial	**SB**		
Beneficial	**B**		
Severe	**S**		
Critic	**C**		

4.3.4 Identification, characterization and evaluation of impacts

4.3.4.1 Impact on Geology and Geomorphology

- Reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the preparation of land in the area where the GIS building will be constructed and for the dismantling of the current substation.

The construction of the building entails excavations and land levelling. The GIS building will be placed on the adjacent area to the substation. The topography of this land is essentially flat and therefore earthmoving is expected to be minimized. Consequently, there will be no significant alteration in the relief due to the project. Nevertheless it shall be noted that this plot is not a current part of the substation, and thus the impact is, in this way, higher.

The dismantling of the substation requires removing the foundations of the support structure, which involves earthmoving and conforming terrain. This terrain will remain part of the substation area and it is not expected to use it for another purpose. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.
The impact is characterized as negative, direct, permanent, short-term, reversible and recoverable, valued as ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.3.4.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.

The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, the area where the GIS building will be built has no agricultural or urban purposes although it is not currently part of the substation. This land shall be grounded and adapted to meet the requirements to be a part of a substation. Any other potential use of this land will be dismissed, however, the size of such land is relatively small and it was not expected to be used for any other purposes. Consequently, the impact destruction and loss of soil quality is considered as negative, direct, temporary, short term, irreversible and recoverable, valued as SMALL ADVERSE.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

These discharges are unlikely to happen due to the existence of specific preventive measures for handling these substances, and the maintenance of machinery and equipment assembly. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Therefore, and because the probability of occurrence is low, the impact is described as negative, direct, temporary, short term, irreversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.3.4.3 Impact on the hydrology

- Reconstruction phase:

In the area where the civil works will be developed there is no natural river channel, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater

is considered negative, direct, temporary, reversible and recoverable, and valued as NOT SIGNIFICANT.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket will be dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. Since the area that will be used is relatively small, the impact disruption of the natural flow of water into aquifers is considered as negative, direct, permanent, short term, irreversible and recoverable, valued as SMALL ADVERSE.

4.3.4.4 Impact on the air/atmosphere

The construction and commissioning of the new GIS substation will produce changes in its surroundings regarding the air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for each stage of the reconstruction and operation.

- Reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.
Moreover, the occurrence of fire would also have an impact on the quality of the air. Insulating oils used in transformers are flammable, consequently preventive measures should be implemented while removing and inserting the oils in the transformers.

Taking into account that the lands surrounding the substation are not inhabited, and that no other civil works are expected to occur in the rehabilitation period, alteration of the air quality is considered as a negative, direct, temporary, short term, reversible and recoverable impact, valued as ADVERSE. Some mitigation

measures shall be held in order to reduce the impact. Preventive and corrective measures can be found in Section 5.1.

During the reconstruction phase an increase of the noise levels will be produced by the operation of machinery when performing excavation, earthwork, installation of equipment, etc.

In any case, the equipment and machinery used for the civil works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection").

All this, together with the temporary nature of the works and the implementation of preventive and protective measures, makes the impact increase of the noise levels be considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric system cells.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. However, SF6 is a strong greenhouse gas and there are strict regulations which must be complied. In Section 5.2.2 is explained the monitoring plan to deal with any leakage of this gas.

Despite the low probability of existence of these products, the few manoeuvres this equipment requires along its lifespan and the minimal risk that their presence represents, when maintenance operations that may involve some manipulation of gas are required they shall be conducted by qualified personnel and complying the appropriate preventive measures for this type of work. In case this works entailed the gas evacuation from its compartments, it would be collected by the empting and filling staff preventing this way a free discharge to the atmosphere.

On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

Therefore, the alteration of the air quality impact is valued at SMALL ADVERSE.
With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. During the operation of an AIS substation there are two main sources of noise: the one produced by the vibrations of the transformers windings, and the one produced by the actuations of the switches.

In the case of the new Kremenchug GIS substation, noise produced by the vibration of the transformers windings will remain the same as transformer will not be encapsulated. On the contrary, noise from the actuation of the switches will be attenuated to a very low level. It should also be noted that in GIS substations another source of noise appears, however it is given only in the full load time: noise characteristic of the operation of exhaust fans in the GIS room and the climate control in the system control room.

Taking into account everything said so far, it can be said that the reduction of the switches noise is an improvement that not only compensates for the noise produced by the fans, but it also reduces the overall operation noise level of the substation. Therefore this impact is considered as positive, direct and long-term, and valued as BENEFITIAL.

The operation of the substation entails the generation of an electromagnetic field in the surroundings. The project consists in a rehabilitation of the current substation, thus there was already an electromagnetic field cause by the operation of this substation. Consequently this impact is valued as NOT SIGNIFICANT.

4.3.4.5 Impact on fauna and flora

Flora
Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.
The area where the reconstruction will be carried is mainly plain and not used for any agricultural purpose; therefore there will be no need to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, this parcels are considered as empty zones, thus the impact degradation of vegetation is valued as NULL for every phase.

Fauna
Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. The area chosen for the construction of the GIS building is small and apparently

does not represent the habitat for any species. Since currently there are no animals in the area this impact is considered NULL.

The area of the rehabilitation works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term, reversible and recoverable, valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.

Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 16 it is shown part of the area surrounding the SS:

Figure 16 Surroundings of Kremenchug SS

- Operating phase:

The transformation of the AIS substations into a GIS substation entails an improvement in the impact of danger for the avifauna. This danger is reduced to null as the electric equipment is encapsulated inside the GIS building avoiding the electrocution of any bird species. Thus, this impact is considered as positive, direct, permanent and short-term, valued as BENEFICIAL.

It might be said that power lines that comes in and out of the substation have impacts on bird's behaviour. However, these lines are not going to be modified and its impact is outside of the scope of this assessment.

The regular operation of the substation does not involve any other impact on the fauna.

4.3.4.6 Impacts on the population

- Reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the reconstruction phase excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will be carried out within the confines of the substation and the adjacent areas, and therefore, the size of the trucks required does not cause any inconvenience regarding the entrance to the site or the damage of infrastructures. On the contrary, if a transformer in-out movement was necessary, special trucks would be required that may not fit into the roads or entrance to the SS.

As explained above in this document, the area where the substation is placed is surrounded by plain parcels were there is a low number of usual residents and industrial or agricultural areas.

Taking into account the information given above together with the temporary nature of the effect and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact be considered as negative, direct, temporary, short term, reversible and recoverable, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable, consequently, preventive measures shall be implemented when removing and inserting them from the transformers, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase the substation will need certain maintenance work; however, since these jobs are intermittent and the new configuration of the substation involves the automation of the operation, there would be a decrease of

the current number of employees working at the substation. As Ukrenergo is growing as a company it should be able to relocate these job positions that might be lost. Consequently, the impact employment generation is considered as negative, indirect and permanent, valued as ADVERSE.

Regarding effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply. It should be borne in mind that the former operating conditions of the substation allowed a normal operation. Consequently this impact is considered as positive, direct, permanent and short-term, valued as SMALL BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in Kremenchug SS. However, as explained in the Section 4.1.5.4 in this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection systems causing its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.
In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained in Section 4.1.5.4 this impact is within the normal/safe values (below 5 kV/m) as the SS was already operating below these limits. The substation is placed in sparsely populated area and outside of a residential zone; consequently it is complying with the regulation. Thus this impact is valued as NOT SIGNIFICANT.
During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). In any case, the change of the SS configuration, from

AIS to GIS, improves the security of insulation reducing the possibilities of electrocution of external people. Consequently this impact is considered as positive, indirect, permanent and short-term, valued as SMALL BENEFICIAL.

Furthermore, the introduction of GIS technology into the country can be considered as an improvement of the national technological advance, apart from encourage the creation of trained workers in this area. Therefore, introduction of new technology can be seen as an impact considered positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.3.4.7 Impacts on the economic sectors

- Reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.
Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.3.4.8 Impacts on natural sites and other areas of cultural interest

- Reconstruction phase:

There are not any protected natural sites or any other area of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.3.4.9 Impacts on the infrastructure and service roads

- Reconstruction phase:

Access to the site of Kremenchug SS will be made, first, through a main road, whose width and preservation is sufficient for the circulation of big vehicles in which all materials need to be transported. This road gives access to a dirt road that leads to the substation. Bearing in mind that lands around are empty and there are no major infrastructures, this path shall allow perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment without causing damaged. Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.
Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and thus the impact is NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.3.4.10 Impacts on the landscape

- Reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

In this phase the impacts on the landscape caused after the rehabilitation of the SS are assess. In this case, the impact shall be analyzed as the improvement or aggravation of the visual impact of the SS before the rehabilitation. GIS configurations reduce the size of the substations about a 40% and in the same way the height is reduced. Consequently, the impact landscape quality is considered as positive, permanent and short-term, valued as BENEFITIAL.

4.3.4.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Transformers are transported from the substation to the adjacent area where the new configuration will be placed. Therefore, mineral oil would only be transported small distances inside of the SS area and to an area that will become part of the

SS. Necessary measures described in Section 4.1.5.3 shall be implemented when handling the oils.
Thus, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old Kremenchug configuration. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in Section 4.1.5.2.

In the event of equipment structure or system malfunction, there might be a loss of SF6 from the electric system cells. As explained in Section 4.1.5.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. Regarding the greenhouse effects a leakage might have, a monitoring plan explained in Section 5.2.2 is carried out, avoiding further consequences.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.3.5 Classification of the Project based on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Kremenchug Rehabilitation can be classified between Categories B and C. The proposed project has some site-specific adverse impacts, although in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

It also shall be highlighted that the area where the rehabilitation works are planned to be carried out is sparely populated and negative direct impacts to the population are minimal.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.
The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in

order to eliminate environmental and social impacts or to reduce them to acceptable levels.
The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.4 Cherkassy Rehabilitation

4.4.1 Project description and actions arising

4.4.1.1 Site and locality

Substation 330/110/35/10kV Cherkassy is one of the main sources of electricity supply of Cherkasy and Cherkasy region.

Given the locality of the SS, placed in the centre of Cherkasy city and within a residential area, in order to minimize the impact the rehabilitation plan shall not involve expansion of the current area of the substation.

The fact that the substation is located in this area also entails that the fauna and flora around it is limited.

Figure 17 Location of Cherkassy Substation

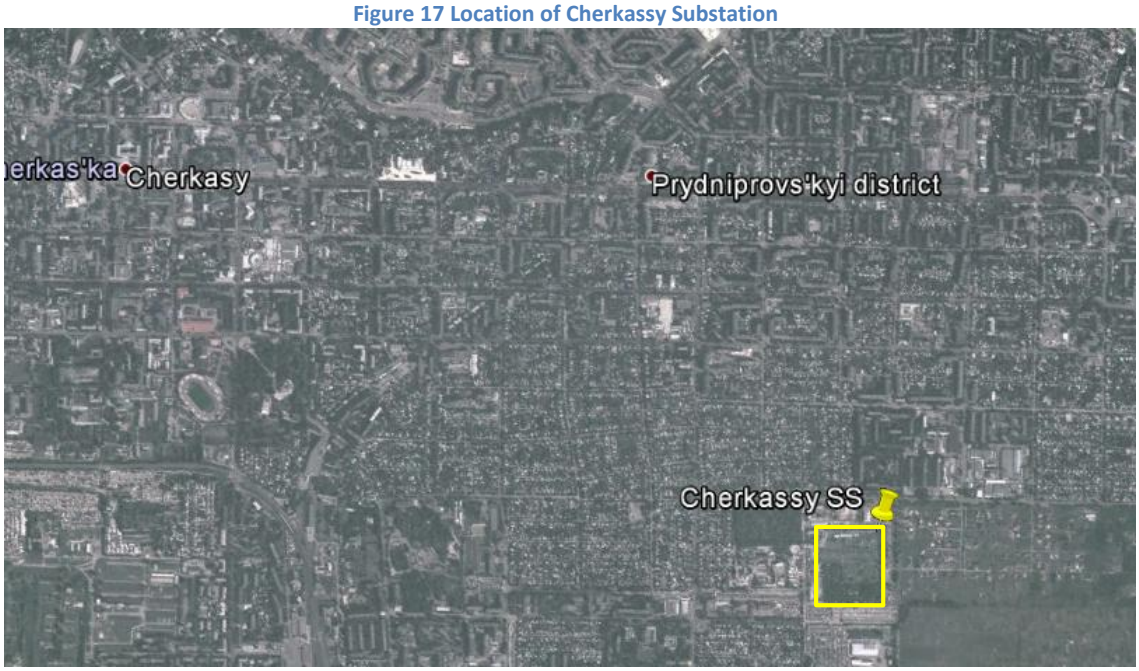


Figure 18 Cherkassy SS

Cherkasy is an important economic and cultural educational centre. The main branches of industry are: the chemical industry, (VAT Azot chemical complex), light industry, machine building industry, food industry and the construction industry.
The ecological situation of the city is stable. The cumulative pollution index as of 2008 is 7.56, average with other Ukraine cities. The main pollutant in the city is the chemical plant Azot (south-east part of the city), and thus the nearby area is the most affected. Azot plant is located 3km far to the south east of the substation.
The downtown area is also high contaminated due to the high traffic volume.

4.4.1.2 Description of Substation New Configuration

Currently, the outdoor switchyard 330 kV of the SS is configured as a transformer-busbars with lines connection via two circuit breakers scheme. Outdoor switchyard 110 kV is configured as a two main busbars and transfer busbar scheme.

SS Cherkassy reconstruction project envisages replacement of obsolete and physically worn-out primary equipment of outdoor switchyard 330 kV without modification of the existing standard scheme, and replacement of outdoor switchyard 110 kV with indoor GIS using up-to-date relay protection, automation and data transmission equipment. The 110 GIS building shall be built under the scheme of two main busbars without a transfer busbar.

330 kV configuration is formed by 4 bays, two of which were renovated in years 2008 and 2009. Therefore during this rehabilitation only the two left bays shall be replaced.

The scheme of the Outdoor Switchyard 330kV envisages 4 connections (AT-1, AT-2 and 2 OTLs), Outdoor Switchyard 110kV – 11 connections (existing AT-1, AT-2, T-1, 6 OTLs + prospective 1 OTL and 1 cable line) – total 13 new circuit-breakers.

4.4.1.3 Description of Rehabilitation Constructive Process and Civil work

Reconstruction of the SS comprises replacement of high-voltage equipment of switchyards 330kV (2 bays) under traditional technology. Outdoor switchyard 110 kV will be replaced by indoor GIS 110 kV.

In order to accelerate construction and installation works at the Outdoor Switchyards, they may be performed by several teams in parallel at the Outdoor Switchyard 330kV and GIS 110kV. At the same time, it is possible to start construction of GIS 110 kV on the free space.

Upon the results of inspection of the SS territory by the Consultant, expansion of the substation is possible in the direction of the repair and production facility of the Cherkassy MEM adjacent to the SS territory. For this purpose it is necessary to demolish a part of existing buildings. Possibility of such expansion is not denied by administration of the Production and Technical Service of the Central Power System.

Figure 19 Cherkassy Current configuration

Figure 20 Cherkassy current configuration

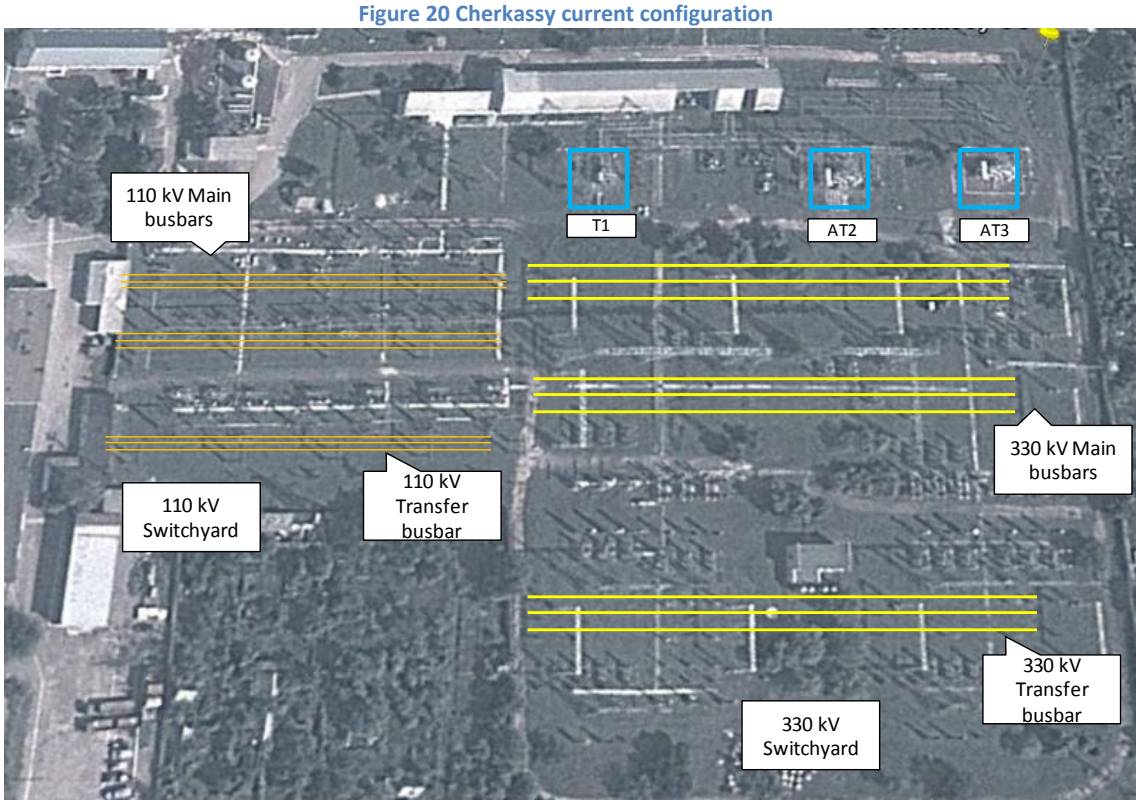
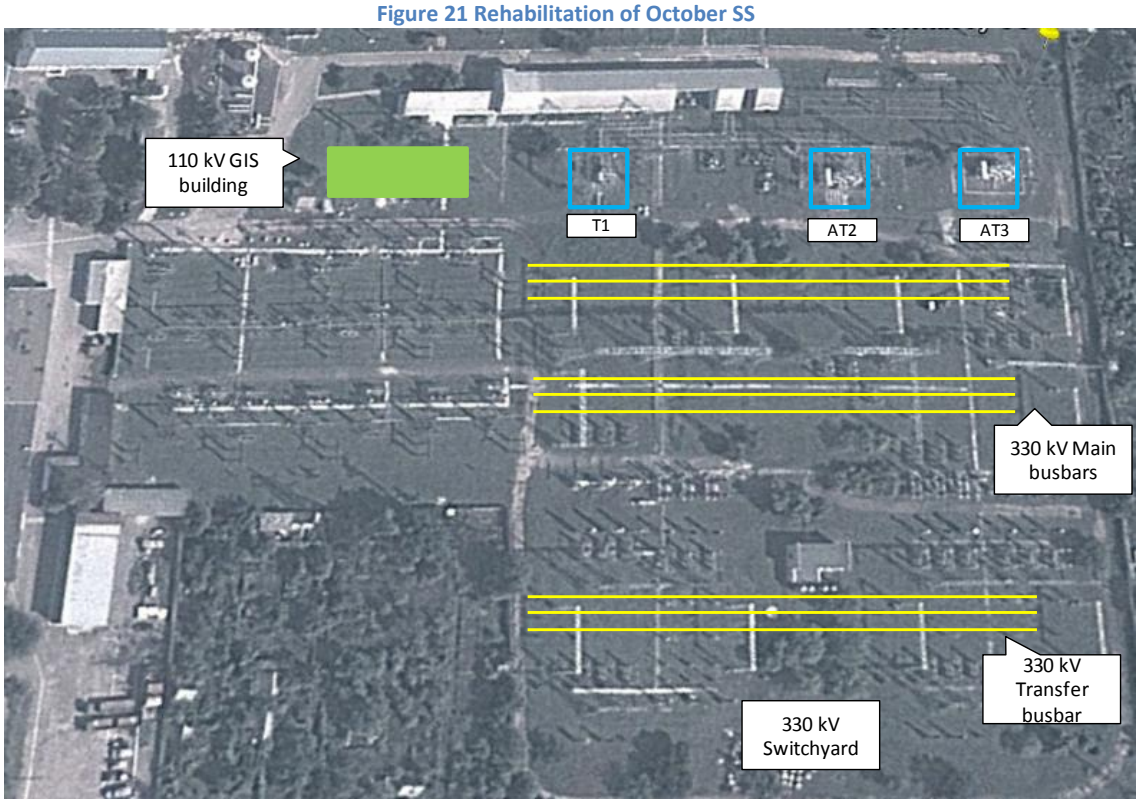


Figure 21 Rehabilitation of October SS



Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, grading and surrounding walls, foundations of all equipment (including loading platforms and railways), concrete fire wall, grounding system, gates for vehicles and pedestrian, concrete roads and site concrete covering works, outdoor lighting poles, building works, air conditioned system and guardian house.

4.4.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.4.3 Summary of the Impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 7 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
Pedology	Destruction and loss of soil quality	R	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R	**NULL**	N/A
	Contamination of groundwater	R	**NS**	N/A
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SB**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R/O	**NULL**	N/A
	Elimination of vegetation	R/O	**NULL**	N/A
	Direct destruction of species	R/O	**NULL**	N/A
	Degradation of the habitat	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Population	Employment generation	R	**B**	Positive, direct, temporary and short-term.
		O	**SA**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	R	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		O	**NS**	N/A
	Welfare and life quality	O	**B**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, indirect, permanent and short-term.
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R/O	**NULL**	N/A
Infrastructures	Alteration of roads	R	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Landscape	Effects on the landscape quality	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	Reconstruction phase	R
Not significant	**NS**	Operating hase	O
Small Adverse	**SA**		
Adverse	**A**		
Small Benefitial	**SB**		
Benefitial	**B**		
Severe	**S**		
Critic	**C**		

4.4.4 Identification, characterization and evaluation of impacts

4.4.4.1 Impact on Geology and Geomorphology

- Reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes; that will be produced as a result of earthworks carried out for: the preparation of land in the area where the 110 kV GIS building shall be constructed; renovation of the foundations of switches and disconnectors to be replaced in 330 kV switchyard; and the dismantling of the current configurations.
The construction of the GIS building entails excavations and land levelling. The parcel where the substation is located is essentially flat, and the buildings shall be place inside the area of the substation. Therefore, earthworks needed for the construction of the building are expected to be minimized.

