Contract Documentation

“Supply and installation of a new leachate treatment system ”

Contract No. KhSWP-1

Khmelnytskyi Solid Waste Project

Khmelnytskyi, Ukraine
5 September, 2023

CONTRACT AGREEMENT

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Contract Agreement

THIS AGREEMENT is made on the 5 September of 2023

BETWEEN

(1) **Khmelnytskyi Communal Enterprise "SPETSKOMUNTRANS",** organised and existing under the laws of **Ukraine**, identification code of the legal entity: **03356565**, having its principal place of business at: **1 Kniazia Sviatoslava Khorobroho Street, Khmelnytskyi, 29008, Ukraine**, represented by the **Director Oleksandr ZIMIN**, acting on the basis of the Charter (hereinafter - the "Employer"),

&

(2) **UAB "ARIONEX LT"** organised under the laws of **Republic of Lithuania**, identification code of the legal entity: **300601705** and registered at: 6 Ašigalio, Kaunas, 49142, Lithuania, represented by **Director Giedrius Rutkauskas** acting on the basis of Charter, acting for and on behalf of the Consortium of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH, acting on the basis of JOINT ACTIVITY CONSORTIUM AGREEMENT dated 04.04.2023. (hereinafter called "the Contractor").

WHEREAS the Employer invited tenders for the execution of the Works, described as ***"Supply and installation of a new leachate treatment system"*** and has accepted a Tender by the Contractor for the execution and completion of these Works and the remedying of any defects therein, and the Employer agrees to pay the Contractor the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents, in order of precedence, shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.

(a) the Letter of Acceptance

(b) the Letter of Tender;

(c) the Particular Conditions of Contract

(d) the General Conditions of Contract

(e) Contract Forms

(f) the Requirements

(g) Bill of Quantities

(h) Other Documents

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. Payment of the amounts due to the Contractor under the Contract may only be made to the following bank account(s):

Payee's Account Name:	UAB "ARIONEX LT"
Payee's Account No. (IBAN):	LT45 7180 9000 3046 7809 EUR
Payee's Bank Name:	AB Šiaulių bankas
Payee's Bank Address:	Tilžės g. 149, LT-76348 Šiauliai, LT
SWIFT Code	CBSBL T26XXX

5. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

The Agreement is concluded in accordance with the laws of Ukraine on the day, month and year indicated above.

On behalf of the Employer:

Khmelnytskyi Communal Enterprise "SPETSKOMUNTRANS"

Signed by: _____

Oleksandr ZIMIN
Director

Acting on the basis of the Charter

for and on behalf of the Employer

Signed for and on behalf of the Employer

Date: _____

On behalf of the Contractor:

Consortium of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH

Signed by: _____

Giedrius Rutkauskas
Director of UAB "ARIONEX LT"

acting on the basis of the **Charter and JOINT ACTIVITY CONSORTIUM AGREEMENT dated 04.04.2023**

for and on behalf of the Contractor

Signed for and on behalf of the Contractor

Date: _____

Employer's details	***Contractor's details:***
Registered address: *1 Kniazia Sviatoslava Khorobroho Street, Khmelnytskyi, 29008, Ukraine* EDRPOU code: *03356565* Payment Instructions (Banking Details of the Recipient (the "Payee")): Payee's Account Name: Payee's Account Number (IBAN number): UA153204780000026001924437619 Payee's Bank Name: JOINT – STOCK BANK "UKRGASBANK" Payee's Bank SWIFT Code: UGASUAUK Payee's Bank Address: UKRAINE, 03087, KYIV, YEREVANSKA STREET, 1	Registered address: *6 Ašigalio, Kaunas, 49142, Lithuania* Identification code of the legal entity: *300601705* Payment Instructions (Banking Details of the Recipient (the "Payee")): Payee's Account Name: UAB "ARIONEX LT" Payee's Account Number (IBAN number): LT45 7180 9000 3046 7809 EUR Payee's Bank Name: AB Šiaulių bankas Payee's Bank SWIFT Code: CBSBL T26XXX Payee's Bank Address: Tilžės g. 149, LT-76348 Šiauliai, LT
Payee's Bank Correspondent Details: Correspondent's Name: Deutsche Bank AG, Frankfurt Am Main, Germany Correspondent's SWIFT Code: DEUTDEFF Correspondent's Address: Taunusanlage 12, 60325 Frankfurt Am Main, Germany Payee's Bank's Account Name: Payee's Bank's Account Number (IBAN number):	Payee's Bank Correspondent Details: Correspondent's Name: AB Šiaulių bankas Correspondent's SWIFT Code: CBSBL T26XXX Correspondent's Address: Tilžės g. 149, L T-76348 Šiauliai, LT Payee's Bank's Account Name: Payee's Bank's Account Number (IBAN

Contract Documents

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(a) Letter of Acceptance

ХМЕЛЬНИЦЬКА МІСЬКА РАДА

ХМЕЛЬНИЦЬКЕ КОМУНАЛЬНЕ ПІДПРИЄМСТВО «СПЕЦКОМУНТРАНС»

вул. Князя Святослава Хороброго, 1, м. Хмельницький, 29008, тел./факс (0382) 67-18-94
e-mail: skt_office@ukr.net, http://www.skt.km.ua, код ЄДРПОУ 03356565

від 24.07.2023 № 2770
на № _____ від _____

Letter of Acceptance

24 July, 2023

To: **Consortium of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH** *(*Ašigalio 6, 49142, Kaunas, Lithuania*)*

Subject: ***Notification of Award Contract No KhSWP-1***.

This is to notify you that your Tender dated April 28, 2023 for execution of the ***Contract No KhSWP-1: "Supply and installation of a new leachate treatment system"*** for the amount of ***2,598,183.00 euro (two million five hundred ninety eight thousand one hundred eighty three) including 5% of Contingencies and including VAT***, as corrected and modified in accordance with the Instructions to Participants is hereby accepted by us.

1. In accordance with Instructions to Participants of the Tender Document, within seven (7) calendar days of receipt of this notification of award, the Contractor is required to acknowledge receipt of the notification of award and to furnish the Employer with details of the bank account(s) that the Contractor proposes to use for the purpose of receiving payments due under the Contract, in the following format:

Payee's Account Name: …… ……..

Payee's Account No. (IBAN): ……...

Payee's Bank Name: ……

Payee's Bank Address: ……..

SWIFT CODE: …….

In the event that payments are to be made in a currency which is not the currency of the country of the Contractor, the correspondent bank details shall be furnished in the following format:

Payee's Bank's Correspondent details: ……..

Correspondent Bank Name: …….

Address: ……

Account Name (IBAN): ……

Account Number: ……..

SWIFT CODE: ……..

2. In accordance with ITP 36.2, upon receipt of the Contractor's acknowledgement of the notification of award and bank account details, the Employer shall sign and send to the Contractor the Contract Agreement. In accordance with ITP 37.2, within fourteen (14) calendar days of Contractor's receipt of the Contract Agreement, the Contractor shall sign, date and return the Contract Agreement to the Employer.

3. Within the period specified in the Contract the Contractor shall furnish the Employer with a Performance Security in the amount of ***259,818.30 euro (two hundred and fifty nine thousand eight hundred and eighteen euros 30 eurocents)*** in accordance with the Conditions of Contract, using for that purpose the Performance Security Form included in Section VII, Contract Terms and Conditions.

4. In addition you are requested to provide a cash flow forecast estimating the payments under the contract which you expect to come due during each month starting from the Contract signing date.

Oleksandr ZIMIN
Director

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(b) Letter of Tender

Letter of Tender

Date: ***04/04/2023***

Tendering No: **ECEPP ID: 12724585**

Contract: ***Contract № KhSWP-1: Supply and installation of a new leachate treatment system;***

To: **KHMELNYTSKYI COMMUNAL ENTERPRISE "SPETSKOMUNTRANS"**

We, the undersigned, declare that:

(a) We have examined and have no reservations to the above referenced Tender Document, including Addenda issued in accordance with Instructions to Participants (ITP);

(b) We offer to execute the works in conformity with the above referenced Tender Document for: ***Supply and installation of a new leachate treatment system***;

(c) The total price of our Tender, excluding any discounts offered in item (d) below, ***inclusive*** of VAT, is: ***2 598 183 (two million five hundred ninety eight thousands and one hundred three) euros***;

(d) The discounts offered and the methodology for their application are: N/A;

(e) Our Tender shall be valid for a period of ***120 days*** from the tender opening, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) We acknowledge that the Appendix to Tender and Attachment 1 to the Letter of Tender – Covenant of Integrity, form part of this Letter of Tender.

(g) If our Tender is accepted, we commit to obtain a performance security in accordance with the Contract;

(h) We, any subcontractors or suppliers and sub-suppliers for any part of the Contract, are eligible for award of the Bank's financed contracts and receiving the payments from the Bank's finance;

(i) We, including any subcontractors or suppliers and sub-suppliers for any part of the contract do not have any conflict of interest in accordance with ITP;

(j) We, including any of our subcontractors or suppliers and sub-suppliers for any part of the Contract, have not been declared ineligible by the Bank, due to conviction of an intentional crime (and any such criminal conviction is final in the relevant national jurisdiction, with no more than ten years having lapsed between the date on which the criminal conviction became final and the date of submission of tender); under relevant national law from entering into commercial relations with the Client, provided the prohibition relates to a Prohibited Practice, which had been determined through judicial or administrative proceedings with adequate due process; or by an act of compliance with a decision of the United Nations Security Council.

(k) We are not participating as a Tenderer or as a partner in a JVCA in more than one Tender in this Tendering process;

(l) We are ***not*** a government owned entity ***but meet the requirements of ITP;***

(m) We have paid, or will pay the following commissions, gratuities, or fees with respect to the Tendering process or execution of the Contract - ***"N/A":***

Name of Recipient	Address	Reason	Amount

N/A			
N/A			

(n) We understand that this Tender, together with your written acceptance thereof included in your notification of award, shall constitute a binding Contract between us, until a formal Contract is prepared and executed;

(o) We understand that you are not bound to accept the most economically advantageous tender or any other Tender that you may receive; and

(p) If awarded the Contract, the person named below shall act as Contractor's Representative:

Name:	Giedrius Rutkauskas
In the capacity of:	Chief Executive Officer
Signed:	
Duly authorised to sign the Tender for and on behalf of:	ArionexLt/ Rotreat Abwasserreinigung, GmbH
Date:	07-04-2023

LIETUVOS RESPUBLIKA UAB "ARIONEX LT" KAUNAS

Covenant of Integrity

(Attachment 1 to Letter of Tender)

To: **KHMELNYTSKYI COMMUNAL ENTERPRISE "SPETSKOMUNTRANS"**

We declare and covenant that neither we nor anyone, including any of our subsidiaries and affiliates, and all of our directors, employees, agents or joint venture partners, as well as any subcontractors, suppliers, sub-suppliers, concessionaires, consultants or sub-consultants, where these exist, acting on our behalf with due authority or with our knowledge or consent, or facilitated by us, has engaged, or will engage, in any Prohibited Practice (as defined below) in connection with the procurement process or in the execution or supply of any works, goods or services for ***Supply and installation of a new leachate treatment system*** (the "Contract") and covenant to so inform you if any instance of any such Prohibited Practice shall come to the attention of any person in our organisation having responsibility for ensuring compliance with this Covenant.

We declare that we have paid, or will pay, the following commissions, gratuities, or fees with respect to the procurement process or execution of the Contract:

Name of Recipient	Address	Reason	Amount
N/A			
N/A			

We declare that no affiliate of the Client is participating in our submission in any capacity whatsoever.

We shall, for the duration of the procurement process and, if we are successful in our tender, for the duration of the Contract, appoint and maintain in office an officer, who shall be a person reasonably satisfactory to you and to whom you shall have full and immediate access, having the duty, and the necessary powers, to ensure compliance with this Covenant.

We declare and covenant that, except for the matters disclosed in this Covenant of Integrity:

(i) we, our subsidiaries and affiliates, and all of our directors, employees, agents or joint venture partners, where these exist, have not been convicted in any court of any offence involving a Prohibited Practice in connection with any procurement process or provision of works, goods or services during the ten years immediately preceding the date of this Covenant;

(ii) none of our directors, employees, agents or a representatives of a joint venture partner, where these exist, has been dismissed or has resigned from any employment on the grounds of being implicated in any Prohibited Practice;

(iii) we, our subsidiaries and affiliates and our directors, employees, agents or joint venture partners, where these exist, have not been excluded by any major Multilateral Development Bank or International Financial Institution (including World Bank Group, African Development Bank Group, Asian Development Bank, EBRD, European Investment Bank or Inter-American Development Bank) from participation in a procurement procedure or entering into a contract with any of such institutions on the grounds of engaging in a Prohibited Practice;

(iv) we, our directors, subsidiaries and affiliates, as well as any subcontractors, or suppliers or affiliates of the subcontracts or supplier are not subject to any sanction imposed by resolution of the United Nations Security Council; and

(v) we further undertake to immediately inform the Client and the Bank if this situation were to occur at a later stage.

If applicable, provide full disclosure of any convictions, dismissal, resignations, exclusions or other information relevant to Articles (i), (ii), (iii) or (iv) in the box below.

Name of Entity Required to be Disclosed	Reason Disclosure is Required[1]
N/A	
N/A	

We understand that a misrepresentation in relation to or an omission to provide full disclosure of the information as required by this Covenant may result in the rejection of the tender and it may also lead to Enforcement Actions and Disclosure Actions as set out in the Bank's Enforcement Policy and Procedures.

For the purpose of this Covenant, the terms set forth below define Prohibited Practices as:

(i) a **Coercive Practice** which means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of any party to influence improperly the actions of a party;

(ii) a **Collusive Practice** which means an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iii) a **Corrupt Practice** which means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

(iv) a **Fraudulent Practice** which means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(v) a **Misuse of Bank's Resources or Bank Assets** which means improper use of the Bank's Resources or Bank Assets, committed either knowingly or recklessly;

(vi) an **Obstructive Practice** which means any of (1) destroying, falsifying, altering or concealing of evidence material to a Bank investigation, which impedes the Bank's investigation; (2) making false statements to investigators in order to materially impede a Bank investigation into allegations of a Prohibited Practice; (3) failing to comply with requests to provide information, documents or records in connection with a Bank investigation; (4) threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to a Bank investigation or from pursuing the investigation; or (5) materially impeding the exercise of the Bank's contractual rights of audit or inspection or access to information; and

(vii) a **Theft** which means the misappropriation of property belonging to another party.

At any time following the submission of our tender, we shall permit, and shall cause our JVCA partners, as well as our directors, employees, agents, Subcontractors and any other third parties engaged or involved for any part of the Contract to permit the Bank and/or persons appointed by them, the right to inspect and copy all accounts, books, records, and other documents (on any media or in any format) relating to the Procurement Process and execution of the Contract and to have any such accounts, books, records, and documents audited the Bank and by auditors appointed by the Bank. We accept to preserve these records generally in accordance with applicable law but in any case for at least six years from the date of substantial completion of the Contract.

Name:	Giedrius Rutkauskas
In the capacity of:	Chief Executive Officer
Signed:	
Duly authorised to sign for and on behalf of:	Arionex LT
Date:	07-04-2023

LIETUVOS RESPUBLIKA UAB „ARIONEX LT" KAUNAS

[1] For each matter disclosed, provide details of the measures that were taken, or shall be taken, to ensure that neither the disclosed entity nor any of its directors, employees or agents commits any Prohibited Conduct in connection with the procurement process for the Contract.

Covenant of Integrity

(Attachment 1 to Letter of Tender)

To: **KHMELNYTSKYI COMMUNAL ENTERPRISE "SPETSKOMUNTRANS"**

We declare and covenant that neither we nor anyone, including any of our subsidiaries and affiliates, and all of our directors, employees, agents or joint venture partners, as well as any subcontractors, suppliers, sub-suppliers, concessionaires, consultants or sub-consultants, where these exist, acting on our behalf with due authority or with our knowledge or consent, or facilitated by us, has engaged, or will engage, in any Prohibited Practice (as defined below) in connection with the procurement process or in the execution or supply of any works, goods or services for ***Supply and installation of a new leachate treatment system*** (the "Contract") and covenant to so inform you if any instance of any such Prohibited Practice shall come to the attention of any person in our organisation having responsibility for ensuring compliance with this Covenant.

We declare that we have paid, or will pay, the following commissions, gratuities, or fees with respect to the procurement process or execution of the Contract:

Name of Recipient	Address	Reason	Amount
.....	.....	.....	.....
.....	.....	.....	.....

We declare that no affiliate of the Client is participating in our submission in any capacity whatsoever.

We shall, for the duration of the procurement process and, if we are successful in our tender, for the duration of the Contract, appoint and maintain in office an officer, who shall be a person reasonably satisfactory to you and to whom you shall have full and immediate access, having the duty, and the necessary powers, to ensure compliance with this Covenant.

We declare and covenant that, except for the matters disclosed in this Covenant of Integrity:

(i) we, our subsidiaries and affiliates, and all of our directors, employees, agents or joint venture partners, where these exist, have not been convicted in any court of any offence involving a Prohibited Practice in connection with any procurement process or provision of works, goods or services during the ten years immediately preceding the date of this Covenant;

(ii) none of our directors, employees, agents or a representatives of a joint venture partner, where these exist, has been dismissed or has resigned from any employment on the grounds of being implicated in any Prohibited Practice;

(iii) we, our subsidiaries and affiliates and our directors, employees, agents or joint venture partners, where these exist, have not been excluded by any major Multilateral Development Bank or International Financial Institution (including World Bank Group, African Development Bank Group, Asian Development Bank, EBRD, European Investment Bank or Inter-American Development Bank) from participation in a procurement procedure or entering into a contract with any of such institutions on the grounds of engaging in a Prohibited Practice;

(iv) we, our directors, subsidiaries and affiliates, as well as any subcontractors, or suppliers or affiliates of the subcontracts or supplier are not subject to any sanction imposed by resolution of the United Nations Security Council; and

(v) we further undertake to immediately inform the Client and the Bank if this situation were to occur at a later stage.