The same way, for the replacement of the existing foundations of switches and disconnectors requires small excavations. However, this works shall be done in the current location of the equipment and thus, should not have a significant impact in the ground.

The dismantling of the current 110 kV configuration requires removing the foundations of the support structure, which involves earthmoving and conforming terrain. In part of this area the GIS building will be built, and the rest of the terrain will remain part of the substation area and it is not expected to be used for another purpose. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.

Taken into account all above, and since the area affected is wholly inside the area of the substation and it will not be used for any other purposed, this impact is considered as negative, direct, permanent and short-term, valued as SMALL ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.4.4.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.

The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, as mentioned above, the area where the earthworks shall be carried out is inside the substation, and thus it has no agricultural or urban purposed and it is currently used for the same activity as it will be after the rehabilitation.

Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

In the case of Cherkassy rehabilitation, transformers will not be moved avoiding this risk. All machinery used in the civil works shall have passed all relevant inspections and be in good condition to perform the work, minimizing, in this way, any risk of leakage. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Due to the small possibility of these discharges to happen, and the fast measured that would be develop if it did, this impact is considered as NOT SIGNIFICANT.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.4.4.3 Impact on the hydrology

- Reconstruction phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone of the rehabilitation, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered NOT SIGNIFICANT.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket will be dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. As the area was already part of the former substation, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.4.4.4 Impact on the air/atmosphere

The rehabilitation of the substation and construction and commissioning of the new GIS building, will produce changes in its surroundings regarding air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for the stages of reconstruction and operation.

- Reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

The area surrounding the substation is a residential zone, and thus population will be directly affected. The impact alteration of the air quality is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures are shown in Section 5.1.

During the reconstruction phase an increase of the noise level will be produced by the operation of machinery when performing the excavation, earthwork, installation of equipment, etc. In any case, the equipment and machinery used for the civil works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection"). However, even though civil works are expected to comply with the noise regulations, since the substation is located in a residential area, work noises may reach bothering values. If the maximum level if noise produced during the works is under 100 dB (see Anex 7.2 Table Noise Levels of some construction equipment), using the Law of the Distance, and given that the closes residential area is only 200m far:

$$L_2 = L_1 + 20 \cdot \log\left({}^{d_1}/_{d_2}\right)$$

Being L_1 the noise level (dB) in a distance d_1 and L_2 the noise level in a distance d_2. Considering a noise level of 100 dB in a distance of 1 meter, 200 m far the noise level is 54 dB. This level of noise is equivalent to that produced by a mass of people.

Therefore the impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some corrective measures shall be performed, as strictly complying with schedules in order to minimize the working time and reduce the inconvenience to the population living or working in the surroundings.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric system cells in the 110 kV switchyard.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. Despite the low probability of existence of these products, the few manoeuvres this equipment requires along its lifespan and the minimal risk that their presence represents, when maintenance operations that may involve some manipulation of gas are required they shall be conducted by qualified personnel and complying the appropriate preventive measures for this type of work. In case this works entailed the gas evacuation from its compartments, it would be collected by the empting and filling staff preventing this way a free discharge to the atmosphere.

On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled

and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

On the 330 kV switchyard, it should be noticed the possibility of ozone production due to corona. The target of this assessment is to analyze the impact produced by the rehabilitation. In this case, the substation is already operating, and thus this is not an impact produced by the operation after the rehabilitation. Anyway, the ozone production in a high voltage line ranges between 0.5 and 5 g per kW/h due corona, depending on the weather conditions. Even under the worse conditions, this amount of ozone is insignificant and it is immediately dissipated to the atmosphere.
The alteration of the air quality impact is considered as negative, direct, permanent and reversible, valued as SMALL ADVERSE.

With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. During the operation of an AIS substation there are two main sources of noise: the one produced by the vibrations of the transformers windings, and the one produced by the actuations of the switches.

In the case of Cherkassy SS, the 110 kV configuration will be modified to a GIS building. However, transformers will not be replaced, and thus the noise produced by the vibration of the windings will remain the same. On the contrary, noise from the actuation of the switches will be attenuated to a very low level. It should be noted that in GIS substations another source of noise appears, however it is given only in the full load time: noise characteristic of the operation of exhaust fans in the GIS room and the climate control in the system control room.

Taking into account everything said so far, it can be said that the reduction of the switches noise is an improvement that not only compensates for the noise produced by the fans, but it also reduces the overall operation noise level of the substation.
However, the 330 kv switchyard remains AIS, and therefore this impact is considered as positive, direct and long-term, and valued as SMALL BENEFITIAL.
The generation of an electromagnetic field does not change from the former operation of the substation, in which the limits set by the regulation were respected. Therefore this impact is considered as NOT SIGNIFICANT.

4.4.4.5 Impact on fauna and flora

Flora

- Reconstruction phase:

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and mostly it will not be necessary to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, this parcels are considered as residential zones, thus the impact degradation of vegetation is valued as NULL.

- Operating phase:

No impact on the flora is considered in this phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the performance of the works is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

The area of the rehabilitation works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term and reversible valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.
Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

The transformation of the AIS substations into a GIS substation (in the 110 kV switchyards) entails an improvement in the impact of danger for the avifauna. This danger is reduced to null as the electric equipment is encapsulated inside the GIS building avoiding the electrocution of any bird species. Thus, this impact is considered as positive, direct, permanent and short-term, valued as BENEFICIAL.
It might be said that power lines that comes in and out of the substation have impacts on bird's behaviour. However, these lines are not going to be modified and its impact is outside of the scope of this assessment.

The regular operation of the substation does not involve any other impact on the fauna.

4.4.4.6 Impacts on the population

- Reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the reconstruction phase, excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will not be necessary, and therefore, regular trucks can be used. On the contrary, if a transformer in-out movement was necessary, normal size trucks are not valid and special ones would be required.

Taking into account this information together with the temporary nature of the effects and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact to be considered as negative, direct, temporary, shor-term and reversible, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, works near transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable; consequently, preventive measures shall be implemented when performing works near them, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase the substation will need certain maintenance work; however, the new GIS configuration in the 110 kV switchyards involves the automation of the operation and there would be a decrease of the current number of employees. This number should not be high since the 300 kV switchyard will continue to have a conventional configuration. Ukrenergo is strong and should be able to relocate these job positions that might be lost. Consequently, the impact employment generation is considered as negative, indirect and permanent, valued as SMALL ADVERSE.

With regard to the effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply of the customers fed by the SS Cherkassy. It should be borne in mind that the former operating conditions of the substation allowed a normal operation although it had a low reliability. Consequently this impact is considered as positive, direct, permanent and short-term, valued as BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in Cherkassy SS. However, as explained in the Section 4.2.4.4 in this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection systems causing its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.

In conclusion, the risk of fire can be considered as low. However it will be born in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained before, the rehabilitation will not change the values of the electromagnetic fields produced by the operation of Cherkassy SS. These values will remain under the maximum valued allowed for a residential area, which is 1 kV/m.
During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). In any case, the change of the SS configuration in the 110 kV switchyard, from AIS to GIS, improves the security of insulation reducing the possibilities of electrocution of external people. Consequently this impact is considered as positive, indirect, permanent and short-term, valued as SMALL BENEFICIAL.

Furthermore, the introduction of GIS technology into the country can be considered as an improvement of the national technological advance, apart from encourage the creation of trained workers in this area. Therefore, introduction of new technology can be seen as an impact considered positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.4.4.7 Impacts on the economic sectors

- Reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.
Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.4.4.8 Impacts on natural sites and other areas of cultural interest

- Reconstruction phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.4.4.9 Impacts on the infrastructure and service roads

- Reconstruction phase:

Access to Cherkassy SS will be made through roads whose width and preservation is sufficient to perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment.
Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 11 the roads used for the access to the substation are shown.

Figure 22 Access roads to Cherkassy SS

Regarding the possible effects en the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.4.4.10 Impacts on the landscape

- Reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

In this phase the impacts on the landscape caused after the rehabilitation of the SS are assess. In this case, the impact shall be analyzed as the improvement or aggravation of the visual impact of the SS before the rehabilitation. GIS configurations reduce the size of the substations about a 40% and in the same way the height is reduced. However, only the 110 kV switchyard will be converted to GIS; consequently, the impact landscape quality is considered as positive, permanent and short-term, valued as SMALL BENEFITIAL.

4.4.4.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Movements of transformers are not necessary in this rehabilitation and thus the risk of possible mineral oil discharges is avoided. Therefore, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old Cherkassy 110 kV configuration. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in Section 4.4.4.2.

In the event of equipment structure or system malfunction, there might be a loss of SF6 from the electric system cells. As explained in Section 4.2.4.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.4.5 Classification of the Project based on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Cherkassy Rehabilitation, given the urban nature of the area where it is located, the project can be classified as Category B. The proposed project has some site-specific adverse impacts, although they are not critical and can be mitigated or avoided with the implementation of corrective or protective measures. Besides, it also entails beneficial impacts.

The necessary EA for this kind of projects depends on the specific characteristics of each one. In any case, it examines the porject's potential negative and positive environmental impacts and recommends any measured needed to prevent, minimize, mitigate or compensate for adverse repercussions and improve environmental performance.

The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.5 Zhytomyr Rehabilitation

4.5.1 Project description and actions arising

4.5.1.1 Site and locality

Substation 330/110/35/10kV Zhytomyr is located in the North-East of Zhytomyr city, 4.5 km far from the city centre. The closest residential area is placed 1.5 km to the south of the substation.

Lands surrounding the substation are generally flat and don't have an agricultural purpose, although in most of them trees are abundant.

Figure 23 Location of Zhytomyr Substation

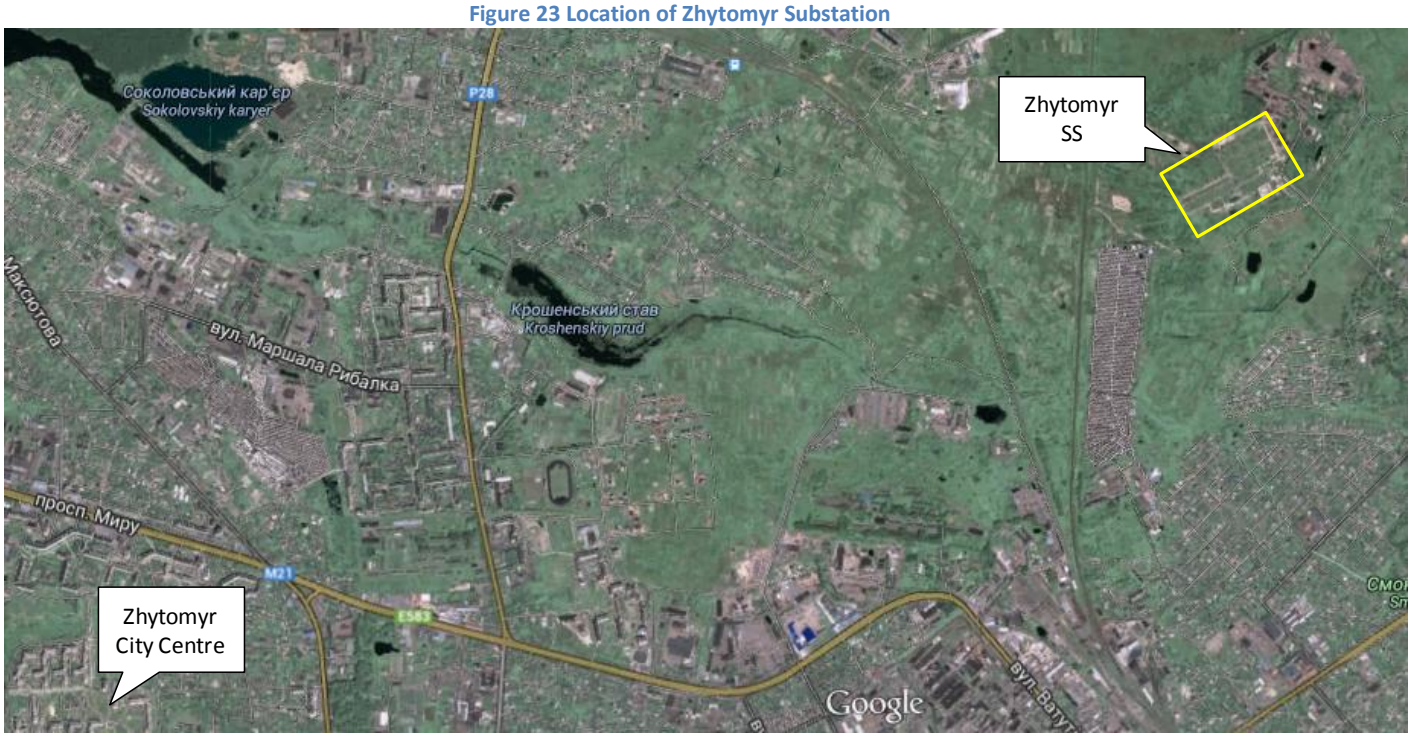
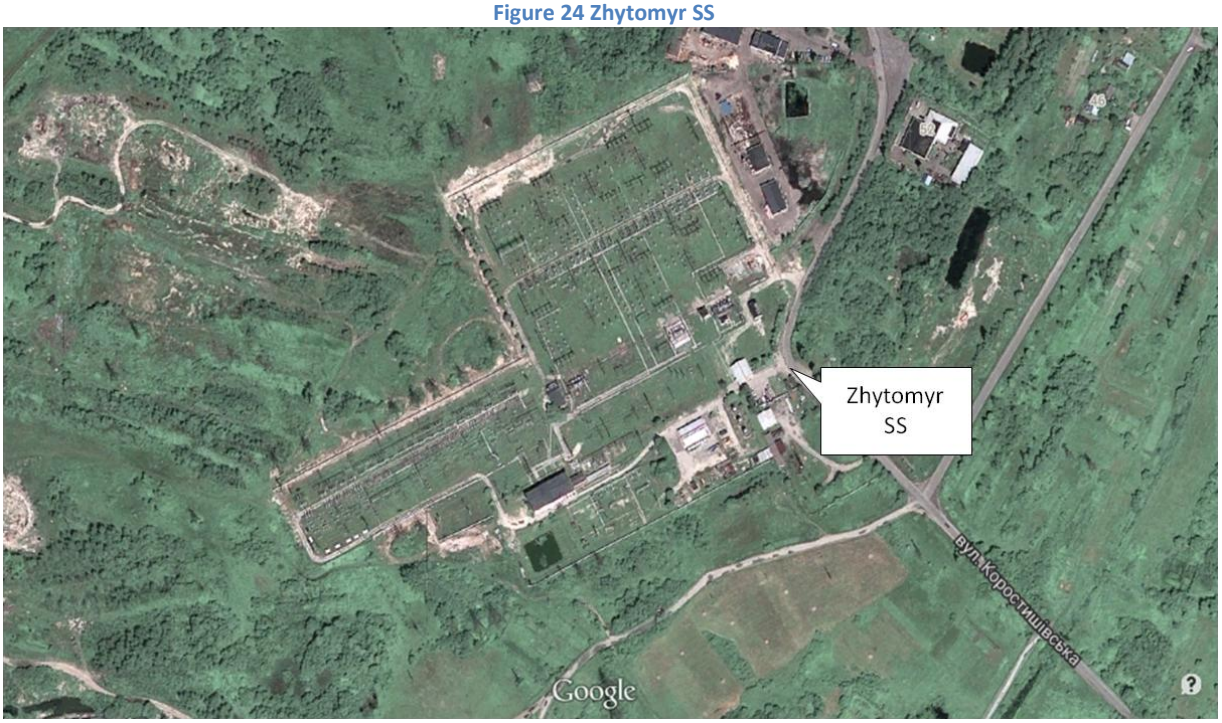


Figure 24 Zhytomyr SS



Zhytomyr is a significant economic, scientific and technical centre of the region and one of the most important transport nodes of Ukraine. There is an important development of residential construction and relevant infrastructure happening currently, as well as an active restoration of industries (steel structures, electronic devices, LED screens, car parts, etc).

Zhytomyr is one if the cities located within the most contaminated regions of Ukraine. There is no data available from the air quality monitoring points in Zhytomyr, but according to the perception of the population it has a pollution index of 75.8. Air pollution is considered to have an impact of 75/100- in 2012 the CO_2 emissions in Zhytomyr reached a value of 1643.5 thousand Tons; meanwhile noise and light pollution has a lower value of 25/100. The presence of industries and the closeness to Kyiv are the main reasons for these values.

Zhytomyr region is located in the border line between the forest belt and the forest steppe, what is called Polisia. Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.

Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.
Zhytomyr SS has a large forest area 8 km far to the west. 2 km far from the SS to the east there is a smaller forest zone. Both areas have a rich fauna, however taking into account the distances to the substation and the dimension of the works to be performed, the impacts on the fauna and flora should be minimum.

4.5.1.2 Description of Substation New Configuration

The outdoor switchyard 330 kV of the SS is currently arranged under a non-standard scheme "transformers-buses with lines connection and 1 AT via two

circuit-breakers". Besides, the outdoor switchyard 110 kV is also configured as a non-standard scheme and contains two main busbars with two bypass circuit-breakers and two bus couplers.

SS Zhytomyr reconstruction project envisages construction of **indoor 330kV GIS** using the scheme (330-11) "one-and-a-half-circuit-breaker" for 6 connections: 3 ATs + 3 OTLs, as well as indoor **GIS 110kV** using the scheme (110-8) "two main busbars", segmented by circuit-breakers and a transfer bus system with two bypass circuit-breakers and two bus couplers" for 15 connections: 3 ATs + 12 OTLs.

Main scope of works includes:

- construction of indoor GIS 330kV and 110 kV;
- construction of a new substation control building combined with building for relay protection and automation panels of GIS 330kV and GIS110kV in the free space within the existing substation site taking into account the adopted solutions;
- reconnection of AT to GIS building by enclosed SF6 insulated bus ducts, type "air– SF6";
- reconnection of OTL 330kV to GIS 330 kV by enclosed SF6 insulated bus ducts;
- reconnection of AT, transformers and OTL 110kV to GIS 110 kV by cable inserts;
- reconstruction of communication and telemechanics systems;
- dismantling of all Outdoor Switchyard 330kV and 110 kV.

4.5.1.3 Description of Rehabilitation Constructive Process and Civil work

Upon approval of detailed design and preparation of construction site, on free area within the substation footprint and with consideration of accepted design solutions, the GIS 330kV and 110 kV building and new substation control building combined with building for relay protection and automation will be constructed. Construction of the line bay and bay for installation of bus tie circuit-breaker at the Outdoor Switchyard 110kV can be performed simultaneously.

These construction works will be performed under live SS conditions, without intervention in its normal operation, followed by:

- installation of new equipment of GIS 330kV and 110 kV, installation of the second battery, DC and AC boards, as well as microprocessor-based RPA devices;
- reconnection of AT and OTL 330kV to GIS 330kV by enclosed SF6 insulated bus ducts, type "air– SF6". Depending on solution, OTL can be connected to GIS using cable inserts;
- reconnection of AT-2, AT-3, T1 and OTL 110 kV to GIS 110 kV by the cable inserts;
- equipment and structures of Outdoor Switchyard 330kV and 110 kV will be dismantled;
- pre-commissioning with SCS implementation, reconstruction of the auxiliary power supply and AEMS upgrade.