If applicable, provide full disclosure of any convictions, dismissal, resignations, exclusions or other information relevant to Articles (i), (ii), (iii) or (iv) in the box below.

Name of Entity Required to be Disclosed	Reason Disclosure is Required[1]

We understand that a misrepresentation in relation to or an omission to provide full disclosure of the information as required by this Covenant may result in the rejection of the tender and it may also lead to Enforcement Actions and Disclosure Actions as set out in the Bank's Enforcement Policy and Procedures.

For the purpose of this Covenant, the terms set forth below define Prohibited Practices as:

(i) a **Coercive Practice** which means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of any party to influence improperly the actions of a party;

(ii) a **Collusive Practice** which means an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iii) a **Corrupt Practice** which means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

(iv) a **Fraudulent Practice** which means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(v) a **Misuse of Bank's Resources or Bank Assets** which means improper use of the Bank's Resources or Bank Assets, committed either knowingly or recklessly;

(vi) an **Obstructive Practice** which means any of (1) destroying, falsifying, altering or concealing of evidence material to a Bank investigation, which impedes the Bank's investigation; (2) making false statements to investigators in order to materially impede a Bank investigation into allegations of a Prohibited Practice; (3) failing to comply with requests to provide information, documents or records in connection with a Bank investigation; (4) threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to a Bank investigation or from pursuing the investigation; or (5) materially impeding the exercise of the Bank's contractual rights of audit or inspection or access to information; and

(vii) a **Theft** which means the misappropriation of property belonging to another party.

At any time following the submission of our tender, we shall permit, and shall cause our JVCA partners, as well as our directors, employees, agents, Subcontractors and any other third parties engaged or involved for any part of the Contract to permit the Bank and/or persons appointed by them, the right to inspect and copy all accounts, books, records, and other documents (on any media or in any format) relating to the Procurement Process and execution of the Contract and to have any such accounts, books, records, and documents audited the Bank and by auditors appointed by the Bank. We accept to preserve these records generally in accordance with applicable law but in any case for at least six years from the date of substantial completion of the Contract.

Name:	Christoph Schwager
In the capacity of:	Managing Director
Signed:	

Otto-Baumgartner-Straße 7
RO'TREAT
ABWASSERREINIGUNG GMBH
A-8055 Stattegg-Pirka

[1] For each matter disclosed, provide details of the measures that were taken, or shall be taken, to ensure that neither the disclosed entity nor any of its directors, employees or agents commits any Prohibited Conduct in connection with the procurement process for the Contract.

Appendix to Tender

Conditions	GCC Sub-Clause	Data
Employer's name and address	1.1.2.2 & 1.3	**KHMELNYTSKYI COMMUNAL ENTERPRISE "SPETSKOMUNTRANS"** 1 Tolstoho Street, Khmelnytskyi, 29008, Ukraine
Contractor's name and address	1.1.2.3 & 1.3	*Arionex LT, UAB, Ašigalio 6, 49142, Kaunas, Lithuania*
Engineer's name and address	1.1.2.4 & 1.3	EGIS Ukraina, 29 Antonovycha Street, 5th floor, Kiev, 01003, Ukraine
Bank's name	1.1.2.11	European Bank for Reconstruction and Development
The Borrower:	1.1.2.12	**KHMELNYTSKYI COMMUNAL ENTERPRISE "SPETSKOMUNTRANS"**
Time for Completion	1.1.3.3	36 (thirty-six) months after the Effective Date. This period must include supply, installation and commissioning within 12 (twelve) months with following trial operation period of 24 (twenty-four) months. Early completion of supply and installation of equipment shall be allowed in accordance with the procedure, defined in this Contract.
Defects Notification Period	1.1.3.7	**365** days
Sections	1.1.5.6	The Sections are described in the table "Summary of Sections" below
Electronic transmission systems	1.3	Not allowed
Governing Law	1.4	Law of Ukraine
Ruling language	1.4	English for foreign Contractor Ukrainian for local Contractor
Language for communications	1.4	English and Ukrainian
Time for access to the Site	2.1	**7 days** after Commencement Date

Conditions	GCC Sub-Clause	Data
Performance Security	4.2	The performance security will be in the form of a demand guarantee in the amount(s) of ***10 (%)*** percent of the Accepted Contract Amount and in the same currency of the Accepted Contract Amount.
Normal working hours	6.5	In accordance with the Ukrainian legislation and subject to the Employer/Engineer approval
Delay damages for the Works	8.7 & 14.15(b)	***0,2%*** of the Contract Price per day.
Delay damages for the Sections	8.7 & 14.15(b)	**0.2%** of the price of each Section as indicated on the Price schedules, per day
Maximum amount of delay damages	8.7	***10%*** of the final Contract Price.
Percentage adjustment of Provisional Sums	13.5(b)	***5%***
Adjustments for Changes in Cost	13.8	Not applicable
Total advance payment	14.2	**10%** Percentage of the Accepted Contract Amount payable in the currencies and proportions in which the Accepted Contract Amount is payable
Number and timing of instalments	14.2	***1 (one)*** payment
Currencies and proportions	14.2	The advance payment shall be paid in the currency or currencies and proportions in which the Accepted Contract Amount is payable to the Contractor according to Sub-clause 14.15.
Start repayment of Advance payment	14.2 (a)	Repayment commences from of the second Payment Certificate
Repayment amortization rate of advance payment	14.2(b)	**10%**
Percentage of Retention	14.3	**5%**
Limit of Retention Money	14.3	**5%** of the Accepted Contract Amount

Conditions	GCC Sub-Clause	Data
Plant and Materials	14.5(c)	Bill of Quantities. Price Schedule No.1 – PLANT AND EQUIPMENT
Minimum Amount of Interim Payment Certificates	14.6	***EUR 100 000 (one hundred thousand)***
Currency/Currencies of Payment	14.15	Foreign Contractor – EUR Permanent representation of the Foreign Contractor in Ukraine – The amounts payable shall be nominated in Euro, as it stated in the Price Schedule, and shall be paid in UAH, at the exchange rate stipulated into the Contract Value Added Tax payable in UAH only.
Periods for submission of insurance:	18.1	
(a) evidence of insurance.		**14** days
(b) relevant policies		**28** days
Maximum amount of deductibles for insurance of the Employer's risks	18.2(d)	***100 000 Euro*** or equivalent in UAH.
Minimum amount of third party insurance	18.3	***100 000 Euro*** or equivalent in UAH per accident with the number of occurrence unlimited
The DAB shall be comprised of	20.2	One sole Member
Rules of arbitration	20.6(a)	Rules of procedure for arbitration proceedings: the Rules of Conciliation and Arbitration of the International Commercial Arbitration Court at the Ukrainian Chamber of Commerce and Industry, Kyiv

Definition of Sections:

Section № (Sub-Clause 1.1.5.6)	Name of Section (Sub-Clause 1.1.5.6)	Time for Completion of each Section (Sub-Clause 1.1.3.3)	Delay damages for the Works (Sub-Clause 8.7)
Section №1	Development of the Design Stage "П" (Проект стадія «П»), including obtaining of an approval of the Design	150 days	0.2 % of the Accepted Contract Amount

	by the Central Service of the State Enterprise "Ukrderzhbudekspertiza"		of this Section per day
Section №2	Manufacture, test, deliver, install, precommission, commission of the Works	215 days	0.2% of the Accepted Contract Amount of this Section per day

Name:	Giedrius Rutkauskas
In the capacity of:	Chief Executive Officer
Signed:	
Duly authorised to sign for and on behalf of:	Arionex Lt, UAB
Date:	07-04-2023

LIETUVOS RESPUBLIKA UAB „ARIONEX LT" KAUNAS

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(c) Particular Conditions of Contract

Particular Conditions of Contract (PCC)

The following Particular Conditions of Contract (PCC) shall supplement the GCC. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC.

GCC 1. General Provisions

GCC 1.1 Definitions

GCC 1.1.2 Parties and Persons

Add the following:

1.1.2.11 **"Bank"** means the financing institution (if any) named in the Appendix To Tender

1.1.2.12 **"Borrower"** means the person (if any) named as the borrower in the Appendix To Tender

GCC 1.1.4 Money and Payments

Add the following:

1.1.4.13 "Final Contract Price" (GCC 8.7 in Appendix to Tender) means the total value of all works completed under the Contract as certified in the Final Payment Certificate.

GCC 1.1.6 Other Definitions

Add the following:

1.1.6.10 **"Notice of Dissatisfaction"** means the notice given by either Party to the other under Sub-Clause 20.4 [Obtaining Dispute Adjudication Board's Decision] indicating its dissatisfaction and intention to commence arbitration.

1.1.6.11 "**Enforcement Policy and Procedures"** means the EBRD's Enforcement Policy and Procedures, as amended from time to time, and any policy or procedures adopted by EBRD, as a successor to or replacement of such policy and procedures".

1.1.6.12 **"Prohibited Practices"** has the meaning as defined in the Enforcement Policy and Procedures (EPP, rev. 4th of October, 2017).

1.1.6.13 **"Enforcement Actions"** means such action as defined in the Bank's Enforcement Policy and Procedures.

1.1.6.14 **"Disclosure Actions"** means such action as defined in the Bank's Enforcement Policy and Procedures.

1.1.6.15 **"Third Party Finding**" means a final judgment of a judicial process in a member country of the Bank or a finding by the enforcement (or similar) mechanism of an international organisation, which is not a Mutual Enforcement Institution, that an individual or entity has engaged in a Prohibited Practice or equivalent act of that member country or international organisation.

1.1.6.16 **"Project Complaint Mechanism"** means the accountability mechanism of the Bank as set forth under the Project Complaint Mechanism (PCM) Rules of Procedure dated May 2014, as such rules may be amended, supplemented or replaced from time to time.

1.1.6.17 **"Mutual Enforcement Institution"** means an international organisation that has entered into an agreement with the Bank, pursuant to which such institution and the Bank agree to the mutual enforcement of debarment decisions made by each other, provided that such other institution has given notice to the Bank that it has fulfilled all requirements for the implementation of such agreement and has not subsequently withdrawn from such agreement.

1.1.6.18 **"Environmental and Social Action Plan (ESAP)** means the documents appended to the Specification"

1.1.6.19 **"Environmental, Social, Health and Safety Plan** means part of Contractor's Documents"

1.1.6.20 **"Environmental and Social Policy** means the EBRD's Environmental and Social Policy dated 1 April 2019, as amended from time to time, and any policy adopted by EBRD, as a successor to or replacement of such policy".

1.1.6.21 **"Procurement Policies and Rules** means the EBRD's Procurement Policies and Rules dated 1 November 2017, as amended from time to time, and any policies or rules adopted by EBRD, as a successor to or replacement of such policies and rules".

1.1.6.22 **"ILO Core Conventions and Protocols"** means the following International Labour Organisation conventions: C087 on Freedom of Association and Protection of the Right to Organise (1948), C098 on the Right to Organise and Collective Bargaining (1949), C029 on Forced Labour (1930) and its supplementing protocol P029 (2014), C105 on the Abolition of Forced Labour (1957), C100 on Equal Remuneration (1951), C111 on Discrimination (Employment and Occupation) (1958), C138 on Minimum Age (1973) and C182 on the Worst forms of Child Labour (1999).

GCC 1.2 Interpretation

Add the following:

In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one-twentieth (5%) of this Cost.

GCC 1.3 Communications

Replace Sub-clause:

Wherever these Conditions provide for the giving or issuing of approvals, certificates, valuations, instructions, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt) sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission; and

(b) delivered, sent or transmitted to the address for the recipient's communications. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued

(c) electronic transmission documents only are not allowed. However:

(i) all approvals, certificates, consents, determinations, notices, notification of defects, requests and discharges shall be supplemented with scan copies of originals and widespread among the Parties.

Besides, a list of recipients from each of the Parties shall be made within 14 (fourteen) days after the Parties entered into Contract.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party.
The detailed procedure of communications shall be proposed by the Contractor and submitted for approval by the Employer within 14 (fourteen) days after Contract award.

GCC 1.6 **Contract Agreement**

Add the following:

If the Contractor is a non-resident of the Employer's Country, or if a leading partner of the Contractor, that is a joint venture, is a non-resident of the Employer's Country, the Contractor or a leading partner shall have or shall establish a registered representation in the Employer's Country, which has the status of the permanent representation for the duration of Contract (that is entitled to conduct economic operations and is a payer of the income tax and a payer of the value added tax in the Employer's Country on a general basis)[1]. The copies of appropriate documents shall be submitted to the Employer together with the signed Contract, but not later than within 120 days after the Contractor receives the Letter of Acceptance.

GCC 1.12 **Confidential Details**

Replace Sub-clause:

The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.

Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

[1] In accordance with Tax Code of Ukraine (see: subparagraph 14.1.193, subparagraph 14.1.36, etc.) http://zakon3.rada.gov.ua/laws/show/2755-17/page

GCC 1.13 Contactor's General Obligations

Add Sub-clause:
The Contractor's obligations shall include, but not be limited to the following:

(c) The Contractor shall obtain and maintain licenses as required by the Ukrainian regulations (Law of Ukraine "On the regulation of urban planning") to perform the Contract in Ukraine. The copies of appropriate documents shall be submitted to the Employer together with the signed Contract, but not later than within 150 days after the Contractor receives the Letter of Acceptance.

(d) The Contractor shall obtain and maintain valid registration with Ukrainian Tax authorities for payment of taxes and duties as required by Tax code of Ukraine and other Ukrainian regulations. If the Contractor is a non-resident of Ukraine, or if a leading partner of the Contractor, that is a joint venture, is a non-resident of Ukraine, the Contractor or a leading partner shall have or shall establish a registered representation in Ukraine, which has the status of the permanent representation (that is entitled to conduct economic operations, and is a payer of the income tax and a payer of the value added tax in Ukraine on a general basis). The copies of appropriate documents shall be submitted to the Employer together with the signed Contract, but not later than within 120 days after the Contractor receives the Letter of Acceptance.

GCC 1.14 Joint and Several Liability

Add the following:

(a) JVCA's members are solely responsible for avoiding and resolving their internal disputes. They are not to involve the Employer in their internal affairs. These matters shall in no way relieve the Contractor of his liability under Contract Clause 15.

GCC 1.15 Inspections and Audit by the Bank

The Contractor shall permit the Bank and/or persons appointed by the Bank to inspect the Site and/or the Contractor's (including its suppliers, subsuppliers, subcontractors, consultants or subconsultants) accounts and records relating to the performance of the Contract and to have such accounts and records audited by auditors appointed by the Bank if required by the Bank.

The Contractor shall require its officers, directors, employees or agents with knowledge of the Contract to respond to questions from the Bank and to provide to the Bank any information or documents necessary for (i) the investigation of allegations of Prohibited Practices, or (ii) the Bank's monitoring and evaluation of the Contract and to enable the Bank to examine and address any project-related complaints made under the Bank's Project Complaint Mechanism.

The Contractor shall maintain all documents and records related to the Contract in accordance with applicable law but in any case for at least six years from the date of substantial performance of the Contract.

The Contractor shall provide any documents necessary for the investigation of allegations of Prohibited Practices and require its employees or agents with knowledge of the Contract to respond to questions from the Bank.

GCC 2 The Employer

GCC 2.4 Employer's Financial Arrangements

Add the words:

In addition, if the Bank has notified to the Borrower that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in his notice of the extent to which such funds will be available

GCC 3 The Engineer

GCC 3.1 Engineer's Duties and Authority

Add the words:
Any act by the Engineer in response to a Contractor's request except as otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt

The following provisions shall apply:
The Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions:

(a) Sub-Clause 4.12: Agreeing or determining an extension of time and/or additional cost.

(b) Sub-Clause 13.1: Instructing a Variation, except;

(i) in an emergency situation as determined by the Engineer, or
(ii) if such a Variation would increase the Accepted Contract Amount by not more than any percentage specified in the Appendix To Tender

(c) Sub-Clause 13.3: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2.

(d) Sub-Clause 13.4: Specifying the amount payable in each of the applicable currencies

Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do

all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.

GCC 3.4 Replacement of the Engineer

Replace Sub-clause:

If the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the intended replacement Engineer. If the Contractor considers the intended replacement Engineer to be unsuitable, he has the right to raise objection against him by notice to the Employer, with supporting particulars, and the Employer shall give full and fair consideration to this objection.

GCC 4 The Contractor

GCC 4.2 Performance Security

Add the words :
Performance Security shall be issued by a bank institution that has long-term credit rating as for the national scale rating no lower than "uaAA" and included in the list of top-20 banks with the reliable financial stability rating assessed for the last quarter prior to issuing of the securities as defined via the following link: https://minfin.com.ua/ua/banks/rating/

In case of no national scale rating at international bank groups from one the highest rated companies Fitch, Moody's, S&P, should not be lower than the raised investment class ("Moody's Investors Service" (USA) - "Baa3","Standard & Poor's" (USA) - "BBB-", "Fitch Ratings" (UK) - "BBB-") and which is not included in the list of legal entities, concerning which special economic or other restrictive sanctions have been imposed by the state authorities of Ukraine, the USA or the EU countries. The securities of a JVCA can be in the name of a partner of the JVCA on condition that the securities clearly specifies the names of all partners of the JVCA and states that the Security is submitted for and on behalf of the JVCA.