Figure 25 Current Zhytomyr SS configuration

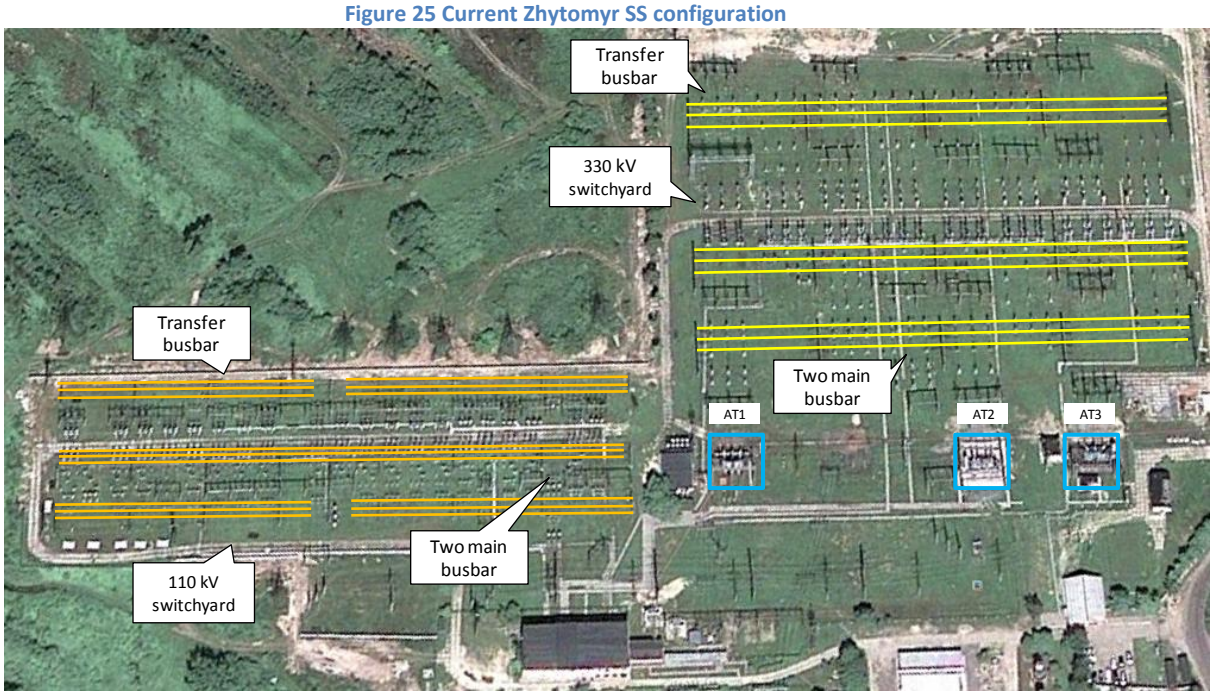
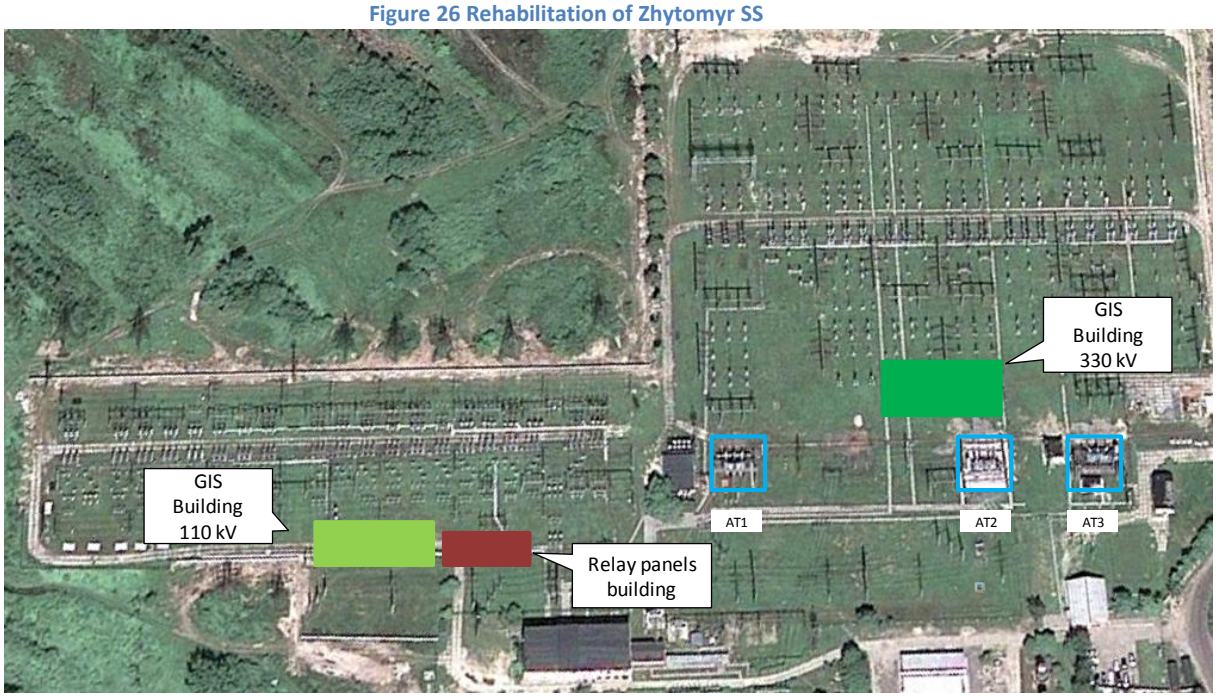


Figure 26 Rehabilitation of Zhytomyr SS



Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, grading and surrounding walls, foundations of all equipment (including loading platforms and railways), concrete fire wall, grounding system, gates for vehicles and pedestrian, concrete roads and site concrete covering works, outdoor lighting poles, building works, air conditioned system and guardian house.

4.5.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.
-

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.5.3 Summary of the Impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 8 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
Pedology	Destruction and loss of soil quality	R	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R/O	**NULL**	N/A
	Contamination of groundwater	R	**NS**	N/A
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R/O	**NULL**	N/A
	Elimination of vegetation	R/O	**NULL**	N/A
	Direct destruction of species	R/O	**NULL**	N/A
	Degradation of the habitat	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Population	Employment generation	R	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	R	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		O	**NS**	N/A
	Welfare and life quality	O	**B**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, indirect, permanent and short-term.
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R/O	**NULL**	N/A
Infrastructures	Alteration of roads	R	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Landscape	Effects on the landscape quality	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	Reconstruction phase	R
Not significant	**NS**	Operating hase	O
Small Adverse	**SA**		
Adverse	**A**		
Small Benefitial	**SB**		
Benefitial	**B**		
Severe	**S**		
Critic	**C**		

4.5.4 Identification, characterization and evaluation of impacts

4.5.4.1 Impact on Geology and Geomorphology

- Reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the preparation of land in the area where the 330 and 110 kV GIS buildings will be constructed and for the dismantling of the current configurations.

The construction of the GIS building entails excavations and land levelling. The parcel where the substation is located is essentially flat, and the buildings shall be place inside the area of the substation. Therefore, earthworks needed for the construction of the building are expected to be minimized.

The dismantling of the current configurations requires removing the foundations of the support structure, which involves earthmoving and conforming terrain. In part of this area the GIS buildings will be built, and the rest of the terrain will remain part of the substation area and it is not expected to be used for another purpose. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.

Taken into account all above, and since the area affected is wholly inside the area of the substation and it will not be used for any other purposed, this impact is considered as negative, direct, permanent and short-term, valued as SMALL ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.5.4.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.
The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, as mentioned above, the area where the earthworks shall be carried out is inside the substation, and thus it has no agricultural or urban purposed and it is currently used for the same activity as it will be after the rehabilitation.

Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out,

there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

In the case of Zhytomyr rehabilitation, transformers will not be moved avoiding this risk. All machinery used in the civil works shall have passed all relevant inspections and be in good condition to perform the work, minimizing, in this way, any risk of leakage. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Due to the small possibility of these discharges to happen, and the fast measured that would be develop if it did, this impact is considered as NOT SIGNIFICANT.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.5.4.3 Impact on the hydrology

- Reconstruction phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered NOT SIGNIFICANT.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket is dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. As the area was already part of the former substation, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.5.4.4 Impact on the air/atmosphere

The rehabilitation of the substation and construction and commissioning of the new GIS building, will produce changes in its surroundings regarding air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for the stages of reconstruction and operation.

- Reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

The area surrounding the substation is not considered as a residential zone, and thus the population will not be directly affected. In any case, the contamination and degradation of the air purity should not be neglected regardless of the degree of occurrence. The impact alteration of the air quality is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures are shown in Section 5.1.

During the reconstruction phase an increase of the noise level will be produced by the operation of machinery when performing the excavation, earthwork, installation of equipment, etc. In any case, the equipment and machinery used for the civil

works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection"). The closest residential area around the SS is 7 km far to the south. If the maximum level if noise produced during the works is under 100 dB (see Anex 7.2 table Noise Levels of some construction equipment), and using the Law of the Distance we have:

$$L_2 = L_1 + 20 \cdot \log\left({}^{d_1}/_{d_2}\right)$$

Being L_1 the noise level (dB) in a distance d_1 and L_2 the noise level in a distance d_2. Considering a noise level of 100 dB in a distance of 1 meter, 7 km far the noise level is 24 dB. This level of noise is lower than the level of a conversation between two people.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE. Some corrective measures shall be performed, as strictly complying with schedules in order to minimize the working time and reduce the inconvenience to the population living or working in the surroundings.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric system cells in the 330 and 110 kV switchyard.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. Despite the low probability of existence of these products, the few manoeuvres this equipment requires along its lifespan and the minimal risk that their presence represents, when maintenance operations that may involve some manipulation of gas are required they shall be conducted by qualified personnel and complying the appropriate preventive measures for this type of work. In case this works entailed the gas evacuation from its compartments, it would be collected by the empting and filling staff preventing this way a free discharge to the atmosphere.

On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

On the 35 kV switchyard, it should be noticed the possibility of ozone production due to corona. The target of this assessment is to analyze the impact produced by the rehabilitation. In this case, the substation is already operating, and thus this is not an impact produced by the operation after the rehabilitation. Anyway, the ozone production in a high voltage line ranges between 0.5 and 5 g per kW/h due corona, depending on the weather conditions. Even under the worse conditions, this amount of ozone is insignificant and it is immediately dissipated to the atmosphere. The alteration of the air quality impact is considered as negative, direct, permanent and reversible, valued as SMALL ADVERSE.

With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. During the operation of an AIS substation there are two main sources of noise: the one produced by the vibrations of the transformers windings, and the one produced by the actuations of the switches.

In the case of Zhytomyr SS, the 330 and 110 kV configurations will be modified to a GIS building. However, transformers will not be replaced, and thus the noise produced by the vibration of the windings will remain the same. On the contrary, noise from the actuation of the switches will be attenuated to a very low level. It should be noted that in GIS substations another source of noise appears, however it is given only in the full load time: noise characteristic of the operation of exhaust fans in the GIS room and the climate control in the system control room.

Taking into account everything said so far, it can be said that the reduction of the switches noise is an improvement that not only compensates for the noise produced by the fans, but it also reduces the overall operation noise level of the substation. Therefore this impact is considered as positive, direct and long-term, and valued as BENEFITIAL.

The generation of an electromagnetic field does not change from the former operation of the substation, in which the limits set by the regulation were respected. Therefore this impact is considered as NOT SIGNIFICANT.

4.5.4.5 Impact on fauna and flora

Flora

- Reconstruction phase:

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and it will not be necessary to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, lands adjacent to the SS are not used for any agricultural purpose, and thus the impact degradation of vegetation is valued as NULL.

- Operating phase:

No impact on the flora is considered in this phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the performance of the works is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

The area of the rehabilitation works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term and reversible valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.

Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

The transformation of the AIS substations into a GIS substation (in the 330 and 110 kV switchyards) entails an improvement in the impact of danger for the avifauna. This danger is reduced to null as the electric equipment is encapsulated inside the GIS building avoiding the electrocution of any bird species. Thus, this impact is considered as positive, direct, permanent and short-term, valued as BENEFICIAL.

It might be said that power lines that comes in and out of the substation have impacts on bird's behaviour. However, these lines are not going to be modified and its impact is outside of the scope of this assessment.

The regular operation of the substation does not involve any other impact on the fauna.

4.5.4.6 Impacts on the population

- Reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the reconstruction phase, excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will not be necessary, and therefore, regular trucks can be used. On the contrary, if a transformer in-out movement was necessary, normal size trucks are not valid and special ones would be required.

Taking into account this information together with the temporary nature of the effects and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact to be considered as negative, direct, temporary, shor-term and reversible, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, works near transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable; consequently, preventive measures shall be implemented when performing works near them, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

During the operating phase the substation will need certain maintenance work; however, the new GIS configurations in the 330 and 110 kV switchyards involve the automation of the operation and there would be a decrease of the current number of employees. Ukrenergo is a growing and strong company and should be able to relocate these job positions that might be lost. Consequently, the impact employment generation is considered as negative, indirect and permanent, valued as ADVERSE.

With regard to the effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply of the customers fed by the SS Zhytomyrr. It should be borne in mind that the former operating conditions of the substation allowed a normal operation although it had a low reliability. Consequently this impact is considered as positive, direct, permanent and short-term, valued as BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in Zhytomyr SS. However, as explained in the Section 4.2.4.4 in

this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection systems causing its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.

In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained before, the rehabilitation will not change the values of the electromagnetic fields produced by the operation of Zhytomyr SS. These values will remain under the maximum valued allowed for a non residential area, which is 5 kV/m.

During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). In any case, the change of the SS configuration in the 330 and 110 kV switchyard, from AIS to GIS, improves the security of insulation reducing the possibilities of electrocution of external people. Consequently this impact is considered as positive, indirect, permanent and short-term, valued as SMALL BENEFICIAL.

Furthermore, the introduction of GIS technology into the country can be considered as an improvement of the national technological advance, apart from encourage the creation of trained workers in this area. Therefore, introduction of new technology can be seen as an impact considered positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.5.4.7 Impacts on the economic sectors

- Reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.
Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.5.4.8 Impacts on natural sites and other areas of cultural interest

- Reconstruction phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.5.4.9 Impacts on the infrastructure and service roads

- Reconstruction phase:

Access to Zhytomyr SS will be made through roads which width and preservation is sufficient to perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment. The entrance to the substation may be modified in order to have enough space to introduce the necessary equipment. However this works shall be minimal.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 11 the roads used for the access to the substation are shown.

Figure 27 Access roads to Zhytomyr SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.5.4.10 Impacts on the landscape

- Reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

In this phase the impacts on the landscape caused after the rehabilitation of the SS are assess. In this case, the impact shall be analyzed as the improvement or aggravation of the visual impact of the SS before the rehabilitation. GIS configurations reduce the size of the substations about a 40% and in the same way the height is reduced. Consequently, the impact landscape quality is considered as positive, permanent and short-term, valued as BENEFITIAL.

4.5.4.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Movements of transformers are not necessary in this rehabilitation and thus the risk of possible mineral oil discharges is avoided. Therefore, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old Zhytomyr 330 and 110 kV configurations. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in Section 4.5.4.2.

In the event of equipment structure or system malfunction, there might be a loss of SF6 from the electric system cells. As explained in Section 4.2.4.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.5.5 Classification of the Project on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Zhytomyr Rehabilitation can be classified between Categories B and C. The proposed project has some site-specific adverse impacts, although in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

It also shall be highlighted that the area where the rehabilitation works are planned to be carried out is sparely populated and negative direct impacts to the population are minimal.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.
The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.6 Sumy Rehabilitation

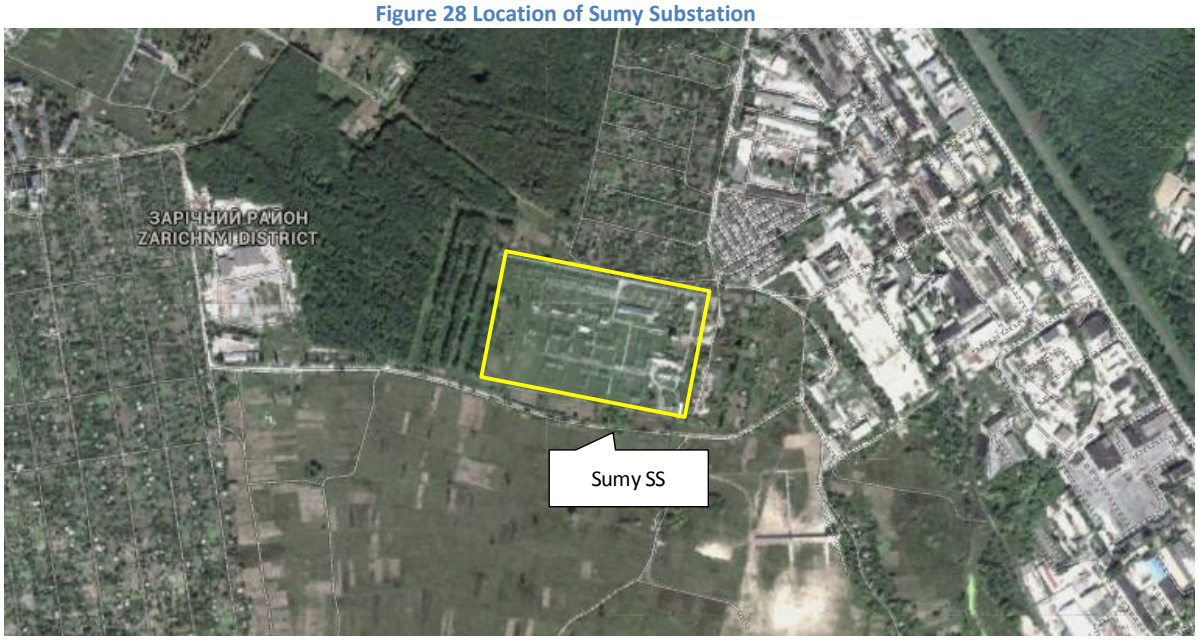
4.6.1 Project description and actions arising

4.6.1.1 Site and locality

Substation 330/110/35/10kV Sumy is located is near Sumy City and is a source of electricity supply to the town and adjacent areas.

The substation is surrounded by a plane area with crops in its south-east, a wooded area in its west and an industrial area in its north and north-east.

Figure 28 Location of Sumy Substation



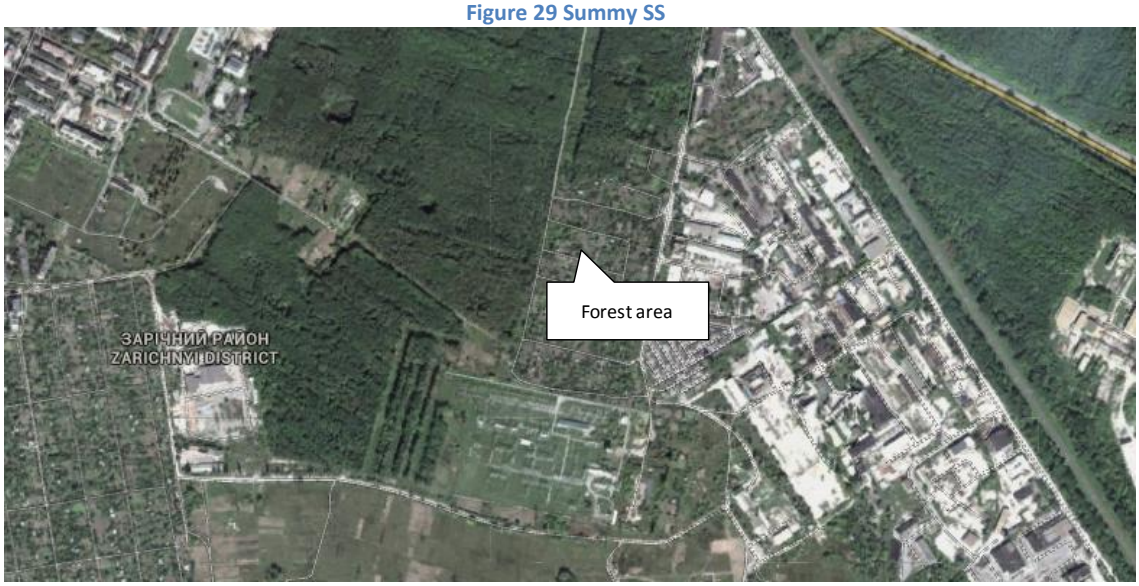
Today Sumy is one of the chief industrial and cultural centres in Northern Ukraine. Its main industries are machine building, the chemical industry, the food industry, light industry, and the construction-materials industry.

Sumy region is located in north-eastern Ukraine, in the Dnipro Lowland. It lies in the Polisia and forest-steppe zones. Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.

Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.

Sumy SS has a small forest area in its north-western area. However given the closeness to the industrial area, no large group of species are expected to leave anywhere nearby the substation.

Figure 29 Summy SS



4.6.1.2 Description of Substation New Configuration

The outdoor switchyard 330 kV of the SS is currently arranged as transformer-busbar with OTL connection via two circuit breakers.

Outdoor Switchyar 110 kV is configured as a substandard scheme two main busbar and a transfer busbar with a bypass CB and bypass CB combined with bus coupler.
Upon reconstruction of SS Sumy the primary connections scheme of the Outdoor Switchyard 330kV will remain unchanged: (330-10) transformers – busbar with lines connection via two circuit-breakers.

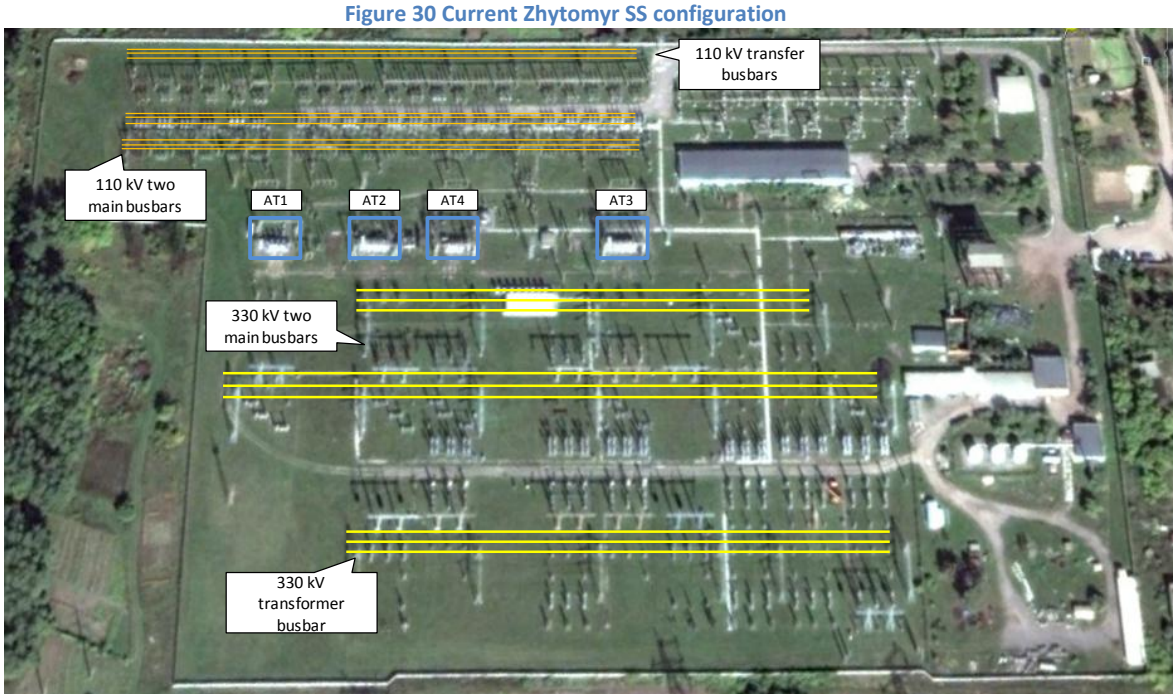
Reconstruction will include expansion of Outdoor Switchyard 110kV by construction of one line bay and bringing primary connections to a standard scheme: "two main busbars, segmented by circuit-breakers and a transfer bus system with two bypass circuit-breakers and two bus couplers" (110-8) by construction of two bays for bus tie CB installation and two bays for bus couplers. At the same time, all primary high-voltage equipment will be replaced (circuit-breakers, disconnectors, voltage transformers, current transformers, valve-type lightning arresters and so on).
Air-insulated circuit-breakers should be replaced by SF6 CBs along with installation of disconnectors with motor-driven main and earthing blades, capacitor-type voltage instrumental transformers and current transformers with SF6 insulation.
Worn-out and obsolete RPA devices, communication and telemechanics systems, AEMS will be replaced by up-to-date equipment.