Any charges connected with the Performance Security, including any commissions, fees, costs and expenses, shall be at the Contractor's cost. Should the respective request be received by the bank that issued the Performance Security from the Employer' s bank, the Contractor, at his own cost, shall pay all bank commissions and charges connected with the confirmation of authenticity of the issued Performance Security and the power and attorney of the person(s) who signed it. These provisions shall also be applicable to any amendment or extension of the Performance Security.

GCC 4.3 Contractor's Representative

Add the words:

If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

GCC 4.4 Subcontractors

Add the words:

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.
Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.
In the interests of quality and progress of the works, harmonious on-site relations, and to avoid complaints to the Employer, the Contractor shall pay subcontractors within 42 days of payment of their work in each IPC by the Employer.

GCC 4.16 Transport of Goods

Add the words:

(d) the Contractor shall be responsible for delivering all Plant, Equipment Materials based on the delivery terms DDP (Incoterms 2020) to the Site and shall bear all expenses related to this activity, including payment of all required taxes, duties and fees. The Contractor shall be responsible for any delays occurring in the process of customs clearance of the Goods, and shall bear all relevant expenses at his cost

GCC 4.21 Progress report

Insert at the end of the sub-clause 4.21
Contractor's Report shall include As-Built Documents as per sub-clause 5.6 for the Works submitted for Interim Payment Certificate

GCC 4.25 Prevention of Prohibited Practices

Add the words:
The Contractor shall not, and shall not authorise or permit any of its officers, directors, authorised employees, affiliates, agents or representatives to, engage in Prohibited Practices with respect to the procurement, award, or execution of the Contract.
The Bank may declare the Contract to be ineligible for financing, and the Bank may take any of the Enforcement Actions and Disclosure Actions set out in the Enforcement Policy and Procedures, if in accordance with the Enforcement Policy and Procedures the Bank determines that:

(a) the Contractor, including its suppliers, sub-suppliers, sub-contractors, concessionaires, consultants, or sub-consultants have engaged in Prohibited Practices with respect to the procurement, award, or execution of the Contract.

(b) a Third Party Finding has sufficient relevance and seriousness for the Bank to warrant Enforcement Actions and Disclosure Actions against entities or individuals;

GCC 4.25 **Agreements with third parties**

Add Sub-clause:
The Contractor shall ensure that in any agreements with suppliers, sub-suppliers, sub-contractors, concessionaires, consultants, or sub-consultants concerning the execution of the Contract provision are included:

(a) stating that the suppliers, sub-suppliers, sub-contractors, concessionaires, consultants, or sub-consultants, shall not, and shall not authorise or permit any of their officers, directors, authorised employees, affiliates, agents or representatives to, engage in Prohibited Practices with respect to such agreements and the execution of the Contract; and

(b) notifying the suppliers, sub-suppliers, sub-contractors, concessionaires, consultants, or sub-consultants, that the Bank has the right to invoke the Enforcement Policy and Procedures, including any Enforcement Action and Disclosure Action set out therein, in respect of allegations of Prohibited Practices with respect to the procurement, award, or execution of the Contract.

GCC 5 Design

GCC 5.1 **General Design Obligations**

Add the words:
The Contractor's design documents shall be provided in the English and Ukrainian languages.

The Contractor shall be responsible for design approval in accordance with the Environmental Impact Assessment procedure, and for submission and obtaining the approval of the State Expertise for the Design in conformity with in accordance with the requirements of the Ukrainian Normative-Technical Documents (NTD) and Ukrainian legislation as follows:

The design and estimate documentation shall be developed by the Contractor according to the State construction codes, rules and standards of Ukraine. According to Decree No. 646 dated 21.12.2012 of the Ministry of Regional Development, Construction and Housing of Ukraine, after the Employer's preliminary approval of the design, it shall be submitted by the Employer for approval to the Ukrderzhbudekspertyza State Body (in charge of the State expert assessment of construction designs). The Contractor shall be in charge of all adjustments and modifications to the design required by this State Body untill its full approval. Only after completion of the above steps, equipment shall be supplied and installation works performed according to the design.

Before starting the preparatory and installation work, it is necessary for Contractor to obtain a permit for the beginning of construction in the State electronic system in the field of construction with Employer support.

The Contractor is responsible for obtaining of other supervising organizations, permits, licenses and other required documents and permission to start construction.

GCC 6 Staff and Labour

GCC 6.1 Engagement of Staff and Labour

Add the words:

The Contractor shall establish Human Resource policies in accordance with the governing Law. The Contractor shall document and communicate to all workers their working conditions and terms of employment, including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity / paternity or holiday).
The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Borrower's Country.

GCC 6.2 Rates of Wages and Conditions of Labour

Add the words:
Where the Contractor is party to a collective agreement or is otherwise bound by it, the Contractor shall comply with its terms and conditions.
Deductions from wages for disciplinary measures shall not be permitted nor shall any deductions from wages not provided for by national law be permitted without the expressed permission of the worker concerned. Deductions must never lead to an employee receiving less than the applicable minimum wage.
All workers shall be provided with clearly understandable verbal and written information about the conditions in respect of wages before they enter employment and of the particulars of their wages for the pay period concerned each time that they are paid. Wages shall be paid in legal tender in full, on time and directly to the workers concerned. The Contractor shall maintain records of all payments and deductions made.

GCC 6.4 Labour Laws

Add the words:
The Contractor shall ensure that obligations to staff and labour under labour, health and safety and social security laws and regulations arising from the employment relationship shall not be avoided through the use of labour-only contracting arrangements.

GCC 6.5 Working Hours

Add the words:
Hours of work shall comply with applicable laws, collective agreements, and industry standards. Overtime shall be voluntary wherever possible, shall not be demanded on a regular basis and shall always be compensated at a premium rate.

GCC 6.6 Facilities for Staff and Labour

Add the words:

Where the Contractor provides living accommodation for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. The accommodation shall comply with national legislation and, where possible, follow international good practice as set out in the IFC / The Bank's Public Guidance

The Contractor shall ensure that workers' freedom of movement to and from the accommodation is not unduly restricted.

GCC 6.7 Health and Safety

Add the words:

The Contractor shall provide the Employer with a written Health and Safety Policy and a project-specific Health and Safety Plan (the Plan) before the commencement of work. The Plan shall identify all risks specific and relevant to the project and shall provide information explaining how the identified risks will be managed by the Contractor. The Plan shall include details of the Contractor's OHS management system, including the Contractor's plans to manage and monitor the health and safety risks associated with all construction work under its control. The Plan shall be made available to the Bank(s) prior to the start of Construction.

Every Contractor shall plan, manage and monitor construction work carried out by him or under his control in a way which ensures that, so far as is reasonably practicable, it is carried out without risks to health and safety. In instances where the Contractor is a joint venture, consortium or a similar entity, the Contractor shall coordinate its planning, management and monitoring activities in a manner that will ensure that any overlap does not create any potential risks to third parties.

All work-related tasks shall be risk assessed before any work is undertaken. All significant hazards shall be identified and control measures introduced to reduce foreseeable risks of injury and ill health, so far is reasonable practicable. High regard shall be given in particular to assess and control the following specific activities and these shall be documented in the Health and Safety Plan;

- Working at Heights;
- Lifting Operations;
- Movement of vehicles and mobile work equipment;
- Ground disturbance and excavations; and,
- Working with and around live electrical conductors.

The Contractor shall ensure that a safe and healthy working environment is provided and that good international occupational health and safety practice is promoted. The Contractor shall take steps to prevent accidents, injury and disease arising in the course of work by identifying and controlling risks to workers, third parties and affected communities, so as far as is reasonably practicable. The Contractor shall ensure that all staff, labourers and persons entitled to be on site receive the necessary supervision, information, instruction and training to do their jobs in a manner that does not place themselves or third parties at risk. With regard to any unauthorised site visitors, the Contractor shall familiarise itself with, and comply with, any relevant provisions of the Applicable Law. Where appropriate, the Contractor shall provide equipment to minimise health and safety risks and enforce its

use. The Contactor shall carry out a risk assessment to ensure the correct selection of equipment is made for every task. The work equipment shall be in good working condition, designed for the specific task and not improvised in any way. The Contractor shall put in place arrangements for emergency prevention, preparedness and response.

GCC 6.7.1 Personal Protective Equipment

The Contractor shall provide, at no cost to its workers, Personal Protective Equipment (PPE) to control residual risks. The PPE shall be suitable for the relevant hazards workers are exposed to and replaced at no cost to the worker, when it becomes damaged or worn. As a minimum, PPE shall be protective toe cap safety footwear, head protection and an item of high visibility clothing.

GCC 6.7.2 Workers Welfare Accommodation

The Contractor shall provide a suitable seating area for workers to use during breaks. This area shall be clean, located where food will not become contaminated and provide reasonable thermal comfort during high and low temperatures. The Contractor shall also provide adequate access to toilets and wash basins for their workers.

GCC 6.7.3 Contractor's Personnel

The Contactor shall ensure that all personnel employed to carry out work are competent and fit to carry out the work they are employed to do. All Contactor personnel shall receive a site safety induction before they start work which should identify the hazards, the risk to their health and safety and the control measures that shall be implemented. Any worker who fails to cooperate with the Contactor or fails to take reasonably care of themselves or others and placing them at risk of injury or ill health, shall be removed from the project site.

GCC 6.7.4 First Aid

Prior to the start of work the Contactor shall carry out a first aid needs assessment to determine the provisions necessary to preserve life and provide immediate first aid to a casualty. The assessment shall consider the degree of hazards, potential risks and the number of employees at the project site. In addition consideration shall be made to risks created in the course of work in particular hot works causing burns and hazardous liquids splashing into the face. The Contractor shall ensure competent first aid trained personnel are available in convenient locations on site to ensure prompt response to administer immediate first aid.

GCC 6.7.5 Working at Heights

The Contractor shall introduce a procedure that requires all working at heights to be avoided where possible. Where working at heights cannot be avoided, the Contractor shall assess all working at heights to satisfy themselves that suitable fall prevention measures are in place before any work activity commences. Where the risk of a fall may still exist, the Contractor shall introduce measures to mitigate a fall, in the event of one occurring. The Contactor shall undertake periodical monitoring of the working platforms and fall prevention measures to ensure they remain adequate and in a good working order.

GCC 6.7.6 Ground Disturbance and Excavations

The Contractor shall ensure all ground disturbance and excavation activities are to be carried out under a safe system of work which includes a comprehensive assessment of the risks by a competent person, regardless of depth, to ensure it is safe and adequately supported. Entry into any excavation by any person is to be avoided where possible. Where entry cannot be avoided, robust engineering methods shall be used to support excavations to prevent any worker being trapped or suffering injury or ill health. At no point shall any worker enter an unsupported excavation.

GCC 6.7.7 Live Electrical Services

The Contactor is to familiarise themselves with all electrical services within the designated project site, this shall include all above and below ground services. All live conductors are to be securely covered and be inaccessible to unauthorised personnel. Where there is a risk of contact, either by a worker or any operated equipment, the Contractor shall arrange for the service to be temporary isolated or rerouted prior to the start of work. At any time no worker or third party shall be exposed to any live conductors unless they are authorised and competent to work on or around these services.

GCC 6.7.8 Movement of Vehicles and Mobile Work Equipment

The Contactor shall minimise the movement of traffic and mobile work equipment and continually assess the on and off site effects. Where possible, one way systems shall be introduced to avoid vehicles coming into contact with each other. Reversing of vehicles and mobile work equipment shall be avoided on site, where this is not possible an effective system must be in place to control reversing so there is no risk of injury or damage to property. All moving vehicles and mobile work equipment on the project site shall have a fitted flashing amber warning beacon which must be in use while in operation. The Contactor shall ensure any vehicles or mobile work equipment entering the project site shall be checked and confirmed suitable for site conditions with specialist consideration to lights, brakes, steering, mirrors and restraints / seatbelts. Fitted restraints / seatbelts shall be worn at all time when the vehicles or mobile plant is in operation.

GCC 6.7.9 Confined Space Working

The Contractor shall identify all areas which are, or could become a confined space, and prevent entry into these areas. If no method of working is possible without entry, the Contactor shall carry out a risk assessment and introduce a system of work to eliminate or control hazards and foreseeable risks and prevent a risk of injury or ill health to workers. At all times the Contactor shall ensure that the worker entering the confined space is provided with, as a minimum, uncontaminated breathable air, a method to detect unhealthy and flammable atmospheres, clear access to and egress from the confined space and emergency arrangements to remove the worker if self-rescue is not possible.

GCC 6.7.10 Preventative Measures

The Contractor shall develop and maintain throughout the execution of the Contract preventative measures relating to worker health concerns, including providing inoculations or other preventative treatments for disease that are either global in nature or endemic in the project area. The Contractor shall undertake appropriate measures to reduce the risk of transfer of STDs and HIV/AIDS among the Contractor's Personnel and the local community including providing condoms and information for raising awareness among employees of sexually transmitted disease and HIV/AIDS.

GCC 6.8 Contractor's Superintendence

Add the words:
The Contractor shall ensure that a grievance mechanism is available to all workers and their organisations to use without fear of intimidation or retaliation. The Contractor will ensure that employees are informed about the grievance mechanism and that this is part of the training for new employees and information is posted in relevant areas on Site.

The Contractor shall ensure that the grievance mechanism involves an appropriate level of management and addresses concerns promptly, using an understandable and transparent process that provides feedback to those concerned without any retribution.

GCC 6.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:

(a) persists in any misconduct or lack of care,
(b) carries out duties incompetently or negligently,
(c) fails to conform with any provisions of the Contract,
(d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment, or
(e) based on reasonable evidence, has engaged in a Prohibited Practice during the execution of the works.

If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

GCC 6.12 **Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereof by Contractor's Personnel. The Contractor shall make all reasonable efforts to ensure no worker on the site under his control brings or consumes any alcohol or illicit drugs onto the site. The Contractor shall also immediately remove any Contractor's Personnel that it suspects or has confirmed is under any influence of alcohol or illicit drugs, from site.

GCC 6.13 **Social Security**

The Contractor shall ensure that obligations to staff and labour under labour or social security laws and regulations arising from the employment relationship shall be respected, and that such obligations shall not be avoided through the use of labour-only contracting arrangements.

GCC 6.14

Compliance with ILO provisions

The Contractor shall, and shall cause their Subcontractors involved in any part of the Contract, (a) to be in compliance with ILO Conventions and Protocols, including those in respect of forced labour, child labour, freedom of association, non-discrimination and equal opportunities; and (b) to permit the Bank and/or persons appointed by them, the right to inspect the aforementioned compliance.

GCC 6.15 **Forced Labour**

The Contractor (Supplier/Consultants) and their Subcontractors shall not employ forced labour, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as involuntary prison labour, indentured labour, bonded labour or similar labour contracting arrangements.

GCC 6.16 **Child Labour**

The Contractor and their Subcontractors shall not employ any person under the age of 18, in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with, their education, or to be harmful to their health or physical, mental, spiritual, moral, or social development. Where the relevant labour laws of the Country have provisions for employment of minors, the Contractor and/or their Subcontractors shall follow those laws applicable to them. The Contractor and/or their Subcontractors shall put in place a procedure to verify the ages of young workers. Persons below the age of 18 years shall not be employed in dangerous work or services.

GCC 6.17 **Workers' Organisations**

In countries where the relevant labour laws recognize workers' rights to form and to join workers' organisations of their choosing without interference and to bargain collectively, the Contractor and their Subcontractors shall comply with such laws. Where the relevant

labour laws substantially restrict workers' organisations, the Contractor and/or their Subcontractors shall enable alternative means for their Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. In either case described above, and where the relevant labour laws are silent, the Contractor and their Subcontractors shall not discourage their Personnel from forming or joining workers' organisations of their choosing or from bargaining collectively, and shall not discriminate or retaliate against the Personnel who participate, or seek to participate, in such organisations and bargain collectively. The Contractor and their Subcontractors shall engage with such workers' representatives. Workers' organisations are expected to fairly represent the workers in the workforce. The Contractor and their Subcontractors shall ensure that workers' representatives have access to all workplaces necessary to enable them to carry out their representative functions.

GCC 6.18 Non-Discrimination and Equal Opportunity

The Contractor and their Sub-contractors shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor and their Subcontractors shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. The Contractor and their Subcontractors shall ensure equal remuneration for men and women for work of equal value. In countries where the relevant labour laws provide for non-discrimination in employment, the Contractor and their Subcontractors shall comply with such laws. When the relevant labour laws are silent on non-discrimination in employment, the Contractor and their Subcontractors shall meet this Clause requirements. Special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination

GCC 6.19 Employment Records of Workers

The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer, and these records shall be available for inspection by the Bank's auditors during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].

GCC 7 Plant, Materials and Workmanship

GCC 7.1 Manner of execution

Add the words:
(d) The materials and equipment to be purchased within the contract should be new (not earlier 2021) and has not been used before.

GCC 8 Commencement, Delays and Suspension

GCC 8.1 Commencement of Works

Replace Sub-clause :

Except as otherwise specified in the Particular Conditions of Contract, the Commencement Date shall be the date at which the following precedent conditions have all been fulfilled and the Engineer's notification recording the agreement of both Parties on such fulfilment and instructing to commence the Works is received by the Contractor:

a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities in the Country;

b) delivery to the Contractor of reasonable evidence of the Employer's Financial arrangements (under Sub-Clause 2.4 [Employer's Financial Arrangements]);

c) possession of the Site given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 [Compliance with Laws] as required for the commencement of the Works;

d) receipt by the Contractor of the Advance Payment under Sub-Clause 14.2 [Advance Payment] provided that the corresponding bank guarantee has been delivered by the Contractor; and

If the above said Engineer's instruction is not received by the Contractor within 180 days from his receipt of the Letter of Acceptance, the Contractor shall be entitled to terminate the Contract under Sub-Clause 16.2 [Termination by Contractor]

The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.

GCC 8.2 Time for Completion

Replace Sub-clause:

(b) (i) Completing all work which is stated in the Contract as being required for the Works to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 *[Taking Over of the Works and Sections]*.

(ii) in respect of each Section completing all work which is stated in the "Work programme" as being required for the respective Section to be considered to be substantially completed as evidenced by the Provisional Completion Certificate for the Section, issued by the Engineer, as referred to in Sub-Clause 10.5'.

(iii) No bonus will be given for earlier Completion of the whole of the Works.

GCC 8.3 Programme

Replace Sub-clause:

The Contractor shall submit the updated Proposal Preliminary Programme to Tender to the Engineer within 21 days after receiving the notice under Sub-Clause 8.1 *[Commencement of Works]*. This Programme shall prevail over the Preliminary Programme.

Full information which shall be included in the Programme specified in the Section VI: Requirements.

Each programme shall include:

(a) the order in which the Contractor intends to carry out of Works, Contractor's Documents, procurements, manufacture of Plant, delivery to Site, construction, erection and testing,
(b) each of these stages for work by each nominated Subcontractor (as defined in Clause 5 *[Nominated Subcontractors]*),
(c) the sequence and timing of inspections and tests specified in the Contract, and
(d) a supporting report which includes:
- a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and
- details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on Site for each major stage.
- an estimate of cash flow disaggregated by the activities included in the Programme, taking into account repayment of the Advance Payment and retention, and calculated using the rates in the Bills of Quantities and the payment terms set out herein

Unless the Engineer, within 21 (twenty-one) days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and / or a proposal under Sub-Clause 13.3 *[Variation Procedure]*.

If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer in accordance with this Sub-Clause.

GCC 8.7 **Delays Damages**

Add the words
Pursuant to the provisions of Sub-Clause 10.1 [Taking Over of the Works and Sections], the Delay Damages shall apply to each Section.

GCC 10 **Employer's Taking Over**

GCC 10.1 **Taking Over of the Works and Sections**

Sub-Clause 10.1 the first and second paragraphs shall be replaced with the following:
The Contractor may apply by the notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be completed and ready for taking over.

Upon receipt of the notice of the issuance of the Taking-Over Certificate the Engineer initiates the Taking Over and Commissioning Procedure of the completed Works in accordance with the Ukrainian legislation, applicable at the time of Taking Over. Currently, the Taking-Over and Commissioning Procedure is regulated by the resolution

of the Cabinet of Ministers of Ukraine Ref No 461 of 13.04.2011 (http://zakon4.rada.gov.ua/laws/show/461- 2011-%D0%BF).

GCC 11 **Defects Liability**

GCC 11.4 **Defects Liability**

item (b) of Sub-clause GCC 11.4 is added with the following*:*

GCC 11.4.1

In case of Contractor's failure to meet the warranty parameters specified in Annex 7 "Contractual Guarantees and Other Reassurances" of Section VI. Requirements, the Employer reserves the right to apply Contractual Penalties subject to the following indicators:

If the treatment efficiency of the Leachate Treatment Plant attained in the Guarantee test, is less than the guaranteed treatment rate 200 m3/day (measured as monthly average), but the actual volume of the treated leachate attained in the Guarantee test is not less than the minimum level of 170 m3/day (measured as monthly average), and the Contractor elects to pay liquidated damages to the Employer in lieu of making changes, modifications and/or additions to the Facilities, then the Contractor shall pay liquidated damages as one percent (1.0%) of the Contract Price for every ten (10) m3/day of the deficiency in the production capacity of the Facility.

GCC 11.9 **Performance Certificate**

Sub-Clause 11.9 shall be replaced with the following:

Performance of the Contractor's obligations shall not be considered to have been completed until the Engineer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.

The Engineer shall, upon consultation with the Employer, issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including any defects. A copy of the Performance Certificate shall be issued to the Employer.

Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

GCC 13 **Variations and Adjustments**

GCC 13.3 **Variation procedure**

Sub-Clause 13.3 (a) shall be replaced with the following:

(a) description of the proposed work to be performed, a programme for its execution and sufficient ESHS information to enable an evaluation of ESHS risks and impacts

GCC 14 Contract Price and Payment

GCC 14.2 **Advance Payment**

To replace the last sentence of the third paragraph starting with "This guarantee shall be issued..." with:

Advance Payment guarantee shall be issued by a bank institution that has long-term credit rating as for the national scale rating no lower than “uaAA” and included in the list of top-20 banks with the reliable financial stability rating assessed for the last quarter prior to issuing of the securities as defined via the following link: https://minfin.com.ua/ua/banks/rating/

In case of no national scale rating at international bank groups from one the highest rated companies Fitch, Moody’s, S&P, should not be lower than the raised investment class ("Moody's Investors Service" (USA) - "Baa3","Standard & Poor's" (USA) - "BBB-", "Fitch Ratings" (UK) - "BBB-") and which is not included in the list of legal entities, concerning which special economic or other restrictive sanctions have been imposed by the state authorities of Ukraine, the USA or the EU countries. The securities of a JVCA can be in the name of a partner of the JVCA on condition that the securities clearly specifies the names of all partners of the JVCA and states that the Security is submitted for and on behalf of the JVCA.

Any charges connected with the advance payment guarantee, including any commissions, fees, costs and expenses, shall be at the Contractor’s cost. Should the respective request be received by the bank that issued the guarantee from the Employer’s bank, the Contractor, at his own cost, shall pay all bank commissions and charges connected with the confirmation of authenticity of the issued advance payment guarantee and the power and attorney of the person(s) who signed it.

These provisions shall also be applicable to any amendment or extension of the advance payment guarantee.

At the request of the Engineer, the Contractor shall provide a written confirmation of the receipt of the advance payment specifying the amount and date at which the advance payment has been received.

GCC 14.6 **Issue of Interim Payment Certificates**

The Contractor shall prepare the documents required for payment in accordance with the forms determined for projects financed by the funds of the international financial institutions specified in the DSTU B.D.1.1-1:2013 “Rules for construction cost calculation” and other regulatory legal documents, and send the forms to the Employer together with other documents for payment for the performed work

GCC 14.7 **Payment**

The final paragraph of the Sub-clause is replaced with the following:

Payment of the amount due in each currency shall be made into the bank account(s), nominated by the Contractor and explicitly stated in the Contract Agreement.

Unless otherwise agreed by the Parties in writing, such bank account(s) shall be held in the name of the Contractor and be located either in the Contractor's country of incorporation or domicile, as applicable, or in the country, where the Contract is implemented.

If the Contractor constitutes (under applicable Laws) a joint venture, consortium or other unincorporated grouping of two or more persons, such account(s) shall be in the name of

any such persons and shall be located in such person's country of incorporation or domicile, as applicable, or in the country where the Contract is implemented.

Notwithstanding the above, the Bank will not make payments to a bank account in a jurisdiction which is deemed by the Financial Action Task Force, hereinafter referred to as the "FATF", to be on the list of non-cooperative countries or territories[21] at the date of payment.

GCC 14.9 **Payment of Retention Money**

Sub-Clause 14.9 shall be replaced with the following:

When the Taking-Over Certificate has been issued for the Works and the Works have passed all specified tests (including the Tests after Completion, if any) the Employer should pay to the Contractor a full amount of Retention Money.

GCC 14.15 Sub-clause 14.15 shall be replaced with the following:

The Contract Price shall be paid in:
the amounts payable shall be nominated in Euro, as it stated in the Bills of Quantities, and shall be paid in UAH, at the rate set by the National Bank of Ukraine on the date of payment.

GCC 14.16 **Taxes and duties**

Value Added Tax shall be payable in UAH only.

Terms of payment of the VAT by the Employer shall not exceed the deadlines set in Sub-Clause 14.7 *[Payment]* for the corresponding payments.

The Contractor shall notify the Employer prior to the payment of the VAT of the details of the bank account specified by the Contractor for the payment of the VAT. All payments of the amounts of the VAT to the Contractor shall be made to such bank account(s).

Foreign Contractors

If the Contractor is a non-resident of Ukraine, the Contractor shall have or shall establish a registered representation in Ukraine, which has the status of the permanent representation (that is entitled to conduct economic operations, and is a payer of the income tax and a payer of the value added tax in Ukraine on a general basis). Payments related to the value added tax, in this case, shall be carried out through such representation.

The amount of the payable VAT shall be determined based on the official exchange rate of the Ukrainian Hryvnia against the EUR set by the National Bank of Ukraine on the date of each Interim Payment Certificate and the Final Payment Certificate. For each Payment

[2] *The FATF list of Non-Cooperative Countries or Territories (the list of High-Risk Jurisdictions subject to a Call for Action), can be found on the following web-page:*

http://www.fatf-gafi.org/publications/high-risk-and-other-monitored-jurisdictions/?hf=10&b=0&s=desc(fatf_releasedate)

Certificate the Contractor shall provide the Employer with the documents for calculating and paying the VAT, as required by the applicable Laws.

GCC 15 Termination by Employer

GCC 15.6 Termination in case of Prohibited Practices

If the Employer determines, based on reasonable evidence, that the Contractor has engaged in Prohibited practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days' notice to the Contractor, terminate the Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such termination had been made under Sub-Clause 15.2.

Should any employee or subcontractor of the Contractor be determined, based on reasonable evidence, to have engaged in a Prohibited practice during the execution of the work then that employee shall be removed in accordance with Sub-Clause 6.9 [Contractor's Personnel].

GCC 16 Suspension and Termination by Contractor

Add the following Sub-clauses :

GCC 16.2 Termination by Contractor

(h) In the event the Bank suspends the loan or credit from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in Sub-Clause 14.7 [Payment] for payments under Interim Payment certificates, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under Sub-Clause 14.8 [Delayed Payment], take one of the following actions, namely (i) suspend work or reduce the rate of work under Sub-Clause 16.1 above, or (ii) terminate under the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice, or

GCC 18 Insurance

GCC 18.1 General Requirements for Insurances

Replace 6-th paragraph:

All the insurances referred to in Clause 18 shall be subject to prior approval, shall take effect from the Commencement Date and shall remain in force until the date of issue of the Taking-Over Certificate under sub-paragraph of Clause 10 [Employer's Taking Over]

GCC 20 Claims, Disputes and Arbitration

GCC 20.5 Amicable Settlement

Replace Sub-clause:

Where a Notice of Dissatisfaction has been given under Sub-Clause 20.4 above, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, the Party giving a Notice of Dissatisfaction in accordance with Sub-Clause 20.4 above should move to commence arbitration after the fifty-sixth day from the day on which a Notice of Dissatisfaction was given, even if no attempt at an amicable settlement has been made.

GCC 20.6 **Arbitration**

Any dispute between the Parties arising out of or in connection with the Contract not settled amicably in accordance with Sub-Clause 20.5 above and in respect of which the Dispute Adjudication Board (DAB)'s decision (if any) has not become final and binding shall be finally settled by arbitration or through consideration of issues by a court of law.

Disposition of issues by a court of law is carried out in accordance with the judicial procedure defined by the law of Ukraine.

The wording of Sub-Clause 20.6 points (a), (b), (c) and (d) shall be replaced with the following:

(a) the dispute shall be finally settled by the International Commercial Arbitration Court at the Ukrainian Chamber of Commerce and Industry ("ICAC"),

(b) the place of arbitration shall be Kyiv, Ukraine,

(c) the rules of arbitration shall be the Rules of Arbitration of the International Commercial Arbitration Court at the Ukrainian Chamber of Commerce and Industry,

the arbitration shall be conducted in the ruling language of contract defined in Sub-Clause1.4 *[Law and Language]*.

The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the DAB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Engineer from being called as a witness and giving evidence before the arbitrators on any matter whatsoever relevant to the dispute.

Neither Party shall be limited in the proceedings before the arbitrators to the evidence or arguments previously put before the DAB to obtain its decision, or to the reasons for dissatisfaction given in its Notice of Dissatisfaction. Any decision of the DAB shall be admissible in evidence in the arbitration.

Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Engineer and the DAB shall not be altered by reason of any arbitration being conducted during the progress of the Works.

ICAC arbitration clause:

"Any dispute, controversy or claim arising out of or relating to this contract, or the interpretation, execution, breach, termination or invalidity thereof, shall be settled by the International Commercial Arbitration Court at the Ukrainian Chamber of Commerce and Industry in accordance with its Rules."

(Source : http://arb.ucci.org.ua/icac/en/clause.html)

Rules of arbitration: http://arb.ucci.org. ua/icac/en/rules.html

The legal status of the International Commercial Arbitration Court at the Ukrainian Chamber of Commerce and Industry (hereinafter - ICAC), i.e. its judicial personality,

activity arrangement, competence, is established primarily by the Law of Ukraine "On International Commercial Arbitration" dated February 24, 1994.

The Law of Ukraine "On International Commercial Arbitration" dated February 24, 1994 takes into account provisions of the model law adopted in 1985 (UNCITRAL Model Law on International Commercial Arbitration) by the UN Commission on International Trade Law and approved by the UN General Assembly for its possible use by States in their legislation. (http://zakon2.rada.gov.ua/laws/show/4002-12)

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(d) General Conditions of Contract

General Conditions of Contract (GCC)

The General Conditions of Contract comprise the "General Conditions" which form part of "Conditions of Contract for Plant and Design-Build", First Edition 1999" prepared by the *Fédération Internationale des Ingénieurs-Conseils* (FIDIC).

These Conditions are subject to the variations and additions set out in Section "Particular Conditions of Contract" (PCC)

Copies of the FIDIC Conditions of Contract can be obtained from:
International Federation of Consulting Engineers
World Trade Centre II
P.O. Box 311
CH-1215 Geneva 15
Switzerland
Phone: +41 22 799 49 00
Fax: +41 22 799 49 01
email: fidic@fidic.org
www: http://www.fidic.org

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(e) Contract Forms

Contract Forms

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1. **Performance Security**

2. **Advance Payment Security**

Performance Security

(Uniform Rules for Demand Guarantee, ICC Publication 758)

[Guarantor Letterhead and SWIFT identifier code]

To: ***[Insert name and address of Beneficiary (the Employer)]***

Date: [***Insert date of issue]***

Type of Guarantee:	***Performance Guarantee***
Guarantee No.:	***[Insert guarantee reference number]***
The Guarantor:	***[Insert name and address of place of issue, unless indicated in letterhead]***
The Contractor	***[Insert name and address of the Contractor]***
The Beneficiary:	***[Insert name and address of the Employer]***
The Underlying Relationship:	The Contractor's obligation in respect of ***[insert reference number and details of the contract]***
Guarantee Amount and currency:	***[Insert in figures and words the maximum amount(s) payable and the currency(ies) in which it is payable]***
Any document required in support of the demand for payment, apart from the supporting statement that is explicitly required in the text below:	The Beneficiary's demand in writing declaring the Contractor to be in default under the Contract
Language of any required documents:	***[Insert "English" or the language of the contract document if not in English]***
Form of Presentation:	***[Insert paper or electronic form. If paper indicate mode or delivery. If electronic indicate the format, system for data delivery and the electronic address for presentation]***
Time as from which a demand can be presented if different from the date of issue:	
Variation of Amount Clause	The Guarantee Amount will be increased by presentation to the Guarantor of the Contractor's statement that the underlying contract was amended to increase the scope or value of the works and specifying the amount and currency or the new value.
Guarantee Expiry:	This Guarantee shall expire no later than the ***[insert number]*** day of ***[insert month] [insert year]***

Any demand for payment under this guarantee must be received by the Guarantor on or before the expiry date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758 except that article 15(a) is hereby excluded.

. . . . . **[Seal of Bank and Signature(s) of authorised representatives of the bank].** . . . .

Advance Payment Security

(Uniform Rules for Demand Guarantee, ICC Publication 758)

[Guarantor Letterhead and SWIFT identifier code]

To: ***[Insert name and address of Beneficiary (the Employer)]***

Date: [***Insert date of issue]***

Type of Guarantee:	***Advance Payment Guarantee***
Guarantee No.:	***[Insert guarantee reference number]***
The Guarantor:	***[Insert name and address of place of issue, unless indicated in letterhead]***
The Contractor	***[Insert name and address of Supplier or Contractor]***
The Beneficiary:	***[Insert name and address of Employer]***
The Underlying Relationship:	The Contractor's obligation in respect of ***[insert reference number and details of the contract]***
Guarantee Amount and currency:	***[Insert in figures and words the maximum amount(s) payable and the currency(ies) in which it is payable]***
Any document required in support of the demand for payment, apart from the supporting statement that is explicitly required in the text below:	The Beneficiary's first demand in writing accompanied by a written statement stating: (a) the Contractor has failed to repay the advance payment in accordance with the conditions of the Contract; and (b) the amount which the Contractor has failed to repay. It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number . . . . . [Contractor's account number]. . . . . at . . . . . [name and address of the bank]. . .
Language of any required documents:	***[Insert "English" or the language of the contract document if not in English]***
Form of Presentation:	***[Insert paper or electronic form. If paper indicate mode or delivery. If electronic indicate the format, system for data delivery and the electronic address for presentation]***
Time as from which a demand can be presented if different from the date of issue:	
Variation of Amount Clause	The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated

	in copies of interim statements or payment certificates which shall be presented to the Guarantor
Guarantee Expiry:	This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that [insert percentage in figures and words] percent of the Contract Price has been certified for payment, or on the ***[insert number]*** day of ***[insert month] [insert year]***, whichever is earlier.

Any demand for payment under this guarantee must be received by the Guarantor on or before the expiry date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758 except that article 15(a) is hereby excluded.

. . . . . [Seal of Bank and Signature(s) of authorised representatives of the bank] . . . .