4.6.1.3 Description of Rehabilitation Constructive Process

The reconstruction of the switchyard 110 kV is made by traditional technology within the existing substation area, in a bay by bay manner with the replacement of all equipment 110 kV, support structures for equipment, cables and cable trays /ducts.

For the period of reconstruction of each individual bay 110 kV transmission line 110 kV is connected to the busbar system made through a bypass breaker.

Figure 30 Current Zhytomyr SS configuration



Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, grading and surrounding walls, foundations of all equipment (including loading platforms and railways), concrete fire wall, grounding system, gates for vehicles and pedestrian, concrete roads and site concrete covering works, outdoor lighting poles, building works, air conditioned system and guardian house.

4.6.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.6.3 Summary of the Impacts

In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 9 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	I	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
Pedology	Destruction and loss of soil quality	I	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	I	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	I/O	**NULL**	N/A
	Contamination of groundwater	I	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	I	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	I	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	I/O	**NULL**	N/A
	Elimination of vegetation	I/O	**NULL**	N/A
	Direct destruction of species	I/O	**NULL**	N/A
	Degradation of the habitat	I	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	I	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
Population	Employment generation	I	**B**	Positive, direct, temporary and short-term.
	Discomfort to the population	I	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	I	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
		O	NS	N/A
	Welfare and life quality	O	SB	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	NS	N/A
	Risk of fire	O	SB	Positive, direct, permanent and short-term.
Economic Sectors	Economic dynamization	I	B	Positive, direct, temporary and short-term.
	Residential and industrial development	O	SB	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	I/O	NULL	N/A
Infrastructures	Alteration of roads	O	SA	Negative, direct, permanent, short-term,reversible and recoverable.
		O	NULL	N/A
	Effects on the rainwater evacuation network	I/O	NULL	N/A
	Effects on the current electricity network	O	B	Positive, direct, permanent and short-term.
Landscape	Effects on the landscape quality	I	SA	Negative, direct, temporary, short-term,reversible and recoverable.
		O	NULL	N/A
Hazardous Materials	Significant hazard to public or environment	I	SA	Negative, direct, temporary, short-term,reversible and recoverable.
		O	NS	N/A

Legend			
Null	NULL	Installation phase	R
Not significant	NS	Operating hase	O
Small Adverse	SA		
Adverse	A		
Small Benefitial	SB		
Benefitial	B		
Severe	S		
Critic	C		

4.6.4 Identification, characterization and evaluation of impacts

4.6.4.1 Impact on Geology and Geomorphology

- Reconstruction phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the renovation of the foundations of circuit-breakers and disconnectors that shall be replaced in the 110 kV switchyard.

The land is already levelled and minimal excavation should be necessary as these foundations are not very deep. Therefore, earthworks needed for the construction of the building are expected to be minimized.

The area where these works shall be done is part of the substation and will remain part of it. After the works, corrective measures shall be implemented in order to restore the area of the reconstruction so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.

Taken into account all above, and since the area affected is wholly inside the area of the substation and it will not be used for any other purposed, this impact is considered as negative, direct, permanent and short-term, valued as NOT SIGNIFICANT.

- Operating phase:

In the operating phase no alteration is expected.

4.6.4.2 Impact on the pedology

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.

The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Reconstruction phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, as mentioned above, the area where the earthworks shall be carried out is inside the substation, and thus it has no agricultural or urban purposed and it is currently used for the same activity as it will be after the rehabilitation.

Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the assembly of power transformers.

In the case of Sumy rehabilitation, transformers will not be moved avoiding this risk. All machinery used in the civil works shall have passed all relevant inspections and be in good condition to perform the work, minimizing, in this way, any risk of leakage. In any case, if a discharge occurs, the immediate withdrawal of the affected soil will be carried out and will be managed according the current regulations.

Due to the small possibility of these discharges to happen, and the fast measured that would be develop if it did, this impact is considered as NOT SIGNIFICANT.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used due to its cooling characteristics for the confinement of power transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. During operation the transformer entails no risk as it is confined in a hermetic tank.

In order to correct any accidental discharge of the transformer oil, a concrete bucket is built under the transformer. This bucket is designed to collect any fluid that may be spilled from the transformer and channel it through its own slope first, and a then through a line pipe to an emergency dielectric fluid containment tank. The tank shall be buried, prefabricated of polyester and reinforced with fibre glass, and shall have enough capacity to store the total volume of the transformer dielectric oil. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.6.4.3 Impact on the hydrology

- Reconstruction phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered NOT SIGNIFICANT.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the transformers. As explained above in this document, a

concrete bucket placed under the transformer is especially designed and built to prevent this to happen. The bucket is dimensioned to be able to contain without spillage the total volume of oil in the transformer.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of transformers by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, the ground characteristics of the SS shall not change, and thus, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.6.4.4 Impact on the air/atmosphere

The rehabilitation of the substation will produce changes in its surroundings regarding air quality, affected by gases emissions from machinery, suspended particles, sound levels and electromagnetic fields. These impacts are analyzed for the stages of reconstruction and operation.

- Reconstruction phase:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

The area surrounding the substation is not considered as a residential zone, and thus the population will not be directly affected (the closes residential area is 1km far). In any case, the contamination and degradation of the air purity should not be neglected regardless of the degree of occurrence. The impact alteration of the air quality is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures are shown in Section 5.1.

During the reconstruction phase an increase of the noise level will be produced by the operation of machinery when performing the excavation, earthwork, installation of equipment, etc. In any case, the equipment and machinery used for the civil works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection"). The closest residential area around the SS is 7 km far to the south. If the maximum level if noise produced during the works is under 100 dB (see Anex 7.2 table Noise Levels of some construction equipment), and using the Law of the Distance we have:

$$L_2 = L_1 + 20 \cdot \log\left({}^{d_1}/_{d_2}\right)$$

Being L_1 the noise level (dB) in a distance d_1 and L_2 the noise level in a distance d_2. Considering a noise level of 100 dB in a distance of 1 meter, 1 km far the noise level is 40 dB. This level of noise is equivalent to the noise produce by a regular conversation of several people.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as ADVERSE. Some corrective measures shall be performed, as strictly complying with schedules in order to minimize the working time and reduce the inconvenience to the population living or working in the surroundings.

- Operating phase:

With regard to alteration of the air quality by emissions during the operating phase, it should be noted that the only gas emission that might be produced, and in any case accidentally, would be a loss of sulphur hexafluoride (SF6) from the electric circuit breakers.

SF6 is a synthetic and inert gas that in pure state, as contained in the equipment, implies no health risks. Only under the continuous action of discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk. During operation SF6 losses of circuit breakers of actual technology are about 1 vol./year or 0.5% vol./year in best cases. Losses leakages during maintenance are usually higher than 2%. On the other hand, assuming that an accidental discharge in any equipment would happen, its dispersion into the air would be completely innocuous, bearing in mind, first, that even containing products of decomposition it would represent no health risk, and second, the volume of these kind of leaks is significantly low. In any case, the leak would be automatically detected, reported and corrected.

Besides, these amounts of gases discharged to the atmosphere do not represent a major contribution to global warming.

The air quality could also be affected by the occurrence of fire while the operation of the substation. Insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers.

It should be noticed the possibility of ozone production due to corona. The target of this assessment is to analyze the impact produced by the rehabilitation. In this case, the substation is already operating, and thus this is not an impact produced by the operation after the rehabilitation. Anyway, the ozone production in a high voltage line ranges between 0.5 and 5 g per kW/h due corona, depending on the weather conditions. Even under the worse conditions, this amount of ozone is insignificant and it is immediately dissipated to the atmosphere.

The alteration of the air quality impact is considered as negative, direct, permanent and reversible, valued as SMALL ADVERSE.

With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substation. The configuration of will remain AIS and thus the noise shall remain the same or similar. Therefore this impact is considered as NOT SIGNIFICANT.

The generation of an electromagnetic field does not change from the former operation of the substation, in which the limits set by the regulation were respected. Therefore this impact is considered as NOT SIGNIFICANT.

4.6.4.5 Impact on fauna and flora

Flora

- Reconstruction phase:

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and it will not be necessary to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, lands adjacent to the SS are not used for any agricultural purpose, and thus the impact degradation of vegetation is valued as NULL.

Operating phase:

No impact on the flora is considered in this phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Reconstruction phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the performance of the works is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

There is a forest area close to the substation. Although no large groups of animals are expected to live in it, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term and reversible valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.

Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

During the operation of the substation no impacts on the fauna are expected.

4.6.4.6 Impacts on the population

- Reconstruction phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the reconstruction phase, excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly. It is important to note that movements of certain equipments, specifically transformers, will not be necessary, and therefore, regular trucks can be used. On the contrary, if a transformer in-out movement was necessary, normal size trucks are not valid and special ones would be required.

Taking into account this information together with the temporary nature of the effects and the mitigation and protective measures that would be implemented (Section 5), makes the impact to be considered as negative, direct, temporary, shor-term and reversible, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments, in particular, works near transformers. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in transformer are flammable; consequently, preventive measures shall be implemented when performing works near them, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

With regard to the effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply of the customers fed by the SS October. It should be borne in mind that the former operating conditions of the substation allowed a normal operation although it had a low reliability. Consequently this impact is considered as positive, direct, permanent and short-term, valued as BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in October SS. However, as explained in the Section 4.2.4.4 in this report, insulating oils used in transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize the safe operation of the transformers. Besides, the rest of the equipment in the substation is provided with automatic protection systems causing its decommissioning in case of any anomaly that may produce over currents, over voltages and abnormal heating during operation of the SS.

In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained before, the rehabilitation will not change the values of the electromagnetic fields produced by the operation of Sumy SS. These values will remain under the maximum valued allowed for a non residential area, which is 5 kV/m.

4.6.4.7 Impacts on the economic sectors

- Reconstruction phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.

Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails an improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as BENEFITIAL.

4.6.4.8 Impacts on natural sites and other areas of cultural interest

- Reconstruction phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.6.4.9 Impacts on the infrastructure and service roads

- Reconstruction phase:

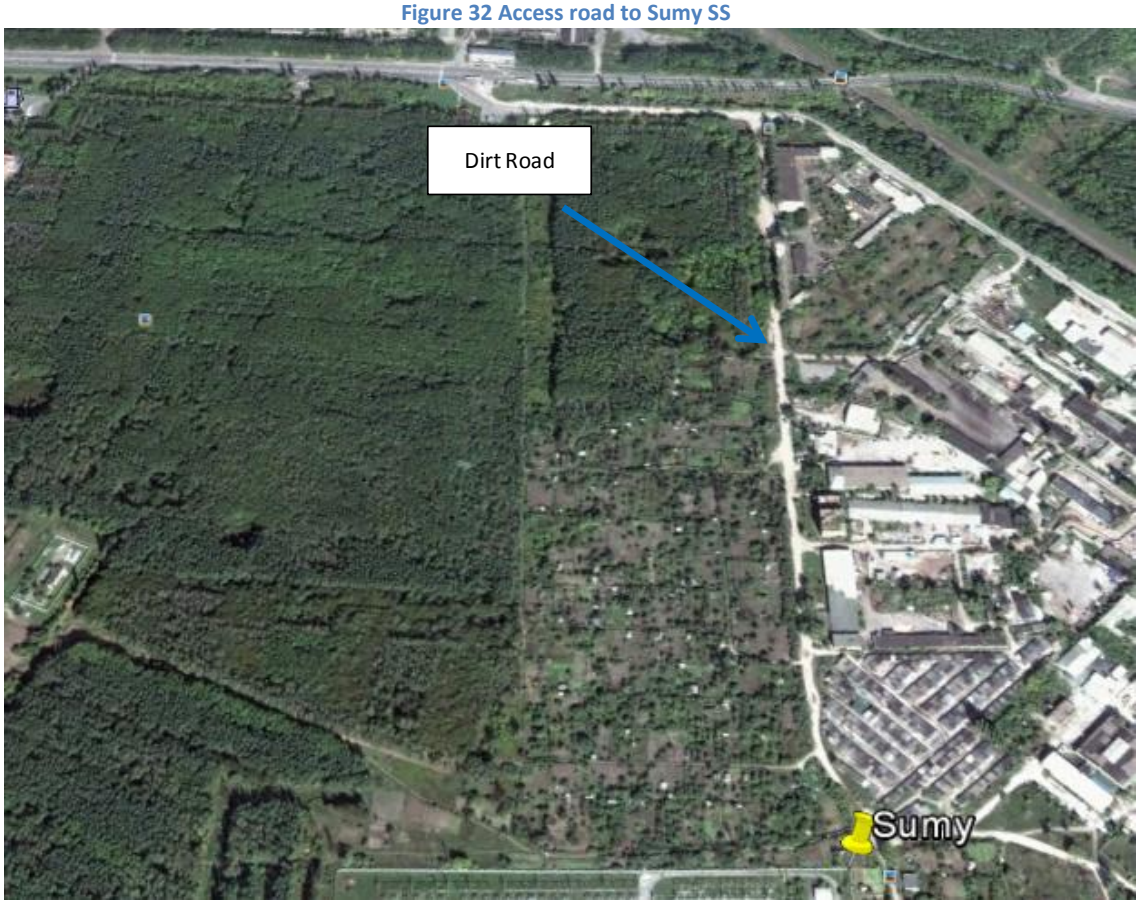
Access to Sumy SS will be made through first a main road which width and preservation is sufficient to perform the transportation manoeuvres necessary for dismantling the current configuration and moving the new equipment; and second through a dirt road. This road has some narrow parts due to the trees on the side of the path. Depending on the size and height of the materials to be transported it might be necessary to chop down some of these trees. However, the number shall not be significant.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS although some degradation of the surroundings of the roads may occur. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 11 (main road) and Figure 32 (dirt road) for the accesses to the substation are shown.

Figure 31 Access road to Sumy SS

Figure 32 Access road to Sumy SS



Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.6.4.10 Impacts on the landscape

- Reconstruction phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

No impacts on the landscape are expected during the operation of the SS.

4.6.4.11 Hazards and Hazardous Materials

Construction and dismantling of a substation may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Reconstruction phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Movements of transformers are not necessary in this rehabilitation and thus the risk of possible mineral oil discharges is avoided. Therefore, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

As the new GIS configuration starts being operational, the dismantling of the old configuration shall be performed: de-energizing, salvageable components removed for reuse, non-reusable materials recycled or scrapped, and the site shall be tasted to ensure no residual contamination remains. No hazardous material impacts are expected with decommissioning the old equipment. Therefore, this impact, hazardous material impacts due to dismantling is considered as negative, direct, temporary, short-term, recoverable and reversible, valued as SMALL ADVERSE.

- Operating phase:

During substation operation, transformers and switchgear equipment contain substances considered hazardous. However the substances are enclosed within the equipment as explained in previous sections.
In the event of equipment structure or system malfunction, there might be a loss of SF6 from the circuit breakers. As explained in Section 4.2.4.4 this gas represents no health risks and only under continuous discharges and electric arcs that may occur as a result from the manoeuvres of the equipment, could this gas represent a product of decomposition, which otherwise involves no greater risk.

Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.6.5 Classification of the Project based on World Bank's Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 Sumy Rehabilitation can be classified between Categories B and C. The proposed project has some site-specific adverse impacts, although in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

It also shall be highlighted that the area where the rehabilitation works are planned to be carried out is sparely populated and negative direct impacts to the population are minimal.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.
The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

4.7 Shunt Reactors Installation

The Consultant proposes the installation of two 35 kV shunt reactors in five substations in Ukraine: Novovolinskaya, Lutks Pivdenna, Kovel, Shepetivka and Kamenets-Podilska Substation.

The process of installation and work plan in the same in every substation, and given the similar characteristics of the five substations the analysis of the impacts is mainly the same. However, the significant differences are considered.

4.7.1 Project description and actions arising

Lutsk Pivdenna Substation

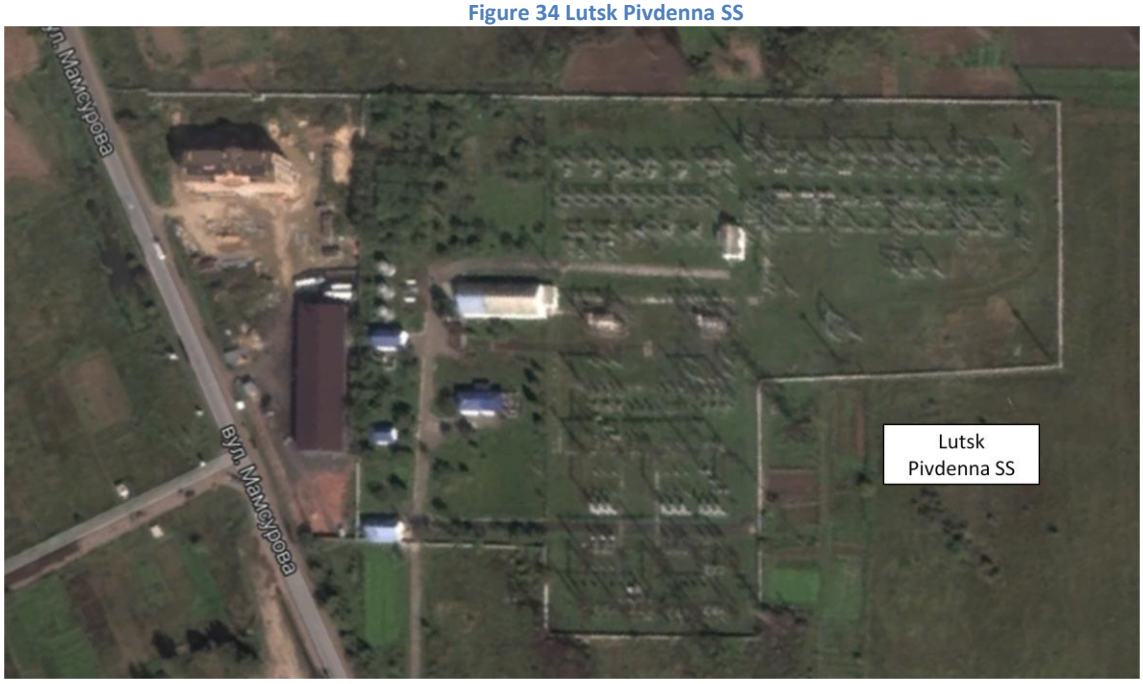
4.7.1.1 Site and locality

Substation 330/110/35/10kV Lutsk Pivdenna is located in the South of Lutsk township city, 5 km far from the city centre.

The area surrounding the substation is occupied by industries, small crops and plane lands. The closest residential area is placed 1 km to the south-west of the substation.

Figure 33 Location of Lutsk Pivdenna Substation

Figure 34 Lutsk Pivdenna SS



Lutsk is an important centre of industry. It has different factories located in the area: car industries, shoes producer, furniture industry, electronics industry, steel mills and chemical plants.

Lutsk is located in the north-west of Ukraine, and it is the administrative center of the Volyn Oblast. This region is located in the border line between the forest belt and the forest steppe, what is called Polisia. Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.

Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.

Lutsk SS is located near to an industry area which is not characterized by having a rich fauna or flora.

4.7.1.2 Description of Shunt Reactors Installation and Civil work

Two 35 kV shunt reactors shall be installed in the 35 kV Switchyard of the substation. In order to connect them directly to the lines it is necessary to add two bays to the 35 kV configuration.

In the case of Lutsk SS there is enough space inside the substation for building up the two bays and installing the shunt reactors without affecting the surrounding outside.

Figure 35 Lutsk SS configuration

The rehabilitation of this substation shall comprise the following steps:

- Preparatory Work: this stage shall involve the necessary administrative steps in order to formally launch the project, namely:
  - Internal authorizations from Ukrenergo's management
  - Information to the relevant stakeholders
  - Application to relevant authorities for permission to start works, use roads, etc.
  - Finalization of administrative aspects with the World Bank,
  - Public dissemination process.
  - Etc.
- Tender for EPC Company.
- Engineering Work, comprising the detailed engineering process for the works.
- Installation preparatory work, comprising the preparation of the substation for the development of the works.
- Supply of Equipment, which comprises the supply of MV and control equipment in order to facilitate the installation in parallel.
- Installation of New Equipment. The installation is expected to be made reasonably quickly since it must not affect the normal operation of the substation.

Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, foundations of all equipment, concrete fire wall, grounding system, gates for vehicles.

Kovel Substation

4.7.1.3 Site and locality

Kovel Substation is located in the South of Lutsk township city, 2 km far from the city centre.

The area surrounding the substation is formed by small crops and plane lands. There is a residential area 600 m far to the north of the SS.

Figure 36 Location of Kovel Substation

Figure 37 Kovel SS

Kovel is city located in the Volyn Oblast, in north-western of Lutsk, situated in Polisia, on the Turiia River.