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(f) The Requirements

The Requirements

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Scope of Works

Project description

Description of the Khmelnytskyi Landfill

The Project Site is located at an elevation of approximately 330-360m above mean sea level (AMSL) on the northern side of a ridge approximately 1.5km north of Khmelnitskyi city centre. The ridge separates a valley occupied by an unidentified local watercourse and the Micro-districts of Otradne and Dyvokray from the main Khmelnitsky conurbation and the Pivdennyi Buh River. The Pivdennyi Buh River flows through the centre of Khmelnitsky, at an elevation of approximately 276m AMSL at its nearest point.

A topographic survey is available for the Project Site.

The existing landfill, which reaches a height of over 25m above the natural ground level, sits on a topography sloping to the east-northeast towards a water-course, situated at approximately 250m to the north-east of the landfill.

It is understood the existing landfill is within a disused clay pit, and that the landfill is unlined and has no engineered containment. The depth of the clay pit and the elevation of the base of the landfill are unknown. The total thickness of the clay layer that was quarried historically is also unknown, consequently it is not possible to state with confidence whether there is any natural clay remaining below the landfill.

Within the surrounding area there are a number of surface water features. The closest of these are the wetland pond associated with the Project and an unnamed stream adjacent to the Project (north and north-east). These features are all located downhill of the Project (to the north). The unnamed stream drains east and joins the Pivdennyi Buh River approximately 8km downstream of the Project Site.

A ground investigation undertaken in 2018, as summarised in the Feasibility Study for the proposed landfill (2018), comprised thirteen boreholes to characterise and prove the thickness of the near surface Quaternary deposits. The base (thickness) of the Quaternary deposits are understood to be up to 10m below ground level (bgl) within the study area. The Quaternary deposits overlying the Neogene limestone clay were classified as:

Topsoil (eIV) – presented by a loam, semi-solid, slightly humus, brownish-yellow;

Tight plasticity silts (edIII) thixotropic, yellow-grey;

Semi-solid silts (edIII) with inclusion of semi-solid clay layers, homogeneous, yellow-grey.

The site investigations indicated a shallow groundwater table on top of the clayey deposits, within the sandy surface layer, and mounded within the waste mass of the landfill. This shallow groundwater flows in a north-easterly direction towards the watercourse. Furthermore, the leachate generated in the waste is flowing directly into this shallow water table, as observed on site. Flowing down to the watercourse.

The site investigation data is available.

The Rehabilitation Project for the Khmelnytskyi Landfill

The rehabilitation project for the existing Khmelnytskyi Landfill will comprise the following:

Reprofiling of the side slopes of the landfill to no more than 3H/1V (18°) to ensure their stability in the long term and provide a suitable support for the final cover

A final cover layer will be installed over the surface of the reprofiled landfill, designed to limit infiltration of rainfall into the waste mass, prevent contact between the waste and the environment, and limit uncontrolled loss of landfill gas. The final cover of the rehabilitated landfill comprises a water- and gas-proof structure, from bottom upwards: 0.2m of soil to level the surface; a gas drainage geocomposite; a GCL; a 1.5mm geomembrane; a drainage geocomposite; a sand drainage layer of 0.15m of sand; a transition layer of 0.15m of loamy soil; and a 0.3m layer of topsoil.

The finished cover layer is then landscaped with sowing of grasses and planting of shrubs on the plateau and the terraces.

Installation of a leachate drainage network around the landfill.

Installation of a landfill gas drainage and collection network, extending the existing landfill gas collection and treatment system.

Installation of a surface water drainage measures to evacuate run-off effectively from the surface of the landfill

Landscaping of the landfill to ensure its integration into the environment

Installation of a leachate treatment plant in two stages: short-term to evacuate the estimated 100 000m^3 of leachate currently in the lagoons at the site, and then a permanent long-term treatment plant for the long-term needs.

The New Landfill

The new landfill will comprise two new cells: Cell 1 (2.8 ha), Cell 2 (2.31 ha). The capacity of the new landfill cells will be 1.354 million m^3 of waste plus 0.108 million m^3 of cover soils, providing six years of operation.

The lining system for the landfill cells comprises a geosynthetic clay liner (GCL) under a 1.5mm high density polyethylene (HDPE) geomembrane. The geomembrane liner is then covered by the leachate drainage layer (see below). It is understood that the site is underlain by clayey soils, which is an advantage because it provides an additional layer of protection.

The leachate drainage system in the landfill cells comprises two components: (i) a drainage geocomposite, which also serves to protect the geomembrane; (ii) 0.5m of gravel. This is present on the bottom and on the sideslopes of the cells.

The leachate is then collected in 300mm drain pipes within a gravel pack (10-20mm) in a geotextile filter.

The new landfill development also includes the associated facilities and infrastructure:

The Reception Area for trucks arriving at the site includes the following:

- Weighbridge
- Radioactivity portal monitor
- Checkpoint building
- Wheelwasher
- Operating facilities – Buildings

The following buildings for operation of the site:

- Workshop
- Hangar for vehicles
- Administrative & personnel building
- Inert materials storage building

The site access road

The temporary site roads

The parking area for vehicles

The sanitary wastewater treatment plant

The hydrocarbons separator for the surface run-off

The electrical power supply & lighting

The perimeter fence

The landfill watering system.

Purpose of the Contract and Description of the Scope of Works

Purpose of the Contract

The purpose of the Contract is to ensure the treatment of leachate at the Khmelnytskyi Landfill at the capacity of 200m^3/day to the output values defined in the Requirements and its Appendices.

The Contractor will be responsible for design, supply, installation and commissioning of a new Leachate Treatment Plant (LTP) of a capacity of 200 m^3/day, together with all enabling infrastructure and works.

The Scope of Works

The Scope of the Works includes the following:

General

All necessary surveying / additional data collection

All basic engineering and design

All permitting, if needed

The preparation of quality and HSE plans

Access Road to the Site

Construction of an Access Road, connecting the existing road situated to the west of the site with the Internal Site Road.

Dimensions of the Access Road: surface area - 1400m²; length – 231.72m; width - 6.0 m.

Structure of the Access Road: 7cm crushed stone aggregate (0-40mm); 25cm crushed stone aggregate (40-70mm); 10cm sand.

The Access Road is intended to provide access for operation and maintenance of the leachate collection reservoirs and the Leachate Treatment Plant (LTP).

The Access Road is shown in Drawings Nos. 17/06-21-00-АД1-01 and 17/06-21-00-АД1-02 (Feasibility Study).

Internal Site Road (part of)

Construction of the north-eastern section of the Internal Site Road around the future landfill cells: section from PK7+24 to PK9+24.

Dimensions of the Internal Site Road: length - 200m; width – 4.50 m.

Structure of the Internal Site Road: 7cm crushed stone aggregate (0-40mm); 25cm crushed stone (40-70mm); 10cm sand.

The Internal Site Road is shown in Drawing Nos. 17/06-21-00-АД1-01 and 17/06-21-00-АД1-03 (Feasibility Study).

Leachate Storage Reservoirs

Construction of two reservoirs for leachate storage before treatment, with the following characteristics:

- Effective storage volume of 100 m^3 per reservoir.
- Dimensions: 12 x 12 m.
- Internal slopes of 1V:1.5H.
- Lined with 2mm HDPE geomembrane over a protection geotextile.

To include the supply, installation and commissioning of all equipment for pumping from the existing leachate ponds and drains to the new leachate storage reservoirs.

The location of the leachate storage reservoirs is shown in Drawing No. 17/06-21-00 ГП-02-00 (Feasibility Study).

The Leachate Storage Reservoirs are surrounded by an access road with the same structure of the Internal Site Road

The leachate storage reservoirs are described in Section 4.2.1 of the Feasibility Study.

Utilities for the LTP

Electrical connection to existing site transformer.substation for LTP. The location of the existing electrical transformer substation (existing capacity to 85 kWh) for connection is shown as object no.5 in Drawing No. 17/06-21-00 ГП-02-00 (Feasibility Study). The technical details of the existing transformer substation are included in **Appendix 3**.

- Potable water connection for the LTP.
- GSM connection for LTP.
- Temporary pumping main for concentrate from LTP to infiltration trenches on the landfill.

Leachate Treatment Plant

Site preparation – levelling and crushed stone platform

Temporary and permanent facilities

Fabrication, shipping, and installation of holding and buffer tanks for untreated leachate with all pumps and accessories

Fabrication, shipping, and installation of pre-treatment units

Fabrication, shipping, and installation of main treatment unit

Fabrication, shipping, and installation of post-treatment units, if required

Fabrication, shipping, and installation of storage tanks for permeate and concentrate with all pumps and accessories

Pumping installations to transfer the leachate from the Leachate Storage Reservoirs to the LTP

Pumping installations to transfer the concentrate to the infiltration trenches on existing landfill, including temporary pipe line from LTP to existing landfill

All associated electrical works, including connection to existing substation, distribution board and accessories, lighting, etc.

All associated automation and instrumentation: SCADA system, hardware, software, etc.

Commissioning of all units

Trial Operation and maintenance (O&M) of the plant for a 24 month period), including all manpower, support services, consumables, reagents, replacement parts, electricity, surveillance, measurements, analyses, etc

Handover at the end of O&M period

Guarantee warranty for all mechanical parts, supply of consumables and spare parts

Defects Liability Period (6 months).

Training of Employer's personnel

Location of the LTP

The location of the leachate treatment plant is shown in Drawing No. 17/06-21-00 ГП-02-00 (Feasibility Study).

The Contractor may propose an alternative location for the leachate treatment plant, to be approved by the Employer.

Time Schedule

The Contractor shall provide a detailed Time Schedule as an integral part of the Contract (Appendix to the Contract Agreement). The Contractor has to perform his contract obligation within the following time:

Activity	Time

Design, Supply and Installation (including commissioning)	12 months
Trial Operation Period	24 months
Total	***36 months***
Defect Liability Period	6 months

General Requirements

Plant and Materials

Except where existing items are to be retained, all Plant and manufactured Materials shall be new, robust, of good quality and workmanship, and incorporated in the Permanent Works in accordance with the manufacturer's recommendations. All Plant and Materials shall be suitable for the substances with which they will come into contact during operation of the Permanent Works.

All new items of Plant and Materials shall be suitable for the local conditions in Khmelnytskyi, Ukraine covering the entire range of temperature, wind, humidity, geological and other climatic and environmental conditions and operating conditions to which they will be exposed to during construction, operation and maintenance of the Permanent Works. All new Plant and Materials shall have a proven record that demonstrates that the items can deliver the required performance with a high operational reliability.

Plant shall be designed to provide protection against the entry of vermin and dust and to minimize fire risk and consequent fire damage. It shall also be protected against dampness and condensation by sealing or temperature compensation.

All equipment that can be controlled manually from outside a building, shall be provided with facilities to prevent operation by unauthorized personnel.

All component parts of each item of the Plant shall be manufactured to strict limits of accuracy and shall be interchangeable with the component parts of similar items of Plant.

Units of Measurement

All designs, drawings, specifications and manuals shall use SI units (kg, m, s, mm, N) and all measurements, dimensions and performance data shall be quoted in those units.

Reference and designation system

The Employer's existing system shall be used.

Design Life

The minimum design life for the various items of the Works shall be as follows:

Item	*Design life*
Buildings, structures, tanks	25
Pipelines	20
Water and drainage pumps, fans, blowers	15
Motors	15
Switchgear and transformers operating at above 1 000 V	20
All other switchgear and motor control centres	15
Instruments, SCADA and controls	10

Health and Safety

The LTP and its operation shall comply with Ukrainian laws and regulations on occupational safety and health.

The Contractor shall prepare a Health and Safety Plan, which shall be a part of the QA/QC Programme.

The Contractor shall notify the Project Manager of any accident, injury, loss or damage to any workperson or third party or any property of a third party or to property of the Beneficiary at or about the Site or in connection with the execution of the Works within 24 hours of occurrence. The Contractor shall also report any such incident to any such authority as may be required by law.

Before commencement of the works, the Contractor's personnel shall be comprehensively instructed by the Employer on all aspects of safety relating to the works/services.

Where applicable, the works/services shall be performed only upon availability of appropriate Work Permit issued by responsible authority.

The Contractor must take all the reasonable safety precautions for protection of the Contractor, Employer and Subcontractors' personnel or any other parties from injuries; for protection of the whole properties from damage due to execution of works; and for minimization of any inconveniences.

Labour protection must be ensured by the following:

- organization of work-related processes in accordance with the requirements of applicable sanitary norms;
- mechanization and automation of hard and dangerous works;
- availability of appropriate means of individual protection of workers (special coveralls, footwear, protective helmets etc.);
- availability of appropriate means of collective protection of workers (fencing, light, ventilation, protective and preventive devices and appliances etc.);
- provision of sanitary and every day rooms and equipment, organization of sanitary and medical service (especially preliminary and periodic medical examinations) in accordance with the applicable norms and specifications of the works being executed.

The following safety norms and regulations shall apply to the works performed by the Contractor:

- Law of Ukraine "On Labour Safety";
- NAPB.03.002-2007 "Norms for Categorization of Facilities, Buildings and External Installation on Explosion and Fire Danger";
- DBN A 3.2.2-2009 "System of Labour Safety Standards. Industrial Safety in Construction. Main Provisions";
- NPAOP 0.00-1.01-07 Codes for installation and safe operation of lifting cranes;
- NPAOP 0.00-1.13-71 Codes for installation and safe operation of stationary compressor, air ducts and gas ducts;
- NAPB A.01.001-2004 Preventive fire-fighting regulations;
- DSN 3.3.6.037-99 "Sanitary Norms of Industrial Noise, Ultrasound and Infrasound";
- DSN 3.3.6.039- 99 "State Sanitary Norms of Total and Local Industrial Vibration";
- Electrical installation Regulations (EIR);
- Regulations for the safe operation of Consumers electrical equipment;
- Rules of technical Operation of Electrical Equipment of Consumers.

Detailed provisions on labour safety, including the list of applicable normative documents shall be indicated by the Contractor in the design documents.

Working with leachate

The Contractor shall make all his personnel aware of, and comply with, the requirements of the Specification with regard to hygiene, training and medical monitoring when working in the proximity of, or in undertaking the Works in contact with leachate.

The Contractor shall note that there is a risk of contracting Leptospirosis, or Weil's disease, when working in contact with leachate. The Contractor shall ensure that all employees are aware of the precautions to be taken when working in such situations.

Noise Limits

In order to prevent noise nuisance, all equipment giving a high noise level are to be covered and insulated (e.g. compressors, blowers, aerator units etc.). The works are to be designed to ensure a maximum noise level of 55 dB(A) at the boundary of the Site of the Plant, when all equipment installed is in operation. Additionally, the noise level at a distance of one meter from any sound-producing mechanical equipment must not exceed 80 dB(A).

Design and Construction Law and Standards

All Design and Construction Works shall comply with Ukrainian Laws and Standards. Where there is no Ukrainian Standards, European Union Standards shall be applied.

Standards on Site

The Contractor shall keep a copy of each of the applicable standards for the construction Works on Site.

Copies of these standards shall be available for use of the Project Manager.

Permits, Licenses and Approvals

The Contractor shall allow a realistic timescale for dealing with the third parties responsible, for permits etc., in his planning and programming of the work. The Contractor shall comply with all conditions stipulated in any permits granted by third parties, including conditions stipulated in those permits obtained by the Employer.

Construction Permit

The Contractor shall prepare and submit all the required technical and financial documents for obtaining a civil works and construction permits. The elaborated documentation with the relevant design documents shall comply with all local laws and regulations.

The Contractor is solely responsible for having the necessary License under current Ukrainian legislation.

Other Permits

Other permit documents will be prepared and submitted by the Employer. The Contractor shall assist the Employer in obtaining other permits.

Environmental and Social Issues during the construction process

The Contractor is responsible to follow and implement applicable sections (items where Contractor is listed as responsible for implementation) in the Environmental and Social Action Plan (ESAP). The ESAP has been developed and approved during design period.

The Contractor must also follow the EBRD Performance Requirements (PRs) during construction. The PRs include (but are not limited to) regulations regarding labour and working conditions, pollution prevention and abatement, community health and safety, biodiversity conservation and sustainable management of living natural resource. The PR's are available at the EBRD website

(https://www.ebrd.com/who-we-are/our-values/environmental-and-social-policy/performance-requirements.html).

Hazards

Hazard Analysis

The Contractor shall undertake and present a Hazard Analysis and Risk Assessment. This analysis shall be developed by the Contractor in conjunction with the Project Manager. The basis of the Hazard Analysis study shall be the Contractor's Draft Final Design Report.

Hazard Areas

A classification of explosive areas shall be undertaken in accordance with Ukrainian Standards for explosive protected electrical equipment - Classification of explosive zones.

The Contractor shall determine the appropriate area classification (Zone 0, Zone 1, Zone 2 or non-hazardous) for each part of the Works, where:

A Zone 0 area is an area or enclosed space within which any flammable or explosive substance, whether as vapour or volatile liquid is continuously present in concentrations within the lower and upper limit of flammability.

A Zone 1 is an area within which flammable or explosive substance, whether gas, vapour or volatile liquid is processed, handled or stored and where during normal operation an explosive or ignitable concentration is likely to occur in sufficient quantity to produce a hazard.

A Zone 2 area is an area within which any flammable or explosive substance, whether gas, vapour or volatile liquid although processed or stored is so well under conditions of control that the production or release of an explosive or ignitable concentration in sufficient quantity to constitute hazard only likely under abnormal conditions.

A non-hazardous area is an area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of (electrical) apparatus

The explosive hazard areas of the plant shall be identified in a Hazardous Area Plan and safety warning signs shall be installed on site, including No Smoking areas.

The Contractor shall be responsible for the training of the Employer's staff in the safety precautions required for working within hazardous areas.

Contractor's Documents to be submitted for Review

General

All documents to be submitted to the Client during the Design and Construction period shall be submitted in six paper copies and one electronic copy.

The submission of documents for review should take appropriate consideration of the Contract Programme.

The following list of documents for review is indicative and the Contractor shall be aware that additional details and documents may be requested for review by the Project Manager.

Preliminary Design

The Contractor shall prepare and submit to the Project Manager the Preliminary Design Documents.

These will include the updated and completed version of the Tender Design with the agreed amendments during contract negotiations:

Site plan

Layout of roads

Layout of buildings

Layout of pipelines

Plant description

Process Flow Diagram (PFD)

Component description

Programme

The items to be indicated shall include the activities of:

Engineering, preparation and submission of Preliminary Design

Drawings and Documents

Procedures to obtain all necessary permits and licenses

Engineering, preparation and submission of Final Design Drawings and Documents

Execution of all significant process units, buildings and other constructions/works, showing detailed activities

Procurement, fabrication and erection/mounting of both mechanical and electrical equipment and pipework

Factory Tests

Testing of the Works

Tests on Completion

Taking Over of the Works and Commissioning

Twenty four months Operation and Maintenance management

Tests After Completion and Performance Tests

Defects Notification Period

Detail Design Documents

The Contractor will be responsible for the preparation of the Construction project documentation.

Preparation of design documents will be performed according to local Ukrainian requirements.

The Contractor shall prepare Documents and submit them in relation with the project progress and in accordance with a detailed Document Submission Programme.

The Final Design will include, but not limited to:

Engineering Works

Document lists for each area of profession

Structuring principles and reference designations

Design standards (also law and regulation)

Layouts of each unit

Layouts with details of all piping, roads, paths and earthworks

Installation plans for the electrical installations

All necessary layouts, sections and views of buildings and constructions, dimensioned for civil engineering works construction, including all necessary details for incorporation and installation of the mechanical equipment

General diagrams for the complete electrical installation.

Specifications and Computations

Document lists for each area of profession

Technical data and details for the equipment to be installed in the Plant

Final calculations for treatment process

Final hydraulic calculations and profile

Building services computations.

Instrumentation Specification

Computations for the electrical installations

Schematic Diagrams and Information

Document lists for each area of profession

Process Specification

Process Flow Diagram

Material/Mass balance

Equipment Specification

Process Design

Functional Block Diagram (FBD)

Piping and Instrumentation Diagram (PID)

Layout of Process Equipment

Hazardous Area Specification Drawing

Electrical and Automation Systems

1. For each system (for very simple systems, the information, which typically is presented in overview diagrams and circuit diagrams, may be included in the installation plan):

a. Document list

b. Function-oriented documents
- Overview diagram
- Function diagram (for complex systems)
- Sequence chart (for complex systems)
- Circuit diagram
- Software Application documents (diagram, list, etc. for systems in which there are software that needs to be configured)

c. Location-oriented documents
- Installation plan
- Arrangement drawing

d. Connections-oriented documents
- Cable diagram
- Interconnection diagram

e. Items lists
- Parts list
- Spare parts list

f. Installation-specific documents
- Erection procedures
- Individual testing procedures and test protocols

g. Commissioning-specific documents

System integration testing procedures and test protocols

2. Layouts for the production of the user interface in the Process control system (process graphics: overviews displays, process displays, trend displays, face plates, alarm lists, event lists, etc.)

3. Layouts for the production of the user interface in the Plant Information Management System and Report Layouts.

4. Layouts for the production of the user interface in the Computerized Maintenance Management System.

Construction Execution Drawings

Document lists for each area of profession
Process Units, Buildings and Other Constructions
Pipe Works
Site Works
Road Works
Mechanical
Piping
Piping Isometrics
Instrument Air Supply

The Contractor shall elaborate a design for the required scope of construction of LTP, incorporating the works and items offered in his bid (i.e. all works, plants and installations, equipment, devices, materials, instruments, etc.) to meet the Employer's Requirements. Structure, composition and content of the design shall comply with the requirements of standard DBN A.2.2-3:2014 "Structure and Content of Construction Design Documents".

The scope of Contractor's design services shall also include follow up of the Expert Review process as required by effective laws of Ukraine until approval, including addressing of expert comments/recommendations, rectification of any identified shortcomings, etc. All expenses associated with the expert review of updated designs shall rest with the Contractor.

The Contractor shall also submit to the Employer two (2) paper copies of the design package and in digital form on a suitable data carrier (flash memory or CD).

Before beginning construction, depending on complexity facility, the Employer should issue permission for commencement of work (declaration or certificate).

Project Meetings and Progress Reports

Project Meetings will be called regularly by the Project Manager. Progress Meetings will be held monthly or when required by the Project Manager. Notice of Meetings will be given by the Project Manager. The Contractor's Representative and supporting Contract Supervision staff will be required to attend Contractual and Progress Meetings and produce Progress Reports regularly. Three English and three Ukrainian paper copies and one electronic copy shall be submitted.

Regular Site Meetings shall be held weekly or as the Project Manager requires. Contractor shall provide all necessary documentation, and also keep the records of all meetings, inspections, tests, etc., both on English and Ukrainian languages. Documentation includes but is not limited to the following:

Work Schedule;

The Contractor shall submit the Construction Schedule. In particular, this requirement applies to the interaction with the existing production process and advance planning by the Contractor of its work and operations, and also timely their coordination with the Employer prior to commencement of the works.

Detailed site layout diagrams;

Detailed construction schedule and timetable;

The resources allocated for works and terms of their carrying out;

Any additional project documentation during construction;

Regular monthly meeting at the Site:

Preparatory materials;

Agenda;

Record of the meeting;

Regular quarterly progress reporting:

Progress Report: the terms of reference in comparison with actually performed works;

Schedules and the analysis of the situation on reporting date;

Deviations from the approved Construction Schedule;

Test equipment during pre-commissioning and acceptance;

The proposed scheme of carrying out and procedures of all tests;

Related information;

Test reports;

Pre-commissioning report;

Acceptance report;

Tests of the equipment and materials at the plant-manufacturer;

Schemes of carrying out and procedure of all tests;

Related documentation;

Inspections, tests and reports on commissioning and acceptance (Taking over Certificate);

Inspections, tests and reports on elimination of defects and completion of the contract (Certificate of completion);

Acceptance Act of the Facility as a whole (necessary for obtaining permission for facility commissioning);

Commissioning certificate.

After acceptance to provide three (3) copies of As-Built documentation prepared according to requirements of Ukrainian standard DBN A.3.1-5-2009 “Organization of a Building Production” shall be provided plus same in digital form on a suitable data carrier (flash memory or CD).

Civil works

The scope of civil works is indicated in Schedule No.2 Design, Installation and Other Services that shall be read in conjunction with the Instructions to Tenderers, General and Special Conditions of Contract and the Employer's Requirements below. The whole cost of complying with the applicable provisions of these documents shall be included in the items provided in the priced schedules, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of works.

The Contractor shall perform all dismantling works needed to complete the works and services. These shall include, inter alia, dismantling of foundations structures, process and electric equipment, cables and other items as needed. Exact quantities, weights, and layout and sectional view of structures and elements to be dismantled shall be clearly indicated by the Contractor in the Design and Working documentation.

Unless otherwise specified, the rates and prices indicated by bidders in the Price Schedule shall include the cost of all items and materials.

The Contractor must also repair worn and/or damaged anticorrosive coating of existing steel pipes and structures that would remain in place inside the facilities after the reconstruction.

Quality Assurance

The Contractor shall, within 28 days from the Commencement Date, provide to the Project Manager its complete and fully developed draft QA/QC Programme/Management Plan. It shall include, in elaborate detail, all policies, procedures and documentation flow procedures to ensure and prove that the Works shall be constructed in accordance with applicable Standards and, when constructed, that the leachate treatment plant will be capable to operate in accordance with the Employer's Requirements and Performance Guarantees. The QA/QC Programme shall describe the activities and procedures for the different phases of the Project:

1. Design Phase
2. Construction Phase
3. Commissioning Phase
4. Trial Operation Phase

The Contractor shall be certified in accordance with and implement a Project Quality Assurance System in accordance with:

ISO 9000 Standards for the quality control and assurance - Guideline for selection and utilisation

ISO 9001 Quality system - Model for the quality assurance in conception development, production, installation.

The Contractor shall perform all of its Contractor's obligations in strict conformity with all policies and procedures set forth in its QA/QC Programme.

Quality Assurance Organization

The Contractor shall appoint and implement a Quality Assurance Organization directed by a "Quality Assurance Manager", which will be responsible for the correct execution of all procedures and activities described in the QA/QC Programme from the Commencement Date through to the end of the Contract Period.

Amendments to the QA/QC Programme

The Contractor shall be responsible for keeping his Quality Assurance Plan up-to-date in accordance with the Quality Assurance Procedure and the events of the Contract. The Contractor shall inform the Project Manager of any circumstances and conditions adversely affecting or which may adversely affect the execution of the Contract, and shall further inform the Project Manager without delay of any circumstances and conditions which cause or which may be likely to cause alternations to the QA/QC Programme and without delay submit a revised programme to the Project Manager.

Audit

The Project Manager shall be allowed at all times to audit the Quality Assurance Procedure of the Contractor. The Contractor shall cooperate with the Project Manager.

The audits will be performed with reference to the Quality Assurance Plan of the Contractor and on the basis of the Quality Assurance Procedure.

Within a period of ten working days from the date of reception of the audit report, the Contractor shall give in writing the corrective actions he wishes to implement, their planning and the name of the persons responsible of the control over these corrective actions.

Identification System

All equipment and piping is to be labelled according to a logical identification system based on equipment position, and type.

The identification system used shall be in accordance with the Ukrainian standard. If not applicable European standard according to the following shall be followed:

EN 81346

DIN2403 Identification of pipelines according to the fluid conveyed

92/58 EEG Identification of hazardous media, chemicals, gas etc.

Labelling shall include as appropriate for the equipment type, but not be limited to:

The Identification Number according to the Plant Identification System

Date of manufacture and Serial Number

Operating parameters

Class

As-Built Drawings

The Contractor shall, during the Construction Period, prepare, and keep up- to-date, a complete set of "As-Built" records of the execution of the Works, showing the exact as-built locations, sizes and details of the work as executed.

The Contractor shall submit three hard copies and three digital copies with editable files such as Word, Excel and in the latest version of AutoCad and in Adobe Acrobat Portable Document Format (PDF). This shall include all design descriptions, reports, calculations, schedules, photo records and other supporting documents.

Lists and instructions shall be readable in Microsoft Office Programmes. All text is to be provided in Ukrainian and English.

All software licenses which are a part of the delivery within this Contract shall be transferred to the Employer, including those necessary for the operation, maintenance, engineering and configuration.

Supply and installation of plant and equipment

Supplied plant and equipment should not be manufactured earlier than 2021. The plant and equipment should be tested at the manufacturing plant, delivered to the worksite, unloaded, unpacked, inspected and stored.

The same equipment (membranes, shut-off valves, pump units, frequency converters, Programmable logic controller (PLC), electricity meter, flow meter) that are supplied must be supplied by the same manufacturer.

All the materials and articles must be new or unused, made after the latest models or those being produced at present and represent the latest advancement in the sphere of design and development of materials.

Submittals

The following documents shall be provided by the Contractor upon each delivery of the plant, equipment and materials:

(i) one (1) copy of UkrSEPRO Certificate of Conformity (type approval) for materials, plant and equipment subject to mandatory certification in Ukraine (list of goods subject to mandatory certification is determined by Decree No.28 or the State Committee for Technical Regulation and Consumer Policy (Derzhspozhivstandard, or DSSU) dated 01.02.2005, available online at http://zakon1.rada.gov.ua/laws/show/z0466-05/page) or one (1) copy of manufacturer's Declaration of Conformity for plant and equipment not subject to mandatory certification in Ukraine (Declaration of Conformity is a formal declaration by a manufacturer, or the manufacturer's representative, that the

product to which it applies meets all relevant requirements of all product safety directives applicable to that product);

(ii) one (1) copy of detailed packing list in waterproof envelope identifying content of each crate or package;

(iii) one (1) original and two (2) copies of Factory Test/Inspection Reports issued by Manufacturer, if applicable;

(iv) one (1) original of statement on the content of precious metals in the plant and equipment, signed and sealed by the Contractor;

(v) one (1) original and two (2) copies of transport document recording the delivery of Goods to the Employer.

The following documents shall be prepared by the Contractor and, upon the Project Manager's request, provided for approval or review, whichever is applicable, during performance of the Contract:

(i) Acts and Logs required under Ukrainian standard DBN A.3.1-5-2016 "Organization of a Building Production".

If required, other submittals relating to specific items of plant, equipment and/or works shall be prepared by the Contractor and provided for approval or review during performance of the Contract. Such submittals may be indicated in corresponding sections of the tender documents below.

Operation and Maintenance Manuals

General

The Operation and Maintenance Manual shall compile data and related information on the operation and maintenance of materials and equipment furnished under the Contract.

The Operation and Maintenance Manual shall be prepared by personnel:

Trained and experienced in maintenance and operation of described materials and equipment

Familiar with requirements of this Section

Quality of documents shall be prepared as follows:

Use a uniform layout for the entire manual and use a consistent format and typography for the written text.

Provide text, sheets, and information from manufacturer etc. in printed form. Do not use photocopies of catalogues, brochures etc.

Provide electronic copy with the above information based on internationally recognized word processing and spreadsheet programmes.

Content

The Contractor must provide an Operation and Maintenance Manual in Ukrainian and English and As-Built Drawings, both as hard copies and in electronic form. The Contractor shall keep the As-Built documents and the Operation and Maintenance Manual up to date and in full conformity with the Plant and all the components thereof as currently in service.

The Contractor shall maintain a list of all equipment, stating serial number, model rating, manufacturer, manufacturer's address, telephone number and fax number and other relevant information.

Without in any way derogating from the above provisions, during the Trial Operational Period, the Contractor shall comply fully with all of the terms and provisions in the Operation and Maintenance Manual.

The Operation and Maintenance Manual shall include detailed descriptions, policies and procedures on at least the following subjects:

Plant Description

Information should include, but is not limited to:

Descriptions for each part of the leachate treatment plant, giving detailed data on the plant design volumes, areas and process capacities shall be provided.

The process equipment and the automation system related to the plant operation shall be presented in a clear and easily understandable way.

Basic operation data, such as chemicals used, and the needed consumption, installed power, and the power required shall be listed.

Drawings and maps of explosive hazard zones shall be included.

Documents of Risk Analyses and CE-labelling of equipment in accordance with European Standards shall be prepared.

Plant Operation

Detailed standard operating procedures on:

Leachate treatment

Troubleshooting guide for all processes and equipment

Function of each equipment or equipment groups

Process Control system (hardware and software)

Emergency plans

Safety procedures and safety plans for every stage of the operation and maintenance

Long Term and Short Term Planning

Short term planning philosophy

Long term planning philosophy

Plant Maintenance and Renewal

Maintenance policies and maintenance procedures shall, as a minimum, consist of:

Detailed schedules of all maintenance requirements, refurbishment, renewal and replacement dates, spare parts schedules and inventory schedules for all civil constructions, buildings, structures, infrastructures, landscaping, open areas, pits, tunnels, pipes, lights, fences;

Detailed schedules of all maintenance requirements, refurbishment, renewal and replacement dates, spare parts schedules and inventory schedules for all equipment, machinery, parts, instruments, computers, software and all other portions of the Plant;

Detailed records of all warranties which may apply to any or all portions of the Plant;

Full records of all suppliers and service providers for the Plant;

All other policies, procedures, documentation that may be necessary or recommended for the optimal and efficient operation and maintenance of the Plant.

Plant Performance

Policy and procedures for the achievement, testing, verification and for ensuring compliance on a continuous basis of the following performance standards:

The sampling and testing of the leachate to determine full compliance with the performance requirements stated as Effluent output conditions in the para 4.2 of this document;

The procedures for performing all tests and sampling;

Control of electrical energy, natural gas, chemical and drinking water consumption.

Registration of Data

The procedures and the forms for:

The collection and organized registration and administration of all operational data, tests, results, sampling and sampling results

Records of all leachate volumes

Records of all quality tests, process performance tests and all other tests, analyses and sampling.

Service Documentation of Equipment and Instruments

The service documentation shall include:

Exploded view or cross sectional drawings

Sub-assembly or parts lists with order numbers and addresses

Assembly/disassembly instructions, with data and directions for adjustment

Lubrication instructions (with indication of lubrication points, lubricants to be employed, draining and filling instructions, details of the required frequency of lubrication, etc.);

List of potentially occurring problems and methods of remedying them;

Indication of all makes and method numbers of incorporated parts in a common parts list;

In addition, manufacturer service documentation, including maintenance prescriptions and recommendations must be appended.

Health and Safety procedures

Health and Safety procedures to ensure compliance with the agreement conditions.

Process Control System

User/operation manuals, including details of system start-up/shut- down and alarm references;

Detailed description of hardware and software system;

Description and specification of the control objectives/requirements;

Programmable controller descriptions including equipment manuals;

Work station descriptions including equipment manuals;

Description of the software functions, including function/flow charts, memory maps and allocations;

Software back-ups and/or erasable programmable read-only memory (EPROM)

Lists of input/output connections including all Video Graphics Array, printers (VGA), etc.

Quality Assurance/Quality Control Procedures to ensure compliance with the agreement conditions.

Training

General

The Contractor shall be responsible for the training and instruction of the Employer's personnel in all aspects of plant management, operation and maintenance, until the end of the Twenty Four Month Operation & Maintenance Period.

The Contractor shall prepare the training programme for the approval of the Project Manager. The Contractor shall make available for this purpose training facilities, competent staff and all information, as may be necessary for effective execution of the training programme and as approved by the Project Manager.