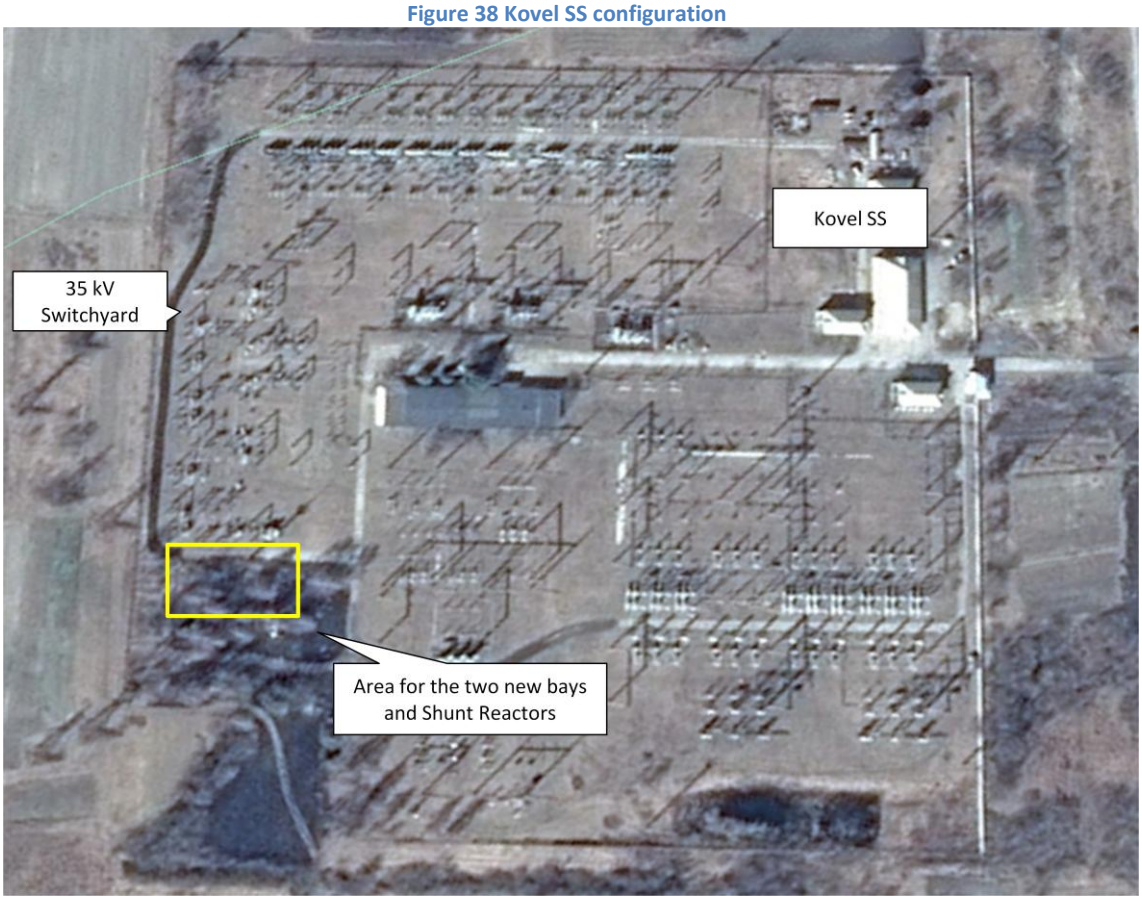
Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.
Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.
Kovel SS is located close to a city, just by a principal road and surrounded by crops. Therefore it doesn't have an area where this kind of flora or fauna exists close by.

4.7.1.4 Description of Shunt Reactors Installation and Civil work

Two 35 kV shunt reactors shall be installed in the 35 kV Switchyard of the substation. In order to connect them directly to the lines it is necessary to add two bays to the 35 kV configuration.

In the case of Kovel SS, next to the 35 kV switchyard there is an area occupied by some trees inside the substation that offers enough space for building up the two bays and installing the shunt reactors without affecting the surrounding outside.

Figure 38 Kovel SS configuration



The rehabilitation of this substation shall comprise the following steps:

- Preparatory Work: this stage shall involve the necessary administrative steps in order to formally launch the project, namely:
  - Internal authorizations from Ukrenergo's management
  - Information to the relevant stakeholders
  - Application to relevant authorities for permission to start works, use roads, etc.
  - Finalization of administrative aspects with the World Bank,

- Public dissemination process.
- Etc.

- Tender for EPC Company.
- Engineering Work, comprising the detailed engineering process for the works.
- Installation preparatory work, comprising the preparation of the substation for the development of the works.
- Supply of Equipment, which comprises the supply of MV and control equipment in order to facilitate the installation in parallel.
- Installation of New Equipment. The installation is expected to be made reasonably quickly since it must not affect the normal operation of the substation.

Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, foundations of all equipment, concrete fire wall, grounding system, gates for vehicles.

Shepetivka Substation

4.7.1.5 Site and locality

Kovel Substation is located in the South of Shepetivka township city, 3 km far from the city centre.

The area surrounding the substation is formed by crops and plane lands. The closest residential area is almost 2 km to the north of the SS.

Figure 39 Location of Shepetivka Substation

Figure 40 Shepetivka SS

Shepetivka is a town located in the Khmelnytskyi Oblast, in south-eastern of Lutsk, situated in Polisia, on the Huska River.

Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.

Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.

Shepetivka SS is surrounded by crops and located more than 7 km far from the forest area situated in the north of the city. Therefore it doesn't have an area where this kind of flora or fauna exists close by.

4.7.1.6 Description of Shunt Reactors Installation and Civil work

Two 35 kV shunt reactors shall be installed in the 35 kV Switchyard of the substation. In order to connect them directly to the lines it is necessary to add two bays to the 35 kV configuration.

In the case of Shepetivka SS, next to the 35 kV switchyard there is an area inside the substation that offers enough space for building up the two bays and installing the shunt reactors without affecting the surrounding outside.

Figure 41 Shepetivka SS configuration

The rehabilitation of this substation shall comprise the following steps:

- Preparatory Work: this stage shall involve the necessary administrative steps in order to formally launch the project, namely:
  - Internal authorizations from Ukrenergo's management
  - Information to the relevant stakeholders
  - Application to relevant authorities for permission to start works, use roads, etc.
  - Finalization of administrative aspects with the World Bank,
  - Public dissemination process.
  - Etc.
- Tender for EPC Company.
- Engineering Work, comprising the detailed engineering process for the works.
- Installation preparatory work, comprising the preparation of the substation for the development of the works.
- Supply of Equipment, which comprises the supply of MV and control equipment in order to facilitate the installation in parallel.
- Installation of New Equipment. The installation is expected to be made reasonably quickly since it must not affect the normal operation of the substation.

Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, foundations of all equipment, concrete fire wall, grounding system, gates for vehicles.

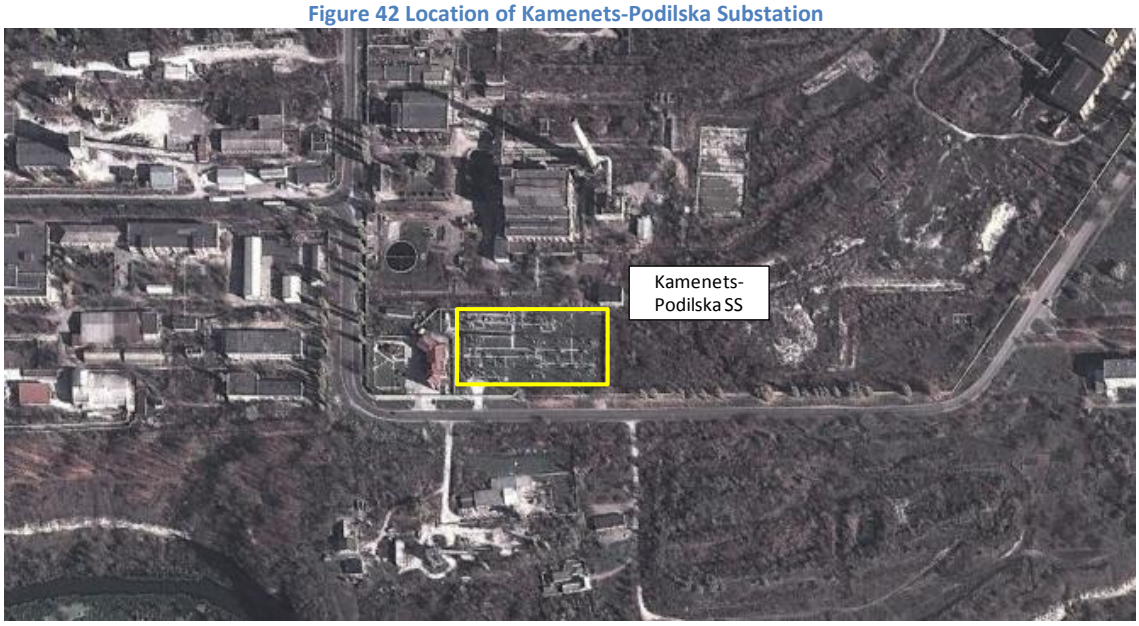
Kamenets-Podilska Substation

4.7.1.7 Site and locality

Kamenets-Podilska Substation is located in the South of Kamenets-Podilska township city, 3 km far from the city centre.

The substation is located in an industry area with abundant forest zones.

Figure 42 Location of Kamenets-Podilska Substation



Kamenets-Podilska is located in the southern portion of the Khmelnytski Oblast, located in the region of Podilia.

Podilia consist of the western port of the forest-steppe belt, Polisia in the north and steppe in the south. Kamenets-Podilska is thus located in the northern-steppe. The northern subzone is characterized by a natural vegetation of meadow fescue and feather grass on ordinary, medium humus content (6–8%) chernozems.

The present fauna of the steppe is dominated by soil-boring rodents and by their predators. Among the rodents are rabbits, marmots, hamsters, mice, and European mole rats; the predators are the polecat, the fox, and the wolf. Bird species include lark, quail, yellow bunting, partridge, windhover, and, less commonly, little and great bustard, owl, and eagle.

4.7.1.8 Description of Shunt Reactors Installation and Civil work

Two 35 kV shunt reactors shall be installed in the 35 kV Switchyard of the substation. In order to connect them directly to the lines it is necessary to add two bays to the 35 kV configuration.

In the case of Kamenets-Podilska SS, next to the 35 kV switchyard there is an area inside the substation that offers enough space for building up the two bays and installing the shunt reactors without affecting the surrounding outside.

The rehabilitation of this substation shall comprise the following steps:

- Preparatory Work: this stage shall involve the necessary administrative steps in order to formally launch the project, namely:
  - Internal authorizations from Ukrenergo's management
  - Information to the relevant stakeholders
  - Application to relevant authorities for permission to start works, use roads, etc.
  - Finalization of administrative aspects with the World Bank,
  - Public dissemination process.
  - Etc.
- Tender for EPC Company.
- Engineering Work, comprising the detailed engineering process for the works.
- Installation preparatory work, comprising the preparation of the substation for the development of the works.
- Supply of Equipment, which comprises the supply of MV and control equipment in order to facilitate the installation in parallel.
- Installation of New Equipment. The installation is expected to be made reasonably quickly since it must not affect the normal operation of the substation.

Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, foundations of all equipment, concrete fire wall, grounding system, gates for vehicles.

Novovolinskaya Substation

4.7.1.9 Site and locality

Novovolinskaya Substation is located in the south-eastern part of Novovolinsk township city, 3 km far from the city centre.

The area surrounding the substation is formed by small crops and plane lands. There are some residential houses near to the SS but they don't form an urban nucleus.

Figure 43 Location of Novovolinskaya Substation

Figure 44 Novovolinskaya SS

Novovolinsk is a town located in the south-western of Volyn Oblast, in south-eastern of Lutsk, situated in Polisia.
Polisia belongs to the mixed forest subzone of the East European broad-leaved forest zone. The most widespread tree is the pine, followed by the oak, birch and black alder.
Polisia contains a richer complex of fauna than the steppe and the forest-steppe of Ukraine. The richest fauna is found in the mixed forest with contain lynx, wolf, forest marten, chamois, fox, Eurasian red squirrel, weasel, ermine, wild boar and brown bear. The rivers support the Old World beaver, European otter and mink.
Novovolinsk SS is surrounded by crops and and is not situated near from any large forest area. Therefore it doesn't have this kind of flora or fauna is very limited around the substation.

4.7.1.10 Description of Shunt Reactors Installation and Civil work

Two 35 kV shunt reactors shall be installed in the 35 kV Switchyard of the substation. In order to connect them directly to the lines it is necessary to add two bays to the 35 kV configuration.

In the case of Novovlinsk SS, next to the 35 kV switchyard there is an area inside the substation that offers enough space for building up the two bays and installing the shunt reactors without affecting the surrounding outside.

The rehabilitation of this substation shall comprise the following steps:

- Preparatory Work: this stage shall involve the necessary administrative steps in order to formally launch the project, namely:
  - Internal authorizations from Ukrenergo's management
  - Information to the relevant stakeholders
  - Application to relevant authorities for permission to start works, use roads, etc.

    - Finalization of administrative aspects with the World Bank,
    - Public dissemination process.
    - Etc.
- Tender for EPC Company.
- Engineering Work, comprising the detailed engineering process for the works.
- Installation preparatory work, comprising the preparation of the substation for the development of the works.
- Supply of Equipment, which comprises the supply of MV and control equipment in order to facilitate the installation in parallel.
- Installation of New Equipment. The installation is expected to be made reasonably quickly since it must not affect the normal operation of the substation.

Civil Works of covers followings: levelling (excavation and backfills), drainage works, retaining, foundations of all equipment, concrete fire wall, grounding system, gates for vehicles.

4.7.2 Evaluation Terminology

The following terminology is used to describe the levels of significance for impacts identified for each area discussed in Section 4.1.5.

- A conclusion of NULL is used when it is determined that the proposed project would have no impact on the resource area under evaluation.
- A conclusion of NOT SIGNIFICANT is used when it is determined that the impact the proposed project would have on the resource area under evaluation has a low probability of occurring, and in case it did, the impacts would be below established thresholds of significance.
- A conclusion of SMALL ADVERSE is used when it is determined that the proposed project would have adverse impacts to a resource area that would not exceed established thresholds of significance.
- A conclusion of ADVERSE is used when it is determined that mitigation measures would be required to reduce the proposed project's adverse impacts below established thresholds of significance.
- A conclusion of SEVERE is used when it is determined that the proposed project's adverse impacts to a resource area potentially cannot be mitigated to a level that is less than significant.
- A conclusion of CRITIC is used when the proposed project's adverse impacts to a resource area represent a critical situation o the environment or the population and cannot be mitigated in any way.
- A conclusion of SMALL BENEFICIAL is used when it is determined that the proposed project would have a positive impact of a small magnitude on the resource area under evaluation.
- A conclusion of BENEFICIAL is used when it is determined that the proposed project's impacts on the resource area are positive and entail significant improvements.

A description of the likely significant effects of the proposed project on the environment should cover any direct or indirect effect considered:

- Negative: the effect is unfavourable to the environment or the population.
- Positive: the effect is advantageous to the environment or the population.
- Permanent: the impact caused on the environment or the population is expected to remain for an indefinite period.
- Temporary: the impact caused on the environment or the population is expected to last only a short time.
- Short-term: the impacts are expected to be noticed in a short time.
- Long-term: the impacts are expected to be noticed in a long time.
- Reversible: the effects caused can be reversed returning the environment or the population affected to the original conditions.
- Irreversible: the effects caused cannot be reversed and thus the conditions of the environment or population affected will remain modified.

4.7.3 Summary of the Impacts

Given the similarities of the works in the five substations, the impacts are the same for all of them.
In the following table a summary of the identification, characterization and evaluation of impacts in each phase of the project is presented:

Table 10 Summary of Impacts

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Geology	Relief changes	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
Pedology	Destruction and loss of soil quality	R	**NULL**	N/A
		O	**NULL**	N/A
	Soil pullution by discharges and wast	R	**SA**	Negative, direct, permanent, short-term,irreversible and recoverable.
		O	**NS**	N/A
Hydrology	Alteration of surface hydrology	R/O	**NULL**	N/A
	Contamination of groundwater	R	**NS**	N/A
		O	**NS**	N/A
	Disruption of natural flow into aquifers	O	**NULL**	N/A
Atmosphere	Alteration of the air quality	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Increase of the noise level	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, long-term.
	Generation of electromagnetic fields	O	**NS**	N/A
Fauna and Flora	Degradation of vegetation	R/O	**NULL**	N/A
	Elimination of vegetation	R/O	**NULL**	N/A
	Direct destruction of species	R/O	**NULL**	N/A
	Degradation of the habitat	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Alteration in animal behaviour	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
	Danger for the avifauna	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Population	Employment generation	R	**B**	Positive, direct, temporary and short-term.
		O	**A**	Negative, indirect, permanent and long-term.
	Discomfort to the population	R	**A**	Negative, direct, temporary, short-term,reversible and recoverable.
	Risk of fire	R	**SA**	Negative, indirect, temporary, short-term, reversible and recoverable.
		O	**NS**	N/A
	Welfare and life quality	O	**B**	Positive, direct, permanent and short-term.
	Generation of electromagnetic fields	O	**NS**	N/A
	Risk of electrocution	O	**SB**	Positive, indirect, permanent and short-term.
	Risk of fire	O	**SB**	Positive, direct, permanent and short-term.
	Introduction of new technology	O	**B**	Positive, indirect, permanent and long-term.
Economic Sectors	Economic dynamization	R	**B**	Positive, direct, temporary and short-term.
	Residential and industrial development	O	**B**	Positive, indirect, permanent and long-term.
Natural Sites	Damage on natural sites	R/O	**NULL**	N/A
Infrastructures	Alteration of roads	R	**SA**	Negative, direct, permanent, short-term,reversible and recoverable.
		O	**NULL**	N/A
	Effects on the rainwater evacuation network	R/O	**NULL**	N/A
	Effects on the current electricity network	O	**B**	Positive, direct, permanent and short-term.

ELEMENT	IMPACT	PROJECT PHASE	EVALUATION	CHARACTERIZATION
Landscape	Effects on the landscape quality	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**B**	Positive, direct, permanent and short-term.
Hazardous Materials	Significant hazard to public or environment	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.
		O	**NS**	N/A
	Hazardous materials due to dismantling	R	**SA**	Negative, direct, temporary, short-term,reversible and recoverable.

Legend			
Null	**NULL**	Reconstruction phase	R
Not significant	**NS**	Operating hase	O
Small Adverse	**SA**		
Adverse	**A**		
Small Benefitial	**SB**		
Benefitial	**B**		
Severe	**S**		
Critic	**C**		

4.7.4 Identification, characterization and evaluation of impacts

4.7.4.1 Impact on Geology and Geomorphology

All the impacts on Geology and Geomorphology are the same for the five substations.

- Installation phase:

The alterations that can occur on geological-geomorphologic system are those relating to relief changes, that will be produced as a result of earthworks carried out for the construction of the foundation needed to put the shunt reactors.

This entails small excavations and land levelling. The parcel where the substation is located is essentially flat, and the shunt reactors shall be place inside the area of the substation. Therefore, earthworks needed for the construction of the building are expected to be minimized. The foundation shall be capable to carry the complete reactor weight plus 10% safety margin. It shall be horizontally balanced. Foundation height depends on the carrier vehicle in which the reactor is transported; it shall be equal to the carrier vehicle height. However, if the reactor shunt is handled by a crane the foundation height is not very important.

After the works, corrective measures shall be implemented in order to restore the area of the works so it is integrated in form and colour of the ground. Thus, the impact on the geomorphology does not have a negative consequence. Preventive and corrective measures can be found in Section 5.1.

Taken into account all above, and since the area affected is wholly inside the area of the substation and it will not be used for any other purposed, this impact is considered as negative, direct, permanent and short-term, valued as SMALL ADVERSE.

- Operating phase:

In the operating phase no alteration is expected.

4.7.4.2 Impact on the pedology

All the impacts on the pedology are the same for the five substations.

The alterations in the soil caused by the project are assessed by the changes that occur in their physical, chemical and biological characteristics.

The most direct impact on the implementation of a project, and in general terms, the most important, is the occupation of land and the loss or reduction of its potential for agricultural use.

- Installation phase:

The magnitude of the impact on the soil is a function of the quality and use of the land affected. In this case, as mentioned above, the area where the earthworks shall be carried out is inside the substation, and thus it has no agricultural or urban purposed and it is currently used for the same activity as it will be after installation.

Consequently, the impact destruction and loss of soil quality is considered as NULL.

Civil works bring certain level of soil pollution by discharges and waste risk. Although during the works no activities involving direct contamination will be carried out, there is a risk of accidental discharges of hazardous substances as oils, fats and/or fuel in machinery, as well as dielectrics mineral oils, during the filling and assembly of shunt reactors.

An oil pit shall be provided beneath the reactor used for drain oil. This pit may also control the spread of fire in case of a reactor failure. The volume of this pit shall be sized such that it can contain all the reactor oil or have a piping system to deliver the oil to other locations.

Due to the small possibility of these discharges to happen, the preventive pit and the fast measured that would be develop if it did, this impact is considered as SMALL ADVERSE. Some preventive and corrective measures to avoid major impacts are explained after in this document.

- Operating phase:

During the operating phase, the only liquid present and likely to contaminate the soil is the mineral oil used in the shunt reactors and transformers.

Under normal use this oil is tested periodically in order to detect the presence of unwanted substances, ensuring it has a long lifespan. As explained in the previous section a pit shall be provided beneath the reactor in order to correct any accidental discharge. The same technique is used for the transformers of the substation. This way the risk of soil pollution by discharges and waste impact is significantly reduced, and consequently valued as NOT SIGNIFICANT.

As in the previous phases the impact of destruction and loss of soil quality is valued as NULL.

4.7.4.3 Impact on the hydrology

All the impacts on the hydrology are the same for the five substations.

- Installation phase:

The area where the civil works will be developed was already part of the substation and there is no natural river channel in the zone, therefore the impact interruption or alteration of surface hydrology is valued as NULL.

Other aspect to consider is the possible contamination of groundwater by accidental spills of hazardous substances on the ground. Such discharges will be prevented establishing adequate practice for handling these substances and for the machinery installation, maintenance and repairs.

Considering the probability of a discharge during construction and the low vulnerability of groundwater of the area, the impact contamination of groundwater is considered SMALL ADVERSE.

- Operating phase:

The contamination of groundwater could be produced by accidental leaks of the dielectric oil confined in the reactors and transformers. As explained above in this document, a pit under this equipment is especially designed and built to prevent this to happen.

The protection offered by this system makes this impact unlikely to happen even in the case an accidental discharge occurs. In such case, it would also be planned the withdrawal of the dielectric oil from the deposit and hazardous substances used for the maintenance of reactors by authorized agents.

Considering the preventive measures described the impact contamination of groundwater is valued as NOT SIGNIFICANT.

Regarding the possible disruption of the natural flow of water into aquifers, it might be considered the potential reduction of rainwater filtration into the ground due to the new buildings and the waterproofing of the land occupied by the substation. As the area was already part of the former substation, the impact disruption of the natural flow of water into aquifers is valued as NULL.

4.7.4.4 Impact on the air/atmosphere

The transportation, installation and commissioning of the shunt reactors may produce changes in its surroundings regarding air quality, affected by gases emissions from machinery, suspended particles and sound levels. These impacts are analyzed for the stages of installation and operation.

- Installation:

Air quality might be affected as a result of the emission of dust and combustion gases produced by the earthwork required for the excavation, and the movement of machinery used for this or other actions relating to the implementation of the project.

The impact is caused primarily from combustion gases of machinery and the dust that can be lifted from the work zone. Emissions generate a local alteration in air quality, which magnitude depends on the volume of the emissions themselves and other parameters such us wind strength and the presence of rainfalls.

The areas surrounding the substations are not considered as a residential zone, and thus the population will not be directly affected. Taking into account this, and the short duration of the works, the impact alteration of the air quality is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE. Some mitigation measures shall be held in order to reduce the impact. Preventive and corrective measures are shown in Section 5.1.

During the installation an increase of the noise level will be produced by the operation of machinery when performing the excavation, earthwork, installation of equipment, etc. In any case, the equipment and machinery used for the civil works shall comply with the legal requirements that regulate the noise emission in the environment (SNiP II-12-77 "Noise Protection").

In case of **Lutsk SS** the closest residential area around the SS is 1 km far to the south-west. If the maximum level if noise produced during the works is under 100

dB (see Anex 7.2 Table Noise Levels of some construction equipment), and using the Law of the Distance we have:

$$L_2 = L_1 + 20 \cdot \log ({}^{d_1}/_{d_2})$$

Being L_1 the noise level (dB) in a distance d_1 and L_2 the noise level in a distance d_2. Considering a noise level of 100 dB in a distance of 1 meter, 1 km far the noise level is 40 dB. This level of noise is equivalent to the one produced by a normal conversation.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

In case of **Kovel SS** the closest residential area around the SS is 600 m far to the north. Considering a noise level of 100 dB in a distance of 1 meter, 1 km far the noise level is 44 dB. This level of noise is equivalent to the one produced by a normal conversation between several people.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

Some corrective measures shall be performed, as strictly complying with schedules in order to minimize the working time and reduce the inconvenience to the population living or working in the surroundings.

In case of **Shepetivka SS** the closest residential area around the SS is 3 km far to the north. Considering a noise level of 100 dB in a distance of 1 meter, 1 km far the noise level is 40 dB. This level of noise is lower to the one produced by a normal conversation between several people.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

In case of **Kamenets-Podilska SS the closest residential area is 600m far.** The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

In case of **Novovolinskaya SS** the closest residential area around the SS is 3 km far to the north. Considering a noise level of 100 dB in a distance of 1 meter, 1.6 km far the noise level is 35 dB. This level of noise is lower to the one produced by a normal conversation between several people.

The impact of increase of the noise levels is considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

No alteration of the air quality is expected during the operation phase.

With respect to the increase of the noise levels the impact should be assessed in comparison to the operating noise of the previous substations. Shunt reactors

produce noise due to the vibration of the windings. This noise should be similar to the one produced by the transformers of the substation. Taking into account that the area is not located near to a residential or working zone, and that the level of sound of this reactors does not exceed levels of discomfort, the impact is considered as NOT SIGNIFICANT.

The generation of an electromagnetic field are similar to the former operation of the substation, in which the limits set by the regulation were respected. Therefore this impact is considered as NOT SIGNIFICANT.

4.7.4.5 Impact on fauna and flora

All the impacts on Fauna and Flora are the same for the five substations.

Flora

- Installation phase:

Impact on the flora mainly occurs in the construction process, movement of machinery and supply and assembly of equipment.

The area where the reconstruction will be carried out is already a part of the substation and it will not be necessary to eliminate vegetation. Consequently the impact of elimination of vegetation is valued as NULL for every phase.

On the other hand, civil work may affect to crops in the surrounding areas. In this case, lands adjacent to the SS are not used for any agricultural purpose, and thus the impact degradation of vegetation is valued as NULL.

- Operating phase:

No impact on the flora is considered in this phase.

Fauna

Impacts on the fauna will be produced only during the reconstruction phase. The intensity of the impact depends overall on the sensitivity of the existing species to the changes in their environment, being this related to degradation of vegetation and changes in the ground of the area.

- Installation phase:

One of the impacts that might be produced during this phase is the direct destruction of existing species due to the preparation of the land and excavations. As the area chosen for the performance of the works is already part of the substation there will be no species affected by the civil works. This impact is valued as NULL.

The area of the works is absent of plant and animal habitat, however, there might be some alteration in the surrounding environmental conditions due to the transportation, earthwork, and management of residuals. These possible impacts shall be minimized implementing preventive and corrective measures, as it is explained in Section 5.1. Thus, degradation of the habitat is considered as negative, direct, temporary, short-term and reversible valued as SMALL ADVERSE.

During the installation of the equipments there could be alteration in the animal behaviour due to the degradation of the habitat as well as the noises.

Bearing in mind the temporality of this situation, the low faunal diversity of the area the impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

No impact on the fauna is expected during the operating phase.

4.7.4.6 Impacts on the population

All the impacts on the population are the same for the five substations.

- Installation phase:

The implementation of the project may have effects on the workforce due to the employment generation. A moderate demand for labour will be produced, although this will take place mainly during the reconstruction phase, consequently these potential job offers would be temporary. Workforce may suffer a positive impact caused by the creation of new job positions. This impact is considered as positive, direct, temporary and short term, valued as BENEFITIAL.

Moreover, the work may cause discomfort to the population, mainly people living or working in the surroundings of the substation. The inconveniences would be caused by earth movements, increased of traffic in the area, movement of machinery and noise produced. This is a temporary and intermittent effect that would cease when the civil work is finished. Concretely, in the installation phase, excavations and movement of equipment will be carried out. This involves the use of cranes, affecting traffic, noise and pollution directly.

It is important to note that movements of shunt reactors require trucks of significant dimensions, and that driving might be difficult in some points of the way.

Taking into account this information together with the temporary nature of the effects and the mitigation and protective measures that would be implemented (Section 5.1), makes the impact to be considered as negative, direct, temporary, shor-term and reversible, valued as ADVERSE.

Inherent to the execution of the reconstruction, a risk of fire exists as a consequence of the use of machinery and movement of the equipments. The equipment to be used during the civil works does not suppose the use of a significant amount of combustible fluids. Insulating oils used in shunt reactors are flammable; consequently, preventive measures shall be implemented when filling and moving them, trying to avoid any action that may cause the fire.

In any case, portable extinguishers shall be available in the work shed and properly signed. The implementation of these protective measures and the medium level of risk considering the nature of the works allow characterizing the impact as negative, indirect, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

With regard to the effects on the welfare and life quality a positive impact is expected on the population receiving electricity from this substation, due to an improvement of the security and conditions of the electricity supply of the

customers fed by the substation. It should be borne in mind that the former operating conditions of the substation allowed a normal operation although it had a low reliability. Consequently this impact is considered as positive, direct, permanent and short-term, valued as SMALL BENEFITIAL.

In terms of risk of fire, it should be noted that the fire is not a risk inherent to the activity develop in Lutsk SS. However, as explained in the Section 4.2.4.4 in this report, insulating oils used in transformers and shunt reactors and transformers are flammable and may cause chemical reactions due to electric arcs or static discharges. This is controlled and prevented to happen by the protections that monitor the temperature and overloads that may jeopardize their safe operation. In conclusion, the risk of fire can be considered as low. However it will be bear in mind and will comply in all cases the corresponding legislation.

Taking into account the above, the impact is considered as negative, direct, short-time, reversible and recoverable, valued as NOT SIGNIFICANT.

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
- 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

As explained before, the rehabilitation will not change the values of the electromagnetic fields produced by the operation of the SS. These values will remain under the maximum valued allowed for a non residential area, which is 5 kV/m.

During the operation of a substation there is a risk of electrocution through touching metal non-energised parts that may become energised when insulation is damaged. However, protective measures to prevent this event to happen shall be implemented (Section 5.1). This risk does not increase with the installation of the shunt reactors, and thus the impact is considered as NOT SIGNIFICANT.

4.7.4.7 Impacts on the economic sectors

All the impacts on the economic sectors are the same for the five substations.

- Installation phase:

The impacts on the economic system depend on the context of the economic activities inside the project area and the characteristics of the infrastructures.

Consequently, in the construction industry certain services may be required providing economic benefits for the population. Some services may be hired from local companies (construction material, machinery, etc) which would cause a temporary economic dynamization. This impact is valued as positive, direct, temporary and short-term, valued as BENEFITIAL.

- Operating phase:

As commented before this reconstruction entails some improvement on the security and supply quality of electricity. This can influence indirectly in the residential and industrial development of the surroundings. This impact is considered as positive, indirect, permanent and long-term, valued as SMALL BENEFITIAL.

4.7.4.8 Impacts on natural sites and other areas of cultural interest

- Installation phase:

There are not any protected natural sites or any other are of cultural interest in the surroundings of the area of the substation, therefore the works carried out during the reconstruction phases will produce an impact of damage on natural sites or areas of cultural interest considered as NULL.

- Operating phase:

The same way and for the same reason the impact is NULL.

4.7.4.9 Impacts on the infrastructure and service roads

- Installation phase:

Access to **Lutsk SS** will be made through roads which width and preservation is sufficient to perform the transportation manoeuvres necessary for moving the new equipment.

Inside the SS there is enough space in order to carry out the works without modifying anything.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 11 and Figure 46 the roads used for the access to the substation and the area inside are shown.

Figure 45 Access roads to Lutsk SS

Figure 46 Area of work inside the SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

Access to **Kovel SS** will be made through a principal road, directly connected to the centre of the city, which width and preservation is sufficient to perform the transportation manoeuvres necessary for moving the new equipment.

Inside the SS there is enough space in order to carry out the works without modifying anything.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 47 the road used for the access to the substation is shown.

Figure 47 Access roads to October SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

Access to **Shepetivka SS** will be made through a road which width and preservation is sufficient to perform the transportation manoeuvres necessary for moving the new equipment. Some parts of this road might have potholes and thus drivers shall take extra precautions when doing the transportations.

Inside the SS there is enough space in order to carry out the works without modifying anything.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 48 the road used for the access to the substation is shown.

Figure 48 Access roads to Shepetivka SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

Access to **Kamenets-Podilska SS** will be made through a road which width and preservation is sufficient to perform the transportation manoeuvres necessary for moving the new equipment. Some parts of this road might have potholes and thus drivers shall take extra precautions when doing the transportations.

Inside the SS there is enough space in order to carry out the works without modifying anything.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 49 the road used for the access to the substation is shown.

Figure 49 Access roads to Kamenets-Podilska SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

Access to **Novovolinskaya SS** will be made, frist through a road which width and preservation is sufficient to perform the transportation manoeuvres necessary for moving the new equipment, and after through a dirt road. This last one road is narrower and when transporting the shunt reactors the trucks will occupy the entire road. However, since this path only has access to the substation this should not cause any inconvenience to people external to the substation. Some parts of this road might have potholes and thus drivers shall take extra precautions when doing the transportations.

Inside the SS there is enough space in order to carry out the works without modifying anything.

Consequently it will not be necessary the alteration or modification of national or local roads in order to carry out the reconstruction of the SS but it is impossible to ensure there will not be any damage or degradation of the infrastructures. Therefore the impact is considered as negative, direct, permanent, short-term, reversible and recoverable, valued as SMALL ADVERSE.

In Figure 50 the road used for the access to the substation is shown.

Figure 50 Access roads to Novovolinskaya SS

Regarding the possible effects on the rainwater evacuation network there will not be any contaminating discharge and no evacuation network will be blocked, and therefore the impact is considered as NULL.

- Operating phase:

During the operation phase no alteration or modification of national or local roads is expected, and as a result the impact is valued as NULL. Effects on the rainwater evacuation network are considered as NULL as well.

However, regarding the effect on the current electricity network in the area the rehabilitation is considered as a positive, direct, permanent, short-term impact, valued as BENEFICIAL.

4.7.4.10 Impacts on the landscape

All the impacts on the landscape are the same for the five substations.

- Installation phase:

Visual impacts related to the loss of landscape quality are produced after the entry of vehicles and heavy machinery into the area, land preparation, dust generation, foundation and construction lift. Construction and material storages sites will be visible; however these will only be temporary features which constitute relatively little change to the overall background of the project area.

Some mitigation and corrective measures are taken when the works are finished in order to minimize the impacts on the landscape. These measures are shown in Section 5.1.

Taking into account the above, the characteristics of the work area and the surroundings this impact is considered as negative, direct, temporary, short term, reversible and recoverable, valued as SMALL ADVERSE.

- Operating phase:

No impact is expected during this phase.

4.7.4.11 Hazards and Hazardous Materials

Transportation and installation of shunt reactors may create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials. The proposed project is not anticipated to create a significant hazard to the public or environment through the routine transport, use or disposal of hazardous materials.

- Installation phase:

During construction activities the use of equipment and vehicles containing petroleum products would occur on the site. However, refuelling would be made outside of the reconstruction area.

Filling of shunt reactors shall be made inside the substation when they are built up and sealed. This process shall be done by experts that will comply with the needed security measures in order to avoid accidental discharges. Therefore, the risk of create a significant hazard to the public or the environment due to the transport, is low, and considered as negative, direct, temporary, short-term and reversible, valued as SMALL ADVERSE.

- Operating phase:

As explained before in this document, shunt reactors contain dielectric oils. However, no leakages are expected during the normal operation of the SS, and in order to avoid major damage in case they happen, an oil pit is located bellow the reactors. Consequently, the possible impact of create a significant hazard to the public or the environment through the normal operation is considered as NOT SIGNIFICANT.

4.7.5 Classification of the Project based on World's Bank Operational Policy

According to the World Bank's Operational Policy (OP) 4.01 the installation of shunt reactors in substations Lutsk Pivdenna, Kovel, Shepetivka, Kamenets-Podilska and Novovolinskaya can be classified as Category C.

Given the dimensions of the works required, and the short period in which they shall be performed, the proposed projects have minimal site-specific adverse impacts, in no case critical, and always mitigated or avoided with the implementation of measures. Besides, it also entails beneficial impacts.

It also shall be highlighted that the areas where the rehabilitation works are planned to be carried out are sparely populated and negative direct impacts to the population are minimal.

For this kind or projects the EA may vary depending on the project characteristics. In any case it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and improve environmental performance.
The implementation of the Environmental Management Plan shall also be done according to the World Bank's Policy. It consists of the set of mitigation, monitoring and institutional measures to be taking during the implementation and operation in order to eliminate environmental and social impacts or to reduce them to acceptable levels.

The EMP includes the following components: Mitigation measures, Monitoring Plan, Cost Estimation and Estimated GANTT.

5 Environmental Management Plan

Rehabilitation of Substations

5.1 Preventive and corrective measures

5.1.1 Preventive measures

5.1.1.1 Ground

- Before starting the works

Machinery and vehicles used shall have successfully passed the corresponding technical inspections and being in perfect working conditions, especially with regard to leakage of lubricants or fuels, emissions and noise.

- During the works
    - Material storage, excavation, construction and assembly areas shall be minimized. The material will be located only within the perimeter of work planned to install the ST.
    - To prevent any discharge of a hazardous material to contaminate the ground a plastic surface shall be installed on the working area where these kind of risks are higher.
    - In case any residual or discharge of a hazardous material happened, the ground shall be removed immediately. Depending on the company in charge of treatment of transformers oil and decontamination of the ground the techniques used may be different. Some of these techniques allow the treatment of the contaminated ground *in situ* and others entail moving the ground from the site.
    - In order to correct the possible risk of an uncontrolled oil leak a concrete bucket shall be built. This bucket shall collect all the fluids that fall upon it and shall be dimensioned to be able to contain, without spillage, the total volume of oil in the transformer.

- After the works
    - Residuals generated in the reconstruction will be removed according to regulations and in no case burning or abandonment will be proceeded, especially hazardous residuals.

5.1.1.2 Water

- After the works

Hazardous residuals generated in the reconstruction shall be treated according to the previous section.

5.1.1.3 Atmosphere

- Before starting the works

With the purpose of minimizing the light pollution the following measures shall be performed:

    - Facilities and lighting equipment shall be designed in such conditions to prevent light pollution and favour energy savings.

- Street lights shall be distributed in the most effective and efficient way, using the minimum amount of light to meet the lighting criteria.
- The components of the lighting shall be properly adjusted to the characteristics of applications and the area, and they will emit preferably in the visible spectrum of long wavelength.
- Maintenance programs shall be adopted in order to preserve the characteristics of the facilities and lighting devices.

- During the works
  - Material storage, excavation, construction and assembly areas shall be minimized. The material will be located only with the perimeter of work planned to install the ST.
  - In the management of machinery and vehicles these guidelines shall be followed: avoid speeding, driving without accelerations or retentions, plan the routes in order to optimize the performance preventing the operation of heavy machinery when unnecessary.
  - Measures shall be taken in order to minimize dust generation in earthworks: applying daily watering to keep moist materials that can generate airborne dust, and thin materials shall be stacked in wind protected areas to avoid overflying particles.
  - To prevent the propagation of vibration, each transformer shall be settled on rails on a concrete slab, independently and isolated from the rest of the installation. In order to reduce to the minimum the emission of electromagnetic fields in the surrounding area of the SS new line portals of 22.5 m high are constructed. These will reduce the electromagnetic field strength to safe values.

- After the works

The high reliability and control of SF6 equipments makes an accidental leakage and venting to the atmosphere highly unlikely to happen. Moreover, considering the type and the small volume of gas confined in the equipments the leakage would be completely harmless and also monitored by the SF6 gas density monitor installed. However, in case installation repair or maintenance work on SF6 insulated devices is needed, it shall be done by qualified personnel, taking the usual precaution in such operations.

5.1.1.4 Population

- During the works
  - Dust creation shall be minimized implementing the measures described in Section 5.1.1.3.
  - All the material and equipment needed to the project shall be gathered in the area of the SS, avoiding the alteration of the surrounding parcels. Material storage, excavation, construction and assembling areas shall be minimized.

5.1.1.5 Socioeconomic Sector

- During the works
  - Works shall be performed in the estimated times, taking place in schedule compliance in order to reduce to minimum the inconvenience caused to the population.

- To prevent population from suffering accidents during the reconstruction works, there shall be a fence with safety signage that impede access to non-authorized staff.
- The building shall have fire detection systems and portable extinguishers shall be available. It also shall have emergency lightning.

- In order to avoid electrocution danger, both in the inside and outside of the SS the measures set out in the specific regulation for such facilities shall be adopted:
  - protective grounding;
  - zeroing;
  - potential levelling;
  - a system of protection wires;
  - protective disconnection;
  - insulation of non-energised parts;
  - electrical segmentation of the network;
  - insulation control;
  - grounding of short-circuit currents;
  - Personal protection equipment.

5.1.1.6 Residuals

- During/After the works
  - Different waste generated in the construction shall be segregated (inert, urban assimilable and dangerous) and deposited in the specific containers for each type, avoiding contamination and mix between them, and then managed according to the regulation.
  - The surplus of the excavation shall be transported to authorized dumping sites.

5.1.1.7 Landscape

All the previous measures entail a minimization of the landscape affectation, especially those inherent to the project as the GIS design, the occupied surface, cleaning measures, and the regulation compliance regarding the energetic efficiency and outside lightning.

Simple measures as moving large equipment and machinery during the night time shall be taken as they can avoid landscape impacts in an efficient and cheap way.

5.1.1.8 Traffic

During the works, the traffic of heavy vehicles should take into account the circulating density of the access roads to the substation to minimize the discomfort, especially in the highway.

5.1.2 Corrective measures

After the works

At the end of works a general cleaning of the area shall be performed, managing according to the regulation all the residuals and materials used and generated.

Every infrastructure damaged as a result of the works shall be restored or conditioned: access, infrastructures, ditches, etc.

External surfaces of the SS area shall be restored so these are integrated in form and colour of the ground.

5.2 Environmental Monitoring Plan

This Plan shall be implemented during the rehabilitation works. The main objectives of the Environmental Monitoring Plan are the following:

- Check compliance with the protective measures proposed.
- Check and verify that the corrective measures applied are effective and reduce the magnitude of the detected impacts.
- If these measures are not efficient, design new measures.
- Avoid and solve problems arising during the implementation of the protective and corrective measures.
- Identify non-expected impacts and provide information about little-known environmental issues.

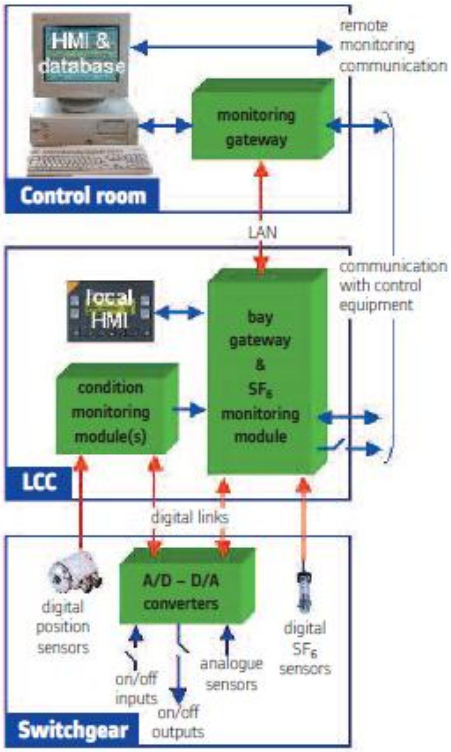
5.2.1 Reconstruction phase

- It shall be checked that the affected area is strictly the needed, and that the parking, daily maintenance of machinery, collection of materials and residuals are made in the areas provided for such activities.
- It shall be checked that the residuals from the works are deposited in the right containers and managed according the regulations.
- Hazardous materials shall be arranged avoiding torrent areas.
- During this phase some analysis shall be done in order to ensure the works are complying with the regulations. The analysis that shall be done are:
    - Air quality: it shall be done every two months at least. The frequency may vary depending on the request of the final provider.
    - Noise: noise levels shall be monitored by the general management, although a control analysis shall be done every two months at least.
    - An environmental report shall be written during the preparatory and installation works. It should summarize the measures taking during these periods as well as the air quality and noise analyses results.
    - Hazardous materials and waste sites.
- Transportation, traffic and access to the site shall be managed and controlled.
- With the purpose of assuring that monitoring activities are performed in the time it shall be necessary to have an environmental monitor on site during construction.

5.2.2 Operating phase

- Transformers shall be equipped with security systems that monitor the oil pressure levels, temperature, etc., detecting any variation out of the range of normal operation.
- It shall be checked that the rest of preventive and corrective measures are implemented.