Trainee Categories

The training shall be planned exclusively for Ukrainian personnel. The Contractor must be prepared to provide a condensed training programme should the Operator fail to have the necessary trainees available at the planned starting date of the training.

Personnel will be at least from the following two (2) categories.

Category I – Managers, Engineers and Graduates

Some staff will be highly qualified with experience at management level at plants of a similar nature. The remainder will be recent graduates for whom training shall be planned to the end of trial operation period. They shall be trained to the required level of technical competency to assume middle management responsibilities by the end of the trial operation period. Training should be conducted in Ukrainian language including technical English as appropriate.

Category II - Already Qualified Skilled Workers

These shall be treated in the same category as equivalent graded expatriates for the training to be carried out during the commissioning and trial operation period. During the erection and trial operation period of the Contract their training shall be aimed at their development to the next or higher level of their particular trade or profession. Training should be conducted in Ukrainian language including technical English as appropriate.

Submittals

The Contractor shall submit an overall comprehensive training plan within three (3) months after award of the Contract.

Detailed programme and instructional material shall be submitted prior to the commencement of the training allowing sufficient time for it to be reviewed, amended as necessary and approved by the Project Manager. A specially prepared training manual in English and Ukrainian shall be submitted.

The Contractor shall list the training equipment to be provided. This equipment together with the necessary software, films, notes, etc, used in the program will remain the property of the Employer at the end of the Contract.

The Contractor shall employ specialist-teaching staff to prepare and conduct the training. They shall be employed solely on the training programme. CV's of staff selected for this task shall be submitted to the Project Manager for approval. Approval shall be given only to staff that have proven training experience.

The Contractor shall maintain proper records of the attendance and performance of each trainee. He shall submit monthly reports on the progress of each trainee and a comprehensive assessment at the completion of the training programme. Close liaison with the Employer shall

be kept so that any necessary corrective action can be taken rapidly.

Training Programmes

The trainee programmes shall provide the necessary basic training to enable the trainees to carry out duties at the leachate treatment plant under the supervision of the skilled staff.

The Contractor shall provide a training programme to enable the Employer's staff to properly operate and maintain the leachate treatment plant from the time of handover. This training programme shall cover two (2) main classes of trainees.

Class A - Familiarization Programme

Firstly, the Contractor shall familiarize skilled and experienced staff in the detailed operation and maintenance techniques for the leachate treatment plant as built.

The familiarization programme shall be set up for senior staff, operators and maintenance technicians and shall include a short classroom course, a practical instructional period and a period of supervised job experience. The Contractor shall provide trainees with sufficient data to enable them to carry out their tasks.

Class B - Training Programme

Secondly, the Contractor shall provide a training programme for the new employees. They will have little or no experience from operation of plants or equipment.

Execution of Training

The Contractor shall provide for the use of modern instructional methods to ensure the efficiency of the training. This will include audiovisual programmes suitable for the trainees.

Training shall be prepared to be carried out in the Ukrainian language. All of the teaching staff shall be fluent in the Ukrainian language, or technical translator shall be provided.

All training resources, i.e. lecture rooms, training facilities, training models, training aids, audiovisual aids, TV/video, all training literature, training manuals, periodic tests and assignments, instructors' manuals and trainee manuals shall be provided by the Contractor. All written literature and pamphlets, manuals, etc, shall be written in both English and Ukrainian languages. Any travelling costs, costs of living, accommodation and other personnel expenses of the trainees shall be fully borne by the Contractor.

An assessment of the standard reached by each trainee will be made both during the training and at the completion of the training period. Where necessary as determined by the Contractor or Engineer the Contractor shall repeat the instruction until the trainee can meet the requirement.

Process Requirements

General

The Contractor will be responsible for design, supply, installation and commissioning of a Leachate Treatment Plant (LTP) of capacity 200 m^3/day: the Process Requirements are to be understood as minimum design requirements. Furthermore, the leachate treatment plant shall comply with Ukrainian norms and regulations.

The LTP for Khmelnytskyi landfill has to comply with the following general principles:

It is important that the process design is well known, well proven and has known references for the design parameters.

In addition to providing process guarantees the Contractor has to submit calculations that prove that the overall Process Requirements can be met.

Process design considerations

The design of the LTP and ancillary works, including any such elements of the existing leachate handling works as are available, shall be in accordance with Best Available Techniques (BAT) and shall be such as to facilitate the operation, monitoring, sampling and maintenance of all processes and equipment.

The overall process design considerations for the new leachate treatment plant shall be based on the following technical aspects.

The design shall be based on existing proven leachate treatment technology that guarantees the sustainable achievement of the required qualitative and quantitative indicators according to the Functional Guarantees.

The capacity of the LTP shall be not less than 200 m^3/day. The proposal of more productive installations is welcomed.

The leachate treatment process shall be based on reverse osmosis leachate treatment with pre- and post-treatment or any other technology of comparable performance to be proposed by the Contractor.

Modularity: The rate of leachate production will change over time: therefore, the system should be easily expandable for both flow and load in the future.

Effluent quality: Leachate parameters are variable, especially due to seasonal or climatic changes. Furthermore, concentrations of leachate parameters will also change with the aging of the landfill. The treatment facility should therefore have the capacity to adequately treat leachate of varying quality.

Process reliability and stability (stand-by and redundancy philosophy). The system shall be protected against the freezing during the long-term stand-by in the winter time at -20°C

High degree of process control (SCADA) in accordance with the Electrical and Automation Works Specifications

Operation reliability and reasonable expertise requirements

Automatable: To minimize operating costs, the municipality has indicated a preference for increased automation, and potentially a degree of remote monitoring or operation, for the plant. This would also enable additional external support to be provided after plant handover.

Optimization of the use of consumables (electrical power, fuel, chemicals etc.)

Ventilation and noise requirements based on health and safety aspects

Design Concept

Treatment technology

The design of the LTP is to be in accordance with best modern practice; well adapted to local conditions, and shall be such as to facilitate construction, operation, inspection and maintenance of all processes and equipment.

The technology for the leachate treatment plant will be proposed by the Contractor to meet the performance requirements. The proposed treatment technology shall be based on reverse osmosis (RO) membrane treatment or any other technology of comparable performance to be proposed by the Contractor.

The RO technique aims to extract clean water from the aqueous solution of organic and inorganic contaminants that constitute the landfill leachate. With the reverse osmosis, high pressure is applied to the leachate; against a semipermeable membrane forcing the water molecules to pass through the membrane, thus forming the clean "permeate". The majority of the solutes or contaminants will be left behind forming the "concentrate". The main advantage of the RO process, in treating leachate, is the high quality of permeate produced - more than 99.9% of the contaminants can be retained and their release to the environment avoided.

In contrast to normal filtration where solids are eliminated from a liquid, reverse osmosis succeeds in removing solutes from a solvent. Advances in membrane technology, in particular in the last 15 years, have allowed the development of RO systems designed specifically for the treatment of leachate.

Most commercial RO plants, designed for the treatment of leachate, are of multi-permeate stage configuration, typically two and rarely three stages. The first stage provides the majority of the leachate cleaning while subsequent stages "polish" the permeate further.

The plants use artificial, semi-permeable membranes of thin film composite construction. Such membranes have high salt rejection and display very high physical and chemical durability. Membrane manufacturers and in particular those of spiral wound type have optimised the construction of these membranes for use with leachate.

The membrane modules are mounted inside pressure tubes on racks, complete with interconnecting pipework and re-circulation pumps that circulates leachate in each membrane block in order to provide constant conditions on the membrane surface. The feed to a membrane must be of a sufficiently high velocity in order to provide an effectual overflow of the membrane surface to avoid concentration polarisation and fouling effects that would decrease their efficiency.

RO plants are designed to provide as large a surface area of membrane as possible for a given treatment unit, based on calculated flux rates of permeate through the membranes. A variety of membrane module systems are available including; proprietary tubular modules, spiral wound modules, hollow fibre modules and disc tube modules. Standard spiral wound modules, hollow fibre modules and disc tube modules are sensitive to the presence of solids in the leachate. For this reason RO plants incorporate a pre-filtration stage by sand-filters and fine filters. Continuously working RO plants operate fully automatic. Operation parameters are permanently recorded and displayed. Start and shutdown procedures occur automatically. In most cases remote control is possible.

As a non-biological process, RO is quite insensitive to changes in leachate strength. Though changes in leachate composition will affect the quality of permeate, well-designed plants will sense this and adjust automatically either the throughput or/and yield ratio to compensate.

Most plants able to reach steady state and full production within 10 to 15 minutes from re-starting. However switching the plant off frequently increases detergent usage, as most plants will go through a membrane wash cycle before shutting down.

The ability of RO plants to operate intermittently as well as their ability to adjust to leachate composition changes minimizes the requirement of large balancing tanks/lagoons. However, care needs to be taken in designing such installation to provide adequate leachate storage capacity to allow for planned and unplanned maintenance of the equipment. The RO installation should display better than 90% plant availability, i.e. not more than 10% of the downtime is allowed. The availability of the plant should be taken into account in designing the storage requirement as well as selecting the maximum capacity of the plant.

RO plants can operate intermittently; indeed RO plants do require frequent stoppages to "wash" the membranes. Washing of the membranes is done with a solution of membrane detergent and permeate produced by the plant. There is no requirement for a fresh water supply permanently connected to the plant though a supply should be made available close to the plant for use during maintenance and in cases were the permeate store is exhausted. "Wash" cycles are generally managed automatically and their frequency is governed by the level of contaminants in the leachate and in particular those of Calcium, BOD_5, COD etc.

The retention efficiency is primarily depended upon the molecular weight and polarity of contaminants. Reverse osmosis membranes can result in the retention of more than 98% of large molecules dissolved in leachate. Ions of valance 1 such as Na+, Cl- can also be retained.

The quantitative cleaning efficiency of reverse osmosis plant can vary between 50% and 90% clean permeate effluent. Experiences on European landfills treating "strong" leachate (e.g. ammoniacal-N >1000 mg/l) show, that values of 75% permeate yield are typical. So modern 2-stages RO plants do reliably and consistently separate 75% - 80% of leachate volume into a high quality water stream.

Permeate is normally suitably clean to be allowed direct discharge without any further treatment. The concentrate is normally re-infiltrated in the landfill body or disposed by other way. The production of a high quality effluent (permeate) is a significant advantage of the RO process. In particular, the removal of non-degradable components

of leachate such as chloride, or residual COD and heavy metals. However, all these contaminants are present within the concentrate, which can be 10-25% of the leachate volume. In addition, all chemicals required for effective operation of an RO plant are contained in the concentrate. This amounts to about 0.3% of each cubic metre of leachate treated. Chemicals including citric acid, membrane cleaner and anti-scaling detergents. Modern designed membrane modules do not require treatment with biocides.

Before the reverse osmosis plant it is necessary to have a proper pre-treatment, which should include the following stages: rough filtration, pH-adjustment with sulfuric acid, fine filtration with sand filters, fine filtration with cartridge filters.

Design Conditions

The design conditions are as follows:

Design Capacity

The treatment capacity will be not less than 200 m^3/day. More productive installations are allowed.

Leachate and Effluent Quality

Leachate Quality

Samples of the leachate from the landfill were taken and sampled in December 2019. The results are in included in **Appendix 4**.

Effluent Discharge Conditions

The effluent must meet the discharge criteria shown in **Appendix 5**.

Climatic conditions

The city is located in a moderate continental climate zone with warm summers, mild winters and sufficient rainfall. In winter, the air of the Siberian anticyclones reaches the area, which brings cold weather. In the summer time, Azores thermal flows affect the climate conditions. During spring and early autumn, Arctic air penetrates into the area, which brings a sharp reduction in air temperature.

Throughout all seasons, the territory is under the influence of cyclones that are formed over the Atlantic Ocean. In the summer, they cause significant cloud cover, precipitation and low air temperature, and in winter - warming, thaws and snowfalls.

The average annual air temperature ranges from 6.8°C in the North and central parts of the region to 7.3°C - in the South. The hottest month is July, and the coldest is January. In summer, the highest average temperatures are between 18.8°C and 19.3°C. The average January temperatures is 5.4°C.

Penetration of continental air masses leads to significant fluctuations of air temperature during all seasons. In summer, the air could be warmed up to + 39°C (absolute maximum), and in the winter cooled down to -34 °C (absolute minimum).

Precipitation in the study area are in the ranges between 530 and 670mm per year. The greatest amount of rainfall takes place during summer months, and the least in winter. Thunderstorms often occur in the summer period and occastionally hailstorms.

Snow cover is formed in mid-late December and lasts predominantly until mid-March. Snow cover thickness is not considered to be significant (ranging between 10-15cm).

During the year, predominant wind blows in North-West and North-East directions. In summer, North-West and West wind directions are predominant. In winter North – North-West and South-East directions.

Leachate pumping from existing ponds

The Contractor shall supply and install at its own cost all necessary leachate abstraction point or points within the existing leachate ponds.

The location of the existing leachate ponds is indicated in the Feasibility Study in **Appendix 1.**

Discharge of effluents from the LTP

The Contractor may discharge the permeate which meets the qualitative requirements from the LTP to the discharge system (installed under a separate contract), transferring the permeate to the local wastewater sewage network.

The alignment and profile of the sewer connection pipeline are shown in **Appendix 6**.

The concentrate from the LTP will be re-injected into the landfill waste mass. The Contractor will be responsible for:

The supply and construction of the concentrate injection trenchs or wells

The pumping of the concentrate from the LTP to the point of reinjection using the means to be proposed by the Contractor. The Contractor shall be responsible for all material, personnel, equipment, consumables, fuel and/or electricity required for discharge of the concentrate.

Process Instrumentation & Measurements

Process instruments shall be installed for continuously measuring process parameters and the leachate treatment plant shall as a minimum be fitted with the following instrumentation:

To ensure that the optimal process control is maintained, monitoring equipment and sampling facilities shall be provided. The influent flow from the leachate storage reservoir and effluent from the leachate treatment works shall be monitored and sampled. Sampling facilities (for 'grab' samples) shall be provided after every process step in the Requirements**.**

Mechanical Specifications

General Requirements

This section indicates the scope, manner, and other details of the permanent services to be performed by the Contractor. It shall be read in conjunction with the Schedules and Drawings.

The Contractor is responsible for any additional temporary or permanent works that may be necessary for appropriate completion of the Works

Equipment and materials

All equipment and materials to be incorporated in the Works shall be new, unused products of reputable, experienced manufacturers and still in production. All equipment shall correspond to the machine directive of the European Community. Similar items in the project shall be the products of the same manufacturer.

Equipment and materials shall conform to sound engineering practice and be applicable to the requirements in the national regulations.

All equipment and materials shall be of industrial grade and of standard construction, and of sturdy design and manufacture.

All mechanical equipment submerged in water or leachate, or in humid areas, or where splashes are likely to occur, or in ground, shall be of stainless steel EN1.4404, EN1.4436 or better. All parts in direct contact with various chemicals shall be completely resistant to corrosion, or abrasion by these chemicals.

Particular attention shall be given to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials of suitable hardness and surface finish and the application of lubricants.

Use of materials and articles which are in contact with leachate or permiate and can add a color or toxicity to the effluent is forbidden.

Records and record drawings

The Contractor shall maintain accurate records, plans and charts showing the dates and progress of all the main operations and the Employer shall have access to this information at all reasonable times.

The Contractor shall mark on a separate copy of the drawings, the positions, levels and other details of all existing water mains, sewers, drains, cables and other services, which are exposed during construction of the work.

Progress photographs

Photographs showing the progress of the Works shall be taken every month.

Special photographs showing particular features of the Plant of interest in connection with the Works shall also be taken when required by the Employer.

All photographs shall be numbered, filed, and handed over to the Employer in a suitable electronic format. The copyright of the photographs shall remain with the Employer.

Standards and regulations

Assemblies, Apparatus, Equipment etc. that are subject to CE-marking under one or more directives issued by the European Union shall meet the applicable requirements for CE-marking. Assemblies, Apparatus, Equipment etc. that meets the applicable requirements for CE-marking shall carry the CE mark and have enclosed the declaration of conformity.

All standards and norms shall be understood as minimum requirements unless the corresponding standard, which is in use in Ukraine, sets higher requirements, in which case the latter applies. Any discrepancies and irregularities between the regulations, standards and codes of practice shall be subject to consultation between the Contractor and the Employer. The Employer takes the final decision.

Note: The tender shall state the standards, which have been used.

The Contractor is obliged to check that the manufacturers of proposed equipment are approved in Ukraine, and provide all necessary certificates of conformity with Ukrainian norms for equipment of foreign origin.

Safety regulations

Apparatus, equipment etc. that are subject to ATEX-marking under one or more directives issued by the European Union shall meet the applicable requirements for ATEX-marking. Apparatus, Equipment etc. that meets the applicable requirements for ATEX-marking shall carry the ATEX-mark and have enclosed the declaration of conformity.

Minimum protection requirements for mechanical equipment shall be:

Areas	**Degree of protection**
Electrical rooms	IP 20
Process Areas	IP 65
Outdoor	IP 65
Outdoor, near water	IP 67
Under water	IP 68

Control of dimensions on site

The Contractor has to check all relevant dimensions, levels and shape of civil structures, embedment, pipes, and existing connections etc. before start of manufacturing.

Alignment, leveling and building-in

All equipment shall be levelled and aligned in such a manner as to comply with the manufacturer's requirements and tolerances. Sufficient temporary packing, supports etc. shall be provided to facilitate the erection and alignment and to ensure the retention of any such level and support blocks during grouting, casting-in or backfilling.

Welding

It is anticipated that piping systems are to the highest extent possible pre-fabricated by the supplier under corresponding supply contract.

An approved specialist shall carry out site welding of steel pipe joints. Site welds shall be made in a manner such that the welds shall have a strength to withstand all applicable stress including temperature due to a variation of + or -20ºC from the mean.