- There shall be periodic inspection in order to verify the good condition of the site and check no other impacts have arisen.
- Since SF6 is a strong greenhouse gas and there are strict regulations, it should be monitored for the gas leakage thoroughly. This could be done by gas density monitors or gas leakage sensors and all of them should be integrated in the control system.



Shunt Reactors Installation

5.2.3 Preventive and corrective measures

PROTECTIVE MEASURES

5.2.3.1 Ground

- Before starting the works:

Machinery and vehicles used shall have successfully passed the corresponding technical inspections and being in perfect working conditions, especially with regard to leakage of lubricants or fuels, emissions and noise.

- During the works
  - Material storage, excavation, construction and assembly areas shall be minimized. The material will be located only with the perimeter of work planned to install the ST.
  - Every residual or discharge of a hazardous material on the ground shall be removed immediately to the corresponding container.
  - In order to correct the possible risk of an uncontrolled oil leak a concrete bucket shall be built. This bucket shall collect all the fluids that fall upon it and shall be dimensioned to be able to contain, without spillage, the total volume of oil in the transformer.

- After the works:

Residuals generated in the reconstruction will be removed according to regulations and in no case burning or abandonment will be proceeded, especially hazardous residuals.

5.2.3.2 Water

- After the works:

Hazardous residuals generated in the reconstruction shall be treated according to the previous section.

5.2.3.3 Atmosphere

- Before starting the works:

With the purpose of minimizing the light pollution the following measures shall be performed:

  - Facilities and lighting equipment shall be designed in such conditions to prevent light pollution and favour energy savings.
  - Street lights shall be distributed in the most effective and efficient way, using the minimum amount of light to meet the lighting criteria.
  - The components of the lighting shall be properly adjusted to the characteristics of applications and the area, and they will emit preferably in the visible spectrum of long wavelength.
  - Maintenance programs shall be adopted in order to preserve the characteristics of the facilities and lighting devices.
- During the works:
  - Material storage, excavation, construction and assembly areas shall be minimized. The material will be located only with the perimeter of work planned to install the ST.
  - In the management of machinery and vehicles these guidelines shall be followed: avoid speeding, driving without accelerations or retentions, plan the routes in order to optimize the performance preventing the operation of heavy machinery when unnecessary.
  - Measures shall be taken in order to minimize dust generation in earthworks, and thin materials shall be stacked in wind protected areas to avoid overflying particles.

5.2.3.4 Population

- During the works:
  - Works shall be performed in the estimated times, taking place in schedule compliance in order to reduce to minimum the inconvenience caused to the population.
  - To prevent population from suffering accidents during the reconstruction works, there shall be a fence with safety signage that impede access to non-authorized staff.
  - Fire detection systems and portable extinguishers shall be available.

- In order to avoid electrocution danger, both in the inside and outside of the SS the measures set out in the specific regulation for such facilities shall be adopted:
  - protective grounding;
  - zeroing;
  - potential levelling;
  - a system of protection wires;
  - protective disconnection;
  - insulation of non-energised parts;
  - electrical segmentation of the network;
  - insulation control;
  - grounding of short-circuit currents;
  - Personal protection equipment.
- Transportation of shunt reactors requires the use of large trucks. The speed of these trucks shall be limited and manoeuvres or narrow part of the roads may cause detentions. Therefore, special measures shall be taken in order to minimize the discomfort to the population:
  - Transport logistics: it is necessary to perform an analysis of the possible routes in order to design one that affects to the minimal number of people.
  - In some cases nigh transportations might be necessary in order not to collapse principal roads.

5.2.3.5 Residuals

- After the works
  - Different waste generated in the construction shall be segregated (inert, urban assimilable and dangerous) and deposited in the specific containers for each type, avoiding contamination and mix between them, and then managed according to the regulation.
  - The surplus of the excavation shall be transported to authorized dumping sites.

5.2.3.6 Landscape

All the previous measures entail a minimization of the landscape affectation, the occupied surface, cleaning measures, and the regulation compliance regarding the energetic efficiency and outside lightning.

Simple measures as moving large equipment and machinery during the night time shall be taken as they can avoid landscape impacts in an efficient and cheap way.

CORRECTIVE MEASURES

- After the works

At the end of works a general cleaning of the area shall be performed, managing according to the regulation all the residuals and materials used and generated.

Every infrastructure damaged as a result of the works shall be restored or conditioned: access, infrastructures, ditches, etc.

External surfaces of the SS area shall be restored so these are integrated in form and colour of the ground.

5.2.4 Environmental Monitoring Plan

This Plan shall be implemented during the rehabilitation works. The main objectives of the Environmental Monitoring Plan are the following:

- Check compliance with the protective measures proposed.
- Check and verify that the corrective measures applied are effective and reduce the magnitude of the detected impacts.
- If these measures are not efficient, design new measures.
- Avoid and solve problems arising during the implementation of the protective and corrective measures.
- Identify non-expected impacts and provide information about little-known environmental issues.

5.2.4.1 Installation phase

- It shall be checked that the affected area is strictly the needed, and that the parking, daily maintenance of machinery, collection of materials and residuals are made in the areas provided for such activities.
- It shall be checked that the residuals from the works are deposited in the right containers and managed according the regulations.
- Hazardous materials shall be arranged avoiding torrent areas.
- Transportation, traffic and access to the site shall be managed and controlled.
- With the purpose of assuring that monitoring activities are performed in the time it shall be necessary to have an environmental monitor on site during construction.

5.2.4.2 Operating phase

- Reactors shall be equipped with security systems that monitor the oil pressure levels, temperature, etc., detecting any variation out of the range of normal operation.
- It shall be checked that the rest of preventive and corrective measures are implemented.
- There shall be periodic inspection in order to verify the good condition of the site and check no other impacts have arisen.

6 Cost Estimation

This section includes the cost estimation of the Environmental Management Plan for the Substations' Rehabilitations and the Shunt Reactors Installation. Some of the tasks described in the Environmental Management Plan and that shall be performed, are inherent to the works and are already included in the total cost estimation calculated for the different rehabilitations.

Others don't represent any cost but only a way to proceed. And the rest of measures entail costs that are estimated as Environmental Impact Assessment and SF6 Monitoring costs.

The following table presents the total Environmental costs for all the expected works:

Table 11 Total EIA Costs

	Rehabilitation of Substations					
	Novokyivska	**October**	**Kremenchug**	**Zhytomyr**	**Cherkassy**	**Sumy**
Total Costs (USD)	75,381	69,601	66,243	70,130	67,561	73,036

	Installation of Shunt Reactors				
	Lutsk Pivdenna	**Novovolinskaya SS**	**Kovel SS**	**Shepetivka SS**	**Kamenets-Podilska**
Total Costs (USD)	6,174	6,174	6,174	6,174	6,174

The cost that may arise when an Environmental project is performed can be divided into different types:

- Material costs: these include either permanent or expendable materials. Expendable materials are those that are not left in the place, such as temporary structures and formwork.
- Equipment costs: acquisition and equipment operating expenses.
- Labor costs: is the money paid directly to the worker. Unit labor cost is controlled by the unit cost per unit of time and the productivity of the crew (an estimate of how many hours it will take to perform the task)

The calculations of the cost for the different substations can be found in Annex 7.1.

6.1 Novokyivska

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 12 EIA Cost Estimation

Novokyivska SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Plastic Surface	Material Cost	Final provider		140	
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final Provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final Provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		4500	
Noise control	Labor Cost	Acoustical Specialist		4500	
Periodic environmetal report	Labor Cost	Environmental Specialist		2167	
Fire detection system and extiguishers	Equipment Cost	Final Provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final Provider	Protection, communication & automation	-	
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	

Novokyivska SS: Environmental Impact Assessment and SF6 Monitoring Cost					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Supervisory work for the environmental analysis	Labor Cost	Environmental Project Manager		48480	
Management of machinery and vehicles environmental issues	Labor Cost	Environmental Project Manager			
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager			
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	Project Supervisor	Supervisor services	-	
II.After the works					
Residuals treatment	Labor Cost	Residual Specialist Company		4176	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist company		2059	
General cleaning	Labor Cost	Residual Specialist Company		2059	
Restoration of external surface	Labor Cost	Residual Specialist Company		555	
Total 1				**73903**	
Accidental discharges, damaged infrastructures (2%)	Labor cost	Residual Specialist Company		1478	
Total				**75381**	

Some of the tasks related to the environmental management of the transformers have not been considered as extra cost, since these measures were already taken in the old configuration.

6.1.1 Estimated GANTT

An estimated GANTT has been developed in order to have an indicative schedule of the Environmental Management Plan activities and the investments required according to project rehabilitation activities.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Novokyivska is shown below.

Table 13 Estimated GANTT for Novokyivska1

	2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory works 330 kV																
Supply of Equipment																
Installation of New Equipment 330 kV																
Dismantling 330 kV																
Installation peparatory works 110 kV																
Installation of New Equipment 110 kV																
Dismantling 110 kV																

The EMP activities carried out in each period are distributed as shown below.

Installation preparatory work:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Plastic Surface
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Periodic environmental report
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

The necessary watering shall be performed every two weeks during the months of April and May, and daily during June.

[1] The GANTT presented in this table is not complete. Only the periods in which the Environmental Management Plan shall be performed are shown.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 14 Estimated GANTT: Installation preparatory work

EMP Activities	2015			2016					
	4Q			1Q			2Q		
Installation preparatory work 330 kV	M10	M11	M12	M1	M2	M3	M4	M5	M6
Plastic Surface									
Protective fence with safety signance									
Specific containers for residuals									
Fire detection System									
Daily watering and protective wind areas									
Air quality analysis									
Noise Control									
Periodic Environmental Report									
Minimize area of use									
Materials located within the perimeter									
Environmental Project Manager tasks									

GANTT: Installation preparatory workow:

of protective and necessary equipment for the rehabilitation ties: y will be implemen

EMP Activities	2017								
	1Q			2Q			3Q		
Installation preparatory work 110 kV	M1	M2	M3	M4	M5	M6	M7	M8	M9
Plastic Surface									
Protective fence with safety signance									
Specific containers for residuals									
Fire detection System									
Daily watering and protective wind areas									
Air quality analysis									
Noise Control									
Periodic Environmental Report									
Minimize area of use									
Materials located within the perimeter									
Environmental Project Manager tasks									

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every three months before starting the installation of the new equipment, since no earthworks is performed in

this phase. During months 4,5 and 6 of 2016 the installation preparatory work is performed and thus this analyses are performed once a month, as explained above. The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 15 Estimated GANTT: Supply of Equipment

EMP Activities	2015			2016					
	4Q			1Q			2Q		
Supply of equipment	M10	M11	M12	M1	M2	M3	M4	M5	M6
Air quality analysis									
Noise control									
Minimize area of usage									
Materials located within perimeter planned									
Environmental Project Manager tasks									

Installation of new equipment

- Minimize area of usage
- SF6 security system
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Both SF6 security system and Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every four months, and the environmental report shall be done at the end of the works.

Table 16 Estimated GANTT: Installation of new equipment

EMP Activities	2016									2017		
	2Q			3Q			4Q			1Q		
Installation of new equipment 330 kV	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3
Minimize area of usage												
SF6 security system												
Anti-electrocution measures												
Air quality analysis												
Noise control												
Periodic environmental report												
Environmental Project Manager tasks												

EMP Activities	2017			2018		
	4Q			1Q		
Installation of new equipment 110 kV	M10	M11	M12	M1	M2	M3
Minimize area of usage						
SF6 security system						
Anti-electrocution measures						
Air quality analysis						
Noise control						
Periodic environmental report						
Environmental Project Manager tasks						

Existing Equipment Dismantling

- Residual treatment
- Management of surplus excavation
- General Cleaning
- Restoration of external surface
- Air quality analysis
- Noise control
- Environmental Project Manager tasks:
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

In case any residual treatment is needed in this phase it shall be done at the beginning of the Dismantling in order to avoid any possible discharge and contamination.

Air quality and Noise control analysis shall be performed once every two months, and an Environmental Report shall be performed at the end of the works showing the final state of the substation area.

Table 17 Estimated GANTT: Existing Equipment Dismantling

EMP Activities	2016		
	4Q		
Dismantling 330 kV	M10	M11	M12
Residual treatment			
Management of surplus excavation			
General Cleaning			
Restoration of external surface			
Air quality analysis			
Noise control			
Periodic Environmental Report			
Environmental Project Manager tasks			

EMP Activities	2018		
	1Q		
Dismantling 110 kV	M1	M2	M3
Residual treatment			
Management of surplus excavation			
General Cleaning			
Air quality analysis			
Noise control			
Restoration of external surface			
Periodic Environmental Report			
Environmental Project Manager tasks			

6.2 October

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 18 EIA Cost Estimation: October SS

October SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		6000	
Noise control	Labor Cost	Acoustical Specialist		6000	
Periodic environmetal report	Labor Cost	Environmental Specialist		2600	
Fire detection system and extiguishers	Equipment Cost	Final provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final provider	Protection, communication & automation	-	
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	

October SS: **Cost for EMP implementation**					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Supervisory work on the enviornmental analysis	Labor Cost	Environmental Project Manager		42420	
Management of machinery and vehicles environmentally kind	Labor Cost	Environmental Project Manager			
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager			
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	-	Supervisor services	-	
II.Afert the works					
Residuals treatment	Labor Cost	Project Supervisor		2736	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist Company		1349	
General cleaning	Labor Cost	Residual Specialist Company		1349	
Restauration of external surface	Labor Cost	Residual Specialist Company		342	
Total 1				68,236	
Accidental discharges, damaged infrastructures (2%)		Residual Specialist Company		1365	
Total				**69,601**	

6.2.1 Estimated GANTT

The total time for this rehabilitation project shall comprise 45 months, including 13 months of field work. Considering the works start in 2015 and that some of the activities can be done in parallel with the rehabilitation of Novokyivska the project is estimated to finalize by 2018.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Novokyivska is shown below.

Table 19 Estimated GANTT for October[2]

	2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work*												
Supply of Equipment												
Installation of New Equipment												
Existing Equipment Dismantling												

In each stage the following EMP activities shall be carried out:

Installation preparatory work:
This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Periodic environmental report
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise control analysis will be performed every three weeks as earthwork and movement of heavy equipment will be done in this phase.

[2] The GANTT presented in this table is not complete. It shows only the periods in which the Environmental Management Plan shall be performed.

The necessary watering shall be performed every two weeks during the months of April and May, and daily during June.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 20 Estimated GANTT: Installation preparatory work

EMP Activities	2017											
	January				February				March			
Installation preparatory work	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
Protective fence with safety signance												
Specific containers for residuals												
Fire detection System												
Daily watering and protective wind areas												
Air quality analysis												
Noise Control												
Periodic environmental report												
Minimize area of use												
Materials located within the perimeter												
Environmental Project Manager tasks												

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every three months before starting the installation of the new equipment, since no earthworks is performed in this phase.

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 21 Estimated GANTT: Supply of Equipment

EMP Activities	2016						2017					
	3Q			4Q			1Q			2Q		
Supply of Equipment	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6
Air quality analysis												
Noise control												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

Installation of new equipment

- Minimize area of usage
- SF6 security system
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Both SF6 security system and Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every month, and the environmental report shall be done after two consecutive analyses have been performed.

Table 22 Estimated GANTT: Installation of new equipment

EMP Activities	2017			2018					
	4Q			2Q			3Q		
Installation of new equipment	M10	M11	M12	M2	M5	M6	M7	M8	M9
Minimize area of usage									
SF6 security system									
Anti-electrocution measures									
Air quality analysis									
Noise control									
Periodic environmental report									
Environmental Project Manager tasks									

Existing Equipment Dismantling

- Residual treatment

- Management of surplus excavation
- General Cleaning
- Restoration of external surface
- Air quality analysis
- Noise control
- Environmental Project Manager tasks:
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

In case any residual treatment is needed in this phase it shall be done at the beginning of the Dismantling in order to avoid any possible discharge and contamination.

Air quality and Noise control analysis shall be performed once a month, and an Environmental Report shall be performed at the end of the works showing the final state of the substation area.

Table 23 Estimated GANTT: Existing Equipment Dismantling

EMP Activities	2017			2018		
	4Q			1Q		
Existing Equipment Dismantling 330 KV	M10	M11	M12	M1	M2	M3
Residual treatment						
Management of surplus excavation						
General Cleaning						
Restoration of external surface						
Air quality anlysis						
Noise control analysis						
Periodic Environmental Report						
Environmental Project Manager tasks						

6.3 Kremenchug

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 24 EIA Cost Estimation

Kremenchug SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Plastic Surface	Material Cost	Final provider		140	
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final Provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final Provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		4800	
Noise control	Labor Cost	Acoustical Specialist		4800	
Periodic environmetal report	Labor Cost	Environmental Specialist		2600	
Fire detection system and extiguishers	Equipment Cost	Final Provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final Provider	Protection, communication & automation	-	
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	

Kremenchug SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	
I.During the works					
Supervisory work for the environmental analysis	Labor Cost	Environmental Project Manager		36360	
Management of machinery and vehicles environmental issues	Labor Cost	Environmental Project Manager			
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager			
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	Project Supervisor	Supervisor services	-	
II.After the works					
Residuals treatment	Labor Cost	Residual Specialist Company		5184	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist company		2556	
General cleaning	Labor Cost	Residual Specialist Company		2556	
Restoration of external surface	Labor Cost	Residual Specialist Company		648	
Total 1				**64,944**	
Accidental discharges, damaged infrastructures (2%)	Labor cost	Residual Specialist Company		1299	
Total				**66,243**	

Some of the tasks related to the environmental management of the transformers have not been considered as extra cost, since these measures were already taken in the old configuration.

6.3.1 Estimated GANTT

An estimated GANTT has been developed in order to have an indicative schedule of the Environmental Management Plan activities and the investments required according to project rehabilitation activities.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Kremenchug is shown below.

Table 25 Estimated GANTT for Kremenchug[3]

	2016				2017			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work								
Construction of GIS building								
Supply of Equipment								
Installation of New Equipment								
Existing Equipment Dismantling								

The EMP activities carried out in each period are distributed as shown below.

Installation preparatory work and Construction of GIS building:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Plastic Surface
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

[3] The GANTT presented in this table is not complete. Only the periods in which the Environmental Management Plan shall be performed are shown.

Air quality and noise control analysis will be performed once a month as earthwork and movement of heavy equipment will be done in this phase. Environmental report shall be done after two consecutive analyses have been performed.

The necessary watering shall be performed every two weeks during the months of April and May, and daily during June.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 26 Estimated GANTT: Installation preparatory work

EMP Activities	2016											
	July				September				August			
Installation work & GIS buildings	W25	W26	W27	W28	W29	W30	W31	W32	W33	W34	W35	W36
Plastic Surface												
Protective fence with safety signance												
Specific containers for residuals												
Fire detection System												
Daily watering and protective wind areas												
Air quality analysis												
Noise Control												
Periodic environmental report												
Minimize area of use												
Materials located within the perimeter												
Environmental Project Manager tasks												

GANTT: Installation preparatory workow:

of protective and necessary equipment for the rehabilitation ties: y will be implemen

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every three months before starting the installation of the new equipment, since no earthworks is performed in this phase.

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 27 Estimated GANTT: Supply of Equipment

EMP Activities	2016											
	1Q			2Q			3Q			4Q		
Supply of Equipment	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Air quality analysis												
Noise control												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

Installation of new equipment

- Minimize area of usage
- SF6 security system
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Both SF6 security system and Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every two months, and the environmental report shall be done after two consecutive analyses have been performed.

Table 28 Estimated GANTT: Installation of new equipment

EMP Activities	2016			2017					
	4Q			1Q			2Q		
Installation of new equipment	M10	M11	M12	M1	M2	M3	M4	M5	M6
Minimize area of usage									
SF6 security system									
Anti-electrocution measures									
Air quality analysis									
Noise control									
Periodic environmental report									
Environmental Project Manager tasks									

Existing Equipment Dismantling

- Residual treatment
- Management of surplus excavation
- General Cleaning
- Restoration of external surface
- Air quality analysis
- Noise control
- Environmental Project Manager tasks:
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

In case any residual treatment is needed in this phase it shall be done at the beginning of the Dismantling in order to avoid any possible discharge and contamination.

Air quality and Noise control analysis shall be performed once every two months, and an Environmental Report shall be performed at the end of the works showing the final state of the substation area.

Table 29 Estimated GANTT: Existing Equipment Dismantling

EMP Activities	2017					
	Q2			Q3		
Existing Equipment Dismantling	M4	M5	M6	M7	M8	M9
Residual treatment						
Management of surplus excavation						
General Cleaning						
Restoration of external surface						
Air quality analysis						
Noise control analysis						
Periodic Environmental Report						
Environmental Project Manager tasks						

6.4 Cherkassy

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 30 EIA Cost Estimation: October SS

Cherkassy SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		8100	
Noise control	Labor Cost	Acoustical Specialist		8100	
Periodic environmetal report	Labor Cost	Environmental Specialist		2600	
Fire detection system and extiguishers	Equipment Cost	Final provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final provider	Protection, communication & automation	-	
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	

Cherkassy SS: **Cost for EMP implementation**					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Supervisory work on the enviornmental analysis	Labor Cost	Environmental Project Manager		36360	
Management of machinery and vehicles environmentally kind	Labor Cost	Environmental Project Manager			
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager			
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	-	Supervisor services	-	
II.Afert the works					
Residuals treatment	Labor Cost	Project Supervisor		2736	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist Company		1349	
General cleaning	Labor Cost	Residual Specialist Company		1349	
Restauration of external surface	Labor Cost	Residual Specialist Company		342	
Total 1				**66,236**	
Accidental discharges, damaged infrastructures (2%)		Residual Specialist Company		1325	
Total				**67,561**	

6.4.1 Estimated GANTT

The total time for this rehabilitation project shall comprise 51 months, including 18 months of field work. Considering the works start at the end of 2014 the project is estimated to finalize by 2018.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Cherkassy is shown below.

Table 31 Estimated GANTT for Cherkassy[4]

	2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work*								
Supply of Equipment								
Installation of New Equipment of AIS 330 kV								
Installation of GIS Equipment 110 kV								
Existing Equipment Dismantling								

*Preparatory works for 330 kV AIS during the second quarter of 2017 and preparatory works for 110 GIS during the fourth quarter of 2017.

In each stage the following EMP activities shall be carried out:

Installation preparatory work:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Periodic environmental report
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance

[4] The GANTT presented in this table is not complete. It shows only the periods in which the Environmental Management Plan shall be performed.

- Control on preventive and corrective measures

Air quality and noise control analysis will be performed once a month as earthwork and movement of heavy equipment will be done in this phase.

The necessary watering shall be performed every two weeks during the months of April and May, and daily during June.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 32 Estimated GANTT: Installation preparatory work

EMP Activities	2017					
	2Q			4Q		
Installation preparatory work	M4	M5	M6	M10	M11	M12
Protective fence with safety signance						
Specific containers for residuals						
Fire detection System						
Daily watering and protective wind areas						
Air quality analysis						
Noise Control						
Periodic environmental report						
Minimize area of use						
Materials located within the perimeter						
Environmental Project Manager tasks						

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
  - Supervisory work on the environmental analysis
  - Management of machinery and vehicles
  - Work schedule compliance
  - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every two months before starting the installation of the new equipment, since no earthworks is performed in this phase.

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 33 Estimated GANTT: Supply of Equipment

EMP Activities	2017											
	1Q			2Q			3Q			4Q		
Supply of Equipment	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Air quality analysis												
Noise control												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

Installation of new equipment of AIS 330 kV

- Minimize area of usage
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
  - Supervisory work on the environmental analysis
  - Management of machinery and vehicles
  - Work schedule compliance
  - Control on preventive and corrective measures

Air quality and noise control analysis shall be performed once every month, and the environmental report shall be done after two consecutive analyses have been performed.

Table 34 Estimated GANTT: Installation of new equipment

EMP Activities	2018					
	2Q			3Q		
Installation of new equipment	M2	M5	M6	M7	M8	M9
Minimize area of usage						
Air quality analysis						
Noise control						
Periodic environmental report						
Environmental Project Manager tasks						

Installation of new equipment of GIS 110 kV

- Minimize area of usage
- SF6 security system
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
  - Supervisory work on the environmental analysis
  - Management of machinery and vehicles
  - Work schedule compliance

- Control on preventive and corrective measures

Both SF6 security system and Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every month, and the environmental report shall be done after two consecutive analyses have been performed.

Table 35 Estimated GANTT: Installation of new equipment

EMP Activities	2018		
	1Q		
Installation of new equipment	M1	M2	M3
Minimize area of usage			
SF6 security system			
Anti-electrocution measures			
Air quality analysis			
Noise control			
Periodic environmental report			
Environmental Project Manager tasks			

Existing Equipment Dismantling

- Residual treatment
- Management of surplus excavation
- General Cleaning
- Restoration of external surface
- Air quality analysis
- Noise control
- Environmental Project Manager tasks:
  - Management of machinery and vehicles
  - Work schedule compliance
  - Control on preventive and corrective measures

In case any residual treatment is needed in this phase it shall be done at the beginning of the Dismantling in order to avoid any possible discharge and contamination.

Air quality and Noise control analysis shall be performed once a month and an Environmental Report shall be performed at the end of the works showing the final state of the substation area.

Table 36 Estimated GANTT: Existing Equipment Dismantling

EMP Activities	2018					
	2Q			3Q		
Existing Equipment Dismantling 330 KV	M4	M5	M6	M7	M8	M9
Residual treatment						
Management of surplus excavation						
General Cleaning						
Restoration of external surface						
Air quality anlysis						
Noise control analysis						
Periodic Environmental Report						
Environmental Project Manager tasks						

6.5 Zhytomyr

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 37 EIA Cost Estimation: October SS

Zhytomyr SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		4500	
Noise control	Labor Cost	Acoustical Specialist		4500	
Periodic environmetal report	Labor Cost	Environmental Specialist		2167	
Fire detection system and extiguishers	Equipment Cost	Final provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final provider	Protection, communication & automation	-	
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	

Zhytomyr SS: **Cost for EMP implementation**					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Supervisory work on the enviornmental analysis	Labor Cost	Environmental Project Manager		42420	
Management of machinery and vehicles environmentally kind	Labor Cost	Environmental Project Manager			
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager			
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	-	Supervisor services	-	
II.Afert the works					
Residuals treatment	Labor Cost	Project Supervisor		4608	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist Company		2272	
General cleaning	Labor Cost	Residual Specialist Company		2272	
Restauration of external surface	Labor Cost	Residual Specialist Company		576	
Total 1				**68,755**	
Accidental discharges, damaged infrastructures (2%)		Residual Specialist Company		1375	1725
Total				**70,130**	

6.5.1 Estimated GANTT

The total time for this rehabilitation project shall comprise 65 months, including 18 months of field work. Considering the works start in 2014 the project is estimated to finalize by 2018.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Zhytomyr is shown below.

Table 38 Estimated GANTT for Zhytomyr[5]

	2015				2016				2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work*																
Construction of GIS Buildings																
Supply of Equipment																
Installation of New Equipment																
Existing Equipment Dismantling																

In each stage the following EMP activities shall be carried out:

Installation preparatory work and Construction of GIS Buildings:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Periodic environmental report
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

[5] The GANTT presented in this table is not complete. It shows only the periods in which the Environmental Management Plan shall be performed.

Air quality and noise control analysis will be performed every month as earthwork and movement of heavy equipment will be done in this phase.

The necessary watering shall be performed every two weeks during the months of October, November and December.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 39 Estimated GANTT: Installation preparatory work

EMP Activities	2017											
	April				May				June			
Installation preparatory work	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24
Protective fence with safety signance												
Specific containers for residuals												
Fire detection System												
Daily watering and protective wind areas												
Air quality analysis												
Noise Control												
Periodic environmental report												
Minimize area of use												
Materials located within the perimeter												
Environmental Project Manager tasks												

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every two months before starting the installation of the new equipment, since no earthworks is performed in this phase.

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 40 Estimated GANTT: Supply of Equipment

EMP Activities	2017											
	1Q			2Q			3Q			4Q		
Supply of Equipment	M1	M2	M3	M10	M11	M12	M7	M8	M9	M7	M8	M9
Air quality analysis												
Noise control												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

Installation of new equipment

- Minimize area of usage
- SF6 security system
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Both SF6 security system and Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every two months, and the environmental report shall be done after two consecutive analyses have been performed.

Table 41 Estimated GANTT: Installation of new equipment

EMP Activities	2017					
	3Q			1Q		
Installation of new equipment	M7	M8	M9	M10	M11	M12
Minimize area of usage						
SF6 security system						
Anti-electrocution measures						
Air quality analysis						
Noise control						
Periodic environmental report						
Environmental Project Manager tasks						

Existing Equipment Dismantling

- Residual treatment

- Management of surplus excavation
- General Cleaning
- Restoration of external surface
- Air quality analysis
- Noise control
- Environmental Project Manager tasks:
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

In case any residual treatment is needed in this phase it shall be done at the beginning of the Dismantling in order to avoid any possible discharge and contamination.

Air quality and Noise control analysis shall be performed every two months, and an Environmental Report shall be performed at the end of the works showing the final state of the substation area.

Table 42 Estimated GANTT: Existing Equipment Dismantling

EMP Activities	2017					
	3Q			1Q		
Existing Equipment Dismantling 330 KV	M7	M8	M9	M10	M11	M12
Residual treatment						
Management of surplus excavation						
General Cleaning						
Restoration of external surface						
Air quality analysis						
Noise control analysis						
Periodic Environmental Report						
Environmental Project Manager tasks						

6.6 Sumy

The following table presents a list of all the tasks described in the Environmental Management Plan. These tasks are classified by the phase in which they shall be performed, the type of costs involved and the estimation of such costs.

In case the cost of a task had been included in other section of the Cost Estimation, such section is specified.

Table 43 EIA Cost Estimation: October SS

Sumy SS: Cost for EMP implementation					
Task	**Type of Cost**	**Responsible Party**	**Previously considered**	**Cost USD**	**Comment**
I.During the works					
Plastic Surface	Material Cost	Final provider		140	
Daily watering and protective wind areas	Material Cost	Final provider and Workforce		1500	Water supply, hoses, electricity, covering materials
Protective fence with safety signance	Equipment Cost	Final provider		3000	
Specific containers for residuals	Equipment Cost	Final provider	Residuals Treatment	-	
SF6 security system	Equipment Cost	Final provider		800	
Air quality analysis	Labor Cost	Air Quality Specialist		5100	
Noise control	Labor Cost	Acoustical Specialist		5100	
Periodic environmetal report	Labor Cost	Environmental Specialist		2600	
Fire detection system and extiguishers	Equipment Cost	Final provider	Protection, communication & automation	-	
Anti-electrocution measures	Labor Cost	Final provider	Protection, communication & automation	-	

Sumy SS: Cost for EMP implementation					
Area used shall be minimized	Labor Cost	Project Manager	General coordination	-	
Materials located within the perimeter planned	Labor Cost	Project Manager	General coordination	-	
I.During the works					
Supervisory work on the enviornmental analysis		Environmental Project Manager			
Management of machinery and vehicles environmentally kind	Labor Cost	Environmental Project Manager		42420	
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager	Supervisor services		
Control on preventive and corrective measures	Labor Cost	Environmental Project Manager			
Periodic inspections	Labor Cost	-		-	
II.Afert the works					
Residuals treatment	Labor Cost	Project Supervisor		5184	Residual containers, movement and treatment
Management of surplus of excavation	Labor Cost	Residual Specialist Company		2556	
General cleaning	Labor Cost	Residual Specialist Company		2556	
Restauration of external surface	Labor Cost	Residual Specialist Company		648	
Total 1				**71,604**	
Accidental discharges, damaged infrastructures (2%)		Residual Specialist Company		1,432	
Total				**73,036**	

6.6.1 Estimated GANTT

The total time for this rehabilitation project shall comprise 51 months, including 21 months of field work. Considering the works start in 2014 the project is estimated to finalize by 2018.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment, Installation of New Equipment and Existing Equipment Dismantling. The estimated GANTT for these activities in Sumy is shown below.

Table 44 Estimated GANTT for Sumy[6]

	2017				2018			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work*								
Supply of Equipment								
Installation of New Equipment								

In each stage the following EMP activities shall be carried out:

Installation preparatory work:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Protective fence with safety signance
- Specific containers for residuals
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Air quality analysis
- Noise Control
- Periodic environmental report
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise control analysis will be performed every month as earthwork and movement of heavy equipment will be done in this phase.

[6] The GANTT presented in this table is not complete. It shows only the periods in which the Environmental Management Plan shall be performed.

The necessary watering shall be performed every two weeks during the months of October, November and December.

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 45 Estimated GANTT: Installation preparatory work

EMP Activities	2017											
	April				May				June			
Installation preparatory work	W37	W38	W39	W40	W41	W42	W43	W44	W45	W46	W47	W48
Protective fence with safety signance												
Specific containers for residuals												
Fire detection System												
Daily watering and protective wind areas												
Air quality analysis												
Noise Control												
Periodic environmental report												
Minimize area of use												
Materials located within the perimeter												
Environmental Project Manager tasks												

Supply of Equipment

- Air quality analysis
- Noise Control
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Air quality and noise analyses shall be performed once every two months before starting the installation of the new equipment, since no earthworks is performed in this phase.

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 46 Estimated GANTT: Supply of Equipment

EMP Activities	2017												2018		
	1Q			2Q			3Q			4Q			1Q		
Supply of Equipment	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3
Air quality analysis															
Noise control															
Minimize area of usage															
Materials located within perimeter planned															
Environmental Project Manager tasks															

Installation of new equipment

- Minimize area of usage
- Anti-electrocution measures
- Air quality analysis
- Noise control
- Periodic environmental report
- Environmental Project Manager tasks:
  - Supervisory work on the environmental analysis
  - Management of machinery and vehicles
  - Work schedule compliance
  - Control on preventive and corrective measures

Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Air quality and noise control analysis shall be performed once every two months, and the environmental report shall be done after two consecutive analyses have been performed.

Table 47 Estimated GANTT: Installation of new equipment

EMP Activities	2017									2018		
	2Q			3Q			4Q			1Q		
Installation of New Equipment	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3
Anti-electrocution measures												
Air quality analysis												
Noise control												
Periodic Environmental Report												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

6.7 Shunt Reactors Installation

The process of installation of the shunt reactors, civil works, electrical equipment, work plan and environmental management plan is the same for the five substations. Therefore the cost estimation is the same for all of them.

Table 48 EIA Cost Estimation for the Installation of Shunt Reactors in one SS

Task	Type of Cost	Responsible Party	Cost USD
I.During the works			
Plastic Surface	Material Cost	-	80
Transport Logistics	Labor Cost	Environmental Project Manager	4800
Materials located within the perimeter planned	Labor Cost	Environmental Project Manager	
Management of machinery and vehicles environmentally kind	Labor Cost	Environmental Project Manager	
Works schedule in order to reduce the inconvenience to population	Labor Cost	Environmental Project Manager	
II.Afert the works			
Management of surplus of excavation	Labor Cost	Residual Specialist Company	1000
General cleaning	Labor Cost	Residual Specialist Company	
Restauration of external surface	Labor Cost	Residual Specialist Company	
Total 1			**5880**
Accidental discharges, damaged infrastructures (0.5% of Total 1)	Labor Cost	Residual Specialist Company	294
Total			**6,174**

6.7.1 Estimated GANTT

The total time for the installation of two shunt reactors in one of the substations is 18 months. Considering the works start in 2014 the project is estimated to finalize by 2017.

Since the EMP activities have the objective of minimizing the impact over the whole rehabilitation process they will be carried out during long-term periods. In general, these activities will be continuous during the implementation period of the following activities: Installation preparatory work, Supply of Equipment and Installation of New Equipment. The estimated GANTT for these activities in Sumy is shown below.

Table 49 Estimated GANTT for Reactors Substation A[7]

	2015				2016				2017			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Installation preparatory work*												
Supply of Equipment												
Installation of New Equipment												

In each stage the following EMP activities shall be carried out:

Installation preparatory work:

This phase comprises the first phase of the rehabilitation explained in the Description of Rehabilitation, above in this document.

- Specific containers for residuals
- Fire detection System
- Daily watering and protective wind areas during earthworks
- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:
    - Supervisory work on the environmental analysis
    - Management of machinery and vehicles
    - Work schedule compliance
    - Control on preventive and corrective measures

Some of these measures require the installation of protective and necessary equipment for the rehabilitation, and they will be set up in the estimated time shown below:

Table 50 Estimated GANTT: Installation preparatory work

EMP Activities	2016											
	October				November				December			
Installation preparatory work	W37	W38	W39	W40	W41	W42	W43	W44	W45	W46	W47	W48
Specific containers for residuals												
Fire detection System												
Daily watering and protective wind areas												
Minimize area of use												
Materials located within the perimeter												
Environmental Project Manager tasks												

Supply of Equipment

- Minimize area of usage
- Materials located within the perimeter planned
- Environmental Project Manager tasks:

[7] The GANTT presented in this table is not complete. It shows only the periods in which the Environmental Management Plan shall be performed.

- Supervisory work on the environmental analysis
- Management of machinery and vehicles
- Work schedule compliance
- Control on preventive and corrective measures
- Transport logistic

The supervisory measures will be carried out continuously since it is essential that the works are controlled at all times.

Table 51 Estimated GANTT: Supply of Equipment

EMP Activities	2016					
	3Q			4Q		
Supply of Equipment	M7	M8	M9	M10	M11	M12
Minimize area of usage						
Materials located within perimeter planned						
Environmental Project Manager tasks						

Installation of new equipment

- Minimize area of usage
- Anti-electrocution measures
- Environmental Project Manager tasks:
  - Supervisory work on the environmental analysis
  - Management of machinery and vehicles
  - Work schedule compliance
  - Control on preventive and corrective measures

Anti-electrocution equipment shall be installed along with the construction of the new configuration, however on the Estimated GANTT are shown at the beginning of the works as the acquisition and costs would occur in that period.

Table 52 Estimated GANTT: Installation of new equipment

EMP Activities	2017											
	January				February				March			
Installation of New Equipment	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
Anti-electrocution measures												
Minimize area of usage												
Materials located within perimeter planned												
Environmental Project Manager tasks												

7 Annexes

7.1 Annex 1: Calculation of Costs

Rehabilitation of Substations

Tasks	Type of cost/ Responsible	Measurement of the cost			Rehabilitation of Substations					
		$/day	$/Report	$/bay	Novokyivska	October	Kremenchug	Zhytomyr	Cherkassy	Sumy
I.During the works										
Plastic Surface	Material Cost				140	140	140	140	-	140
Daily watering and protective wind areas	Material Cost				1500	1500	1500	1500	1500	1500
Protective fence with safety signance	Equipment Cost				3000	3000	3000	3000	3000	3000
Specific containers for residuals	Equipment Cost				-	-	-	-	-	-
SF6 security system	Equipment Cost				800	800	800	800	800	800
Air quality analysis	Labor Cost **Air quality Specialist**		300		4500	6000	4800	4500	8100	5100
Noise control	Labor Cost **Acoustical Specialist**		300		4500	6000	4800	4500	8100	5100
Periodic environmetal report	Labor Cost **Environmental Specialist**		433		2167	2600	2600	2167	2600	2600
Fire detection system and extiguishers	Equipment Cost				-	-	-	-	-	-

Tasks	Type of cost/ Responsible	Measurement of the cost			Rehabilitation of Substations					
		$/day	$/Report	$/bay	Novokyivska	October	Kremenchug	Zhytomyr	Cherkassy	Sumy
Anti-electrocution measures	Labor Cost				-	-	-	-	-	-
Area used shall be minimized	Labor Cost				-	-	-	-	-	-
Materials located within the perimeter planned Supervisory work on the enviornmental analysis Management of machinery and vehicles environmentally kind Works schedule in order to reduce the inconvenience to population Control on preventive and corrective measures	Labor Cost Labor Cost **Environmental Project Manager**	101			48480	42420	36360	42420	36360	42420
Periodic inspections					-	-	-	-	-	-
II.Afert the works										
Residuals treatment	Labor Cost			144	4176	2736	5184	4608	2736	5184
Management of surplus of excavation	Labor Cost			71	2059	1349	2556	2272	1349	2556
General cleaning	Labor Cost			71	2059	1349	2556	2272	1349	2556
Restauration of external surface	Labor Cost			18	522	342	648	576	342	648
Total 1					73903	68,236	64,944	68,755	66,236	71,604
Accidental discharges, damaged infrastructures (1.5% of Total 1)					1478	1,365	1,299	1,375	1,325	1,432
Total					**75381**	**69,601**	**66,243**	**70,130**	**67,561**	**73,036**

Number of Analysis and Reports

	Frequency/month		Novokyivska*		October**		Kremenchug	
Stage of the works	**Air & Noise Analysis Separately**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**
Installation preparatory work	1.00	1.00	3	3	4	2	3	3
Supply of Equipment	0.50	0.00	6	0	4	0	6	0
Installation of New Equipment	0.50	0.25	3	1	9	3	4	2
Existing Equipment Dismantling	0.50	***	3	1	3	1	3	1
Total			15	5	20	6	16	6

	Frequency/month		Zhytomyr		Cherkassy**		Sumi	
Stage of the works	**Air & Noise Analysis Separately**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**	**Air & Noise Analysis**	**Periodic env. Report**
Installation preparatory work	1.00	1.00	5	3	6	2	3	3
Supply of Equipment	0.50	0.00	4	0	6	0	8	0
Installation of New Equipment	0.50	0.25	4	1	9	3	6	3
Existing Equipment Dismantling	0.50	***	2	1	6	1	-	-
Total			15	5	27	6	17	6

* Since the works are divided in two stages the frequency varies

* *Residential area, different frequency of analysis

** *One Environmental Report shall be made at the end of the works

Environmental Project Manager

	Novokyivska	October	Kremenchug	Zhytomyr	Cherkassy	Sumi
Total work time of the Environmental Project Manager (years)	2	1.75	1.5	1.75	1.5	1.75

Number of bays

	Novokyivska	October	Kremenchug	Zhytomyr	Cherkassy	Sumi
330 kV	12	3	7	8	6	12
110 kV	17	16	29	24	13	24
Total	29	19	36	32	19	36

Installation of Shunt Reactors

Tasks	Type of cost/ Responsible	Measurement of the cost		Installation of Shunt Reactors				
		$/day	$/bay	Lutsk Pivdenna	Novovolinskaya SS	Kovel SS	Shepetivka SS	Kamenets-Podilska
I.During the works								
Plastic Surface	Material Cost	-	-	80	80	80	80	80
Transport Logistics Materials located within the perimeter planned Management of machinery and vehicles environmentally kind Works schedule in order to reduce the inconvenience to population	Labor Cost **Environmental Project Manager**	80		4800	4800	4800	4800	4800
II.Afert the works								
Management of surplus of excavation	Labor Cost							
General cleaning	Labor Cost			1000	1000	1000	1000	1000
Restauration of external surface	Labor Cost							
Total 1				**5880**	**5880**	**5880**	**5880**	**5880**
Accidental discharges, damaged infrastructures (0.5% of Total 1)				294	294	294	294	294
Total				**6174**	**6174**	**6174**	**6174**	**6174**

Environmental Project Manager

	Lutsk Pivdenna	Novovolinskaya SS	Kovel SS	Shepetivka SS	Kamenets-Podilska
Total work time of the Environmental Project Manager (months)	3	3	3	3	3

7.2 Annex 2: Level of Noises

Type of Source	Type of Equipment	Range (DBA)
Earth Movement	Roller Compactor	70-75
	Loaders	72-85
	Tractors	77-96
	Graders	80-92
	Pavers	86-88
	Trucks	82-94
Material Handling	Concrete mixers	75-88
	Concrete pumps	80-85
	Craves	75-88
	Hackle	86-88
Stationary Equipment	Pumps	68-72
	Generators	72-84
	Compressors	75-88
Impact Equipment	Pneumatic drive	82-88
	Loosening piston hammers and rocks	82-98
	Peaks and indicators of piles	95-105
Other	Vibrators	69-81
	Saw	72-82

Source: Handbook of Noise Assessment. Daryl N.May 1978