Before any welding is carried out, the Contractor shall develop a program giving the suitable order in which the welds will be carried out.

The Contractor will pay for all X-ray testing of welded joints made on Site.

Testing and defect repair of welded joints shall be done in accordance with requirements of "Non-destructive control. Welded joints of pipelines and metal structures. Radiographic method" or equivalent EU norms adopted in Ukraine.

All welding of pipes shall be done by the TIG-welding method including use of protection gas.

After welding in stainless steel material joints shall be cauterised and passivated to the same corrosion resistance quality as for the stainless steel material used.

Only stainless steel tools shall be used in contact with stainless steel material. Tools for stainless steel shall not be used in contact with other materials.

At transporting, lifting activities etc. of stainless steel material only stainless steel material shall be used.

Protection and packing for dispatch

The Contractor shall adequately protect all equipment against corrosion and accidental damage by painting for dispatch, for the whole period of transit, storage and erection.

Flanges of pipes, valves and fittings shall be protected. Pipe openings shall be covered during installation and storage.

Sleeves and flanges of flexible couplings shall be secured.

Maximum noise levels

In order to prevent noise nuisance, all equipment giving a high noise level are to be covered and insulated (e.g. compressors, blowers, aerator units etc.). The works are to be designed to ensure a maximum noise level of 55 dB(A) at the boundary of the Site of the Plant, when all equipment installed is in operation. Additionally, the noise level at a distance of one metre from any sound-producing mechanical equipment must not exceed the levels in the table below:

Equipment	LA,eq (dBA), 1 m distance
Pneumatically controlled valves	65
Blowers	80
All other equipment	72

Protection against vibrations

Rotating machinery shall be balanced to meet the applicable standards.

Resonance

Rotating machinery shall be free from resonance regarding all types of resonance within normal operation conditions.

Protection class

All parts, which can be damaged by water and/or dust, shall be properly enclosed according to applicable standards.

Forgings

Forgings shall be subject to external examination and non-destructive tests for the detection of flaws and shall be heat-treated for the relief of residual stresses.

All Items to be complete

All items of equipment shall be provided with all necessary apparatus to fulfil the function described herein or reasonably to be inferred and required to make the unit operational and perfect in every part and detail.

All exposed moving parts shall be provided with guards in accordance with the statutory requirement to afford maximum protection and a safe working environment for operating personnel staff and visitors. Guards shall be provided for protecting personnel against exposed moving parts and hot surfaces. Guards shall be easily removable by standard tools for maintenance access.

Guards shall be designed in such a way as to permit easy removal and replacement for efficient maintenance of the equipment. W here safety codes or regulations are applicable; the guards shall conform thereto in all respects.

All drive guards shall be fabricated such that the guards can be removed without disturbing the sensing devices, chain or belt tensioners, field instruments and lubricators.

All locations for discharge of oil shall be provided with discharge tubing and drain cock for easy change of oil. Tubing for refill of oil shall also be provided.

General Equipment Requirements

Pipes

General Requirements for Pipelines

All pipe materials chosen shall be selected to withstand the media properties to where applied as for example corrosivity, temperature and pressure.

Outdoor aboveground pipes shall be insulated and equipped with heating cable. Wherever possible, pressure pipelines shall be designed to avoid high points and the consequent formation of air or gas pockets. If unavoidable, provision shall be made for air release at high points either by automatic air release valves, or manual air release cocks, if approved for locations where infrequent use is anticipated.

Compensators shall be designed and calculated in accordance with requirements of Ukrainian Standards., particularly, to compensate longitudinal displacements caused by changes of temperature, air, soil, for steel pipes inside channels, above surface, where soil may subside, to protect valves. Also compensators shall be designed at pipes penetration of the structures. Special couplings shall be designed to allow dismantling of pipelines without necessity to cut them.

Pipe work shall be designed and installed so that no hydraulic thrust or deadweight loads are transmitted to the pump flanges, castings or other machinery.

Necessary reducers for installation of pumps, flow meters etc. shall be included. Connections for flushing and emptying the pipe system including ball valves, Ø25 mm, shall be included in supply.

Pipes shall have equipotential connection to the earth system.

All pressure pipes shall be constructed for minimum pressure class PN 10.

Wherever possible, pressure pipelines for liquids shall be designed to avoid high points and the consequent formation of air or gas pockets. If unavoidable, provision shall be made for air release at high points either by automatic air release valves (sewage type), or manual air release cocks, if approved for locations where infrequent use is anticipated. Washouts shall be provided into the works liquor drainage system at low points.

All pipes shall be equipped with necessary de-aeration valves, sample valves and flushing connections.

All necessary pipe supports shall be included.

Stainless Steel pipes

Stainless steel pipes above water or leachate surface shall be welded stainless steel EN1.4301 or better.

Submerged pipes in process units for leachate treatment shall be welded in stainless steel EN 1.4404 or better.

All pipes shall be constructed for minimum pressure class PN10.

Pipes in contact with methane gas shall be stainless steel EN 1.4404 or better and designed for a working pressure of 20 bars.

Diameter and wall thickness tolerances shall comply with EN ISO 1127. Stainless steel pipe shall have at least the following wall thickness;

Dim, mm	Wall thickness, mm
< 200	2.0
200-250	2.5
300-500	3.0
> 500	4.0

Bends, reducers and flanges shall be made of stainless steel according to the material of the pipe work to which they will be connected to.

Wall thickness of bends and reducers shall be at least equal to that of the pipe work to which they will be connected to.

Stainless steel shall be correctly pickled and passivated, spots shall be ground out. Where otherwise not stated in mechanical specification, fixing arrangements such as supports, brackets, consoles etc.shall be installed in such a way that secure fixing always is achieved.

For submerged pipes, supports, brackets, consoles etc. shall be made of stainless steel EN 1.4404 or better.

For dry installed pipes, supports, brackets, consoles etc. shall be made of stainless steel EN 1.4301 or better.

At risk of galvanic couple, protection is to be applied by installation of suitable insert etc. or exchange to a higher quality in material.

Required compensators, pipe bends, arrangements for connections etc. shall be included.

Pipes to be embedded in concrete shall be equipped with a puddle flange. Flange diameter of at least the pipe diameter plus 200 mm.

Stainless steel pipe below ground level shall be terminated 0,5 m outside the concrete wall and be provided with a coupling to connect to the continuing pipe in ground.

Bolts, screws and nuts shall be made of stainless steel EN 1.4404 or EN1.4436 for submerged or underground pipe flange connections. For dry installed pipes, bolts, screws and nuts shall be made of hot-dip galvanized steel.

Pipes shall be equipped with collars and flanges of the same material as the pipe. Loose flanges shall be made of silumin or hot-dip galvanized steel.

The piping systems shall be equipped with joints in such a way that disconnection of equipment, valves etc can be done easily.

Pipes and fittings of standard type shall be used.

Where nothing else specified, pipeline fittings shall have the same dimension as pipe. Necessary reducers for installation of pumps, flow meters etc. shall be included.

Connections for flushing and emptying the pipe system including ball valves, Ø25 mm, shall be included on suction and/or pressure side of pumps, flow meters, isolation valves etc.

Suction pipes shall be provided with cleaning hatch suitably located close to the pump. Air release valves, Ø15 mm, shall be installed on pipelines at locations with risk of “air pockets”.

Open ends shall be covered during transport and storage. Pipes shall have equipotential connection to the earth system.

Steel Pipe Work

Steel pipes and fittings shall comply with EN 10255. All joints shall be flanged or other mechanical couplings.

Galvanized steel pipes and fittings shall comply with EN 10255. All joints shall be flanged or other mechanical couplings; no site welding will be permitted.

Galvanized mild steel pipes with diameters less or equal to 150 mm shall comply with EN

10255 (heavy gauge) or other equivalent national standards, with screwed joints, complying with requirement of EN standards or other equivalent national standards. Screwed fittings other than sockets shall be malleable cast iron to EN 1561.

After cutting, pipes shall be reamed, and be free of burrs, rust, scale and other defect sand shall be thoroughly cleaned before erection. Open ends left during progress of the work shall be closed with purpose made wooden plugs.

Polyethylene Pipes and Fittings

Polyethylene pipes and fittings shall comply with the requirement of the following standards or other equivalent national standards:

EN 12201

EN 12666

The material used in the manufacture of the pipes and fittings shall be high- density polyethylene complying with EN 12201, EN 12666.

Copper Tubing

Copper tubing shall conform to the requirements of EN 1057 and shall be type K (soft). Fittings shall be soldered or sweated on and shall be cast bronze or forged containing 85 % copper.

Pipe supports

Piping shall be adequately supported on racks or by anchor brackets, saddles or supports. In no case shall support spacing exceed that recommended by the pipe manufacturer to adequately support the pipework for the service intended. The Contractor shall present calculations of maximum distance between supports.

Pipe supports shall be of stainless steel.

Hangers, supports or pipe racks shall be provided in each direction at each change in direction. This can be in conflict with some expansion requirements. All hangers, racks, saddles and supports shall be of standard manufacture for that purpose.

Pipe supports in the floor trenches, drains, or similar conditions shall be of stainless steel construction.

All pipework with joints not designed to withstand tensile forces tending to separate the joint when the pipeline is subjected to an internal gas or liquid pressure shall be fitted with thrust and anchor blocks at all intersections, branches, changes of direction, valves and dead ends.

Anchorage of pipework shall be provided where there is the possibility of joint separation or subjecting pipework to excessive stresses.

Dismantling joints

Flexible mechanical joint couplings and flange adapters shall be appropriate to the class and type of pipe or pipes being jointed and provide axial restraint. They shall be fabricated from steel or malleable cast iron with steel bolts. Couplings shall be provided without a central register.

Couplings shall be capable of accommodating the following angular deflections between adjacent pipes, without leakage.

up to 450 mm plus or minus 6°

Flange adapters shall accommodate half of the above deflections. Couplings shall be capable of accommodating a repeated pipe movement of 9 mm and flange adapters 4.5 mm between adjacent pipes, without leakage.

Couplings and flange adapters shall be capable of supporting a 6-meter pipe full of water when installed above ground on piers and remaining watertight. Couplings and flange adapters shall be factory-coated with an appropriate nylon finish of minimum thickness of up to 200 microns.

Welding

It is anticipated that piping systems are to the highest extent possible pre-fabricated by the supplier under corresponding supply contract.

All welding shall be done by a welder attested in accordance with the Rules for attesting of welders in Republic of Ukraine by authorized attesting centers.

The Contractor will pay for all X-ray testing of welded joints made on Site.

Welding, testing and defect repair of welded joints shall be done in accordance with requirements of Ukrainian Standard for "Welding, thermal treatment and control of pipe systems of boilers and pipelines during installation and repair of equipment for energy systems".

Testing of welded joints shall be done in accordance with requirements of Ukranian Standards for non-destructive control of welded joints of pipelines and metal structures. or equivalent international (EU) norms adopted in Ukraine.

All welding of pipes shall be done by the TIG-welding method including use of protection gas.

After welding in stainless steel material joints shall be cauterised and passivated to the same corrosion resistance quality as for the stainless steel material used.

Only stainless steel tools shall be used in contact with stainless steel material. Tools for stainless steel shall not be used in contact with other materials.

At transporting, lifting activities etc. of stainless steel material only stainless steel material shall be used.

Forgings

All major stress bearing forgings shall be made to Applicable Law. Forgings shall be subject to external examination and non-destructive tests for the detection of flaws and shall be heat-treated for the relief of residual stresses.

Materials

a) Castings

The structure of castings shall be homogeneous and free from non-metallic inclusions and other defects. All surfaces of castings, which are not machined, shall be smooth and shall be carefully fettled to remove all foundry irregularities.

Minor defects not exceeding 25 % in depth nor 12.5 % of total metal thickness whichever is less and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. If the removal of metal for repair should reduce the stress-resisting cross-section of the casting by more than 25 %, or to such an extent that the corrupted stress in the remaining metal exceeds the allowable stress by more than 25 % then the casting shall be rejected.

Unless otherwise specified castings shall be produced to the following standards of equal:

grey-iron	EN 1561
ductile iron	EN 1563
carbon steel	EN 1563
copper and copper alloy	EN 1982

b) Stainless Steel

Where stainless steel is specified or used it shall have resistance to atmospheric corrosion not less than that provided by 18 % chrome – 8 % nickel steel, EN 10213-4.

Higher corrosion resistance grades shall be provided as required for particular duties.

c) Cast Iron

Shall be of standard grey close-grained quality to EN 1561 or better. The structure shall be homogeneous and free from excessive non-metallic inclusions and other injurious defects. Unfurnished surfaces shall be treated to remove all foundry irregularities.

d) Ductile Iron

Shall be of standard grey close-grained quality to EN 1563 or better. The structure shall be homogeneous and free from excessive non-metallic inclusions and other injurious defects. Unfurnished surfaces shall be fettled to remove all foundry irregularities.

Prohibited Materials

The following materials shall not be used in contact with petroleum products:

lead

copper and copper alloys

zinc and zinc galvanizing

natural rubber

General Accessories

Flanged Joints

All flanges shall comply with ISO 2084. The nominal pressure rating for particular flanges shall be at least equal to the highest pressure rating of the pipes of fittings to which they are attached, but with a minimum nominal pressure of PN 10. The Contractor shall also supply in suitable containers sufficient graphite grease for application to the bolt threads when joints are made.

Nuts, Bolts and Washers

Unless otherwise specified, nuts, bolts and washers shall conform to the requirements of EN 4014 (bolts) or EN 4032 (nuts).

Bolts shall be of sufficient length with minimum two threads shown through the nut when in the fully tightened condition.

Isometric black hexagonal nuts and screws shall comply with EN 4017, strength grade 8.8.

Gaskets and Joint Rings

Gaskets and joint rings shall be manufactured from natural or approved synthetic rubber conforming to EN 1514 standard. Flanged joint gaskets shall be the inside bolt circle type, unless specified otherwise, shall comply with EN 1514 standard.

Flexible Couplings

Flexible couplings shall comply with the pressure of the pipe.

Couplings shall be of type Arpol or Straub or equal where sufficient else of type Viking Johnson or Dresser or equal.

Couplings shall be capable of accommodating the angular deflections between adjacent pipes, without leakage.

Flange adapters shall accommodate half of the above deflections. Couplings shall be capable of accommodating a repeated pipe movement of 9 mm and flange adapters 4.5 mm between adjacent pipes, without leakage.

Rating Plates, Name Plates and Labels

Each main and auxiliary item of Plant shall have permanently attached to it in a conspicuous position a nameplate and rating plate. Upon these shall be engraved, in Ukrainian and English, the manufacturers name, direction of rotation, type and serial number of plant, details of the loading and duty at which the item of Plant has been designed to operate, and such diagrams as deemed necessary.

Motors

Rotating electrical machines shall meet the requirements of EN 60 034-1.

Machines shall be fastened to foundation etc using vibration isolators. The natural frequency of the vibration isolators must not be within the number of revolutions for the machine that corresponds to 80 % - 120 % of the speed range in which the machine operates.

Machines with rated power 37 kW or more shall have heater.

Machines with rated power 75 kW or more shall have winding temperature sensors (Thermistor or PT100), minimum one for each phase.

Asynchronous motors

Asynchronous motors shall be chosen from efficiency class (IE3) according to IEC60034- 30;2008.

Insulation shall be Class F insulation system with class B temperature rise.

Degree of protection shall be IP 68 for submersible motors, and IP 55 or higher for other motors.

Grating and Chequer Plate on Walkways

Open mesh flooring and gratings shall generally comply with EN 14122-2 except where otherwise specified hereinafter. Such flooring and gratings shall be of rectangular mesh and non-slip and shall be Stainless Steel EN1.4301 or hot-dip galvanized.

Toe plates shall be provided around all cut-outs except where otherwise ordered by the Project Manager.

Chequer plate flooring shall be of the non-slip type, not less than 6 mm thick measured excluding the raised pattern. The flooring shall be secured to its frame by stainless steel countersunk set screws.

All flooring shall be designed to carry a loading of 400 kg per square metre and the deflection shall not exceed 0.2 per cent of the span and shall be provided with curbing at the edge of walkways.

All flooring shall be removable. Where frames are to be fixed over openings the frames shall be provided with lugs for building in.

Flooring shall be provided in sizes suitable for lifting and removal by one man and with the appropriate cut-outs to permit its removal without disturbing or dismantling spindles, supporting brackets, cables or pipework. Intermediate supporting members to give the required rigidity to the spanning edges of individual gratings.

Coating and Corrosion Protection

The protective systems specified in these following specifications are to be applied on steel and cast iron.

General

To ensure the proper effectuation of cleaning and preservation processes, under conditions of prescribed temperature and permitted air humidity and with employment of the correct drying times, the Contractor shall solicitously maintain contact with the paint supplier during the execution of the Facility and shall adhere stringently to his (the latter's) instructions. The foregoing applies, in addition, to the preservation of those components of the installation, which are to be purchased from third parties.

The preservation operations shall be executed, as far as possible, in a covered space, prior to the dispatch of components to the site of their installation.

Paint spraying is permissible, provided it is performed with high-pressure or airless apparatus in an enclosed space.

Paintwork of more than one coat shall not consist of any two coats of the same colour.

The colours of the coats of paint shall be determined in consultation with the Project Manager. The paintwork must be free of drips, runs and blisters.

Any areas of damaged paintwork, once discovered, shall be de-rusted immediately with sharp scrapers and brushes, and directly thereafter retouched with the same paint as present on the surrounding surfaces.

Freshly painted components must not be moved or transported before the drying times recommended by the paint supplier have elapsed. The transportation of wholly or partially painted components must be arranged in such way that the changes of the paintwork being damaged are as limited as possible.

Components of the installation that are to be purchased from third parties shall be preserved with a paint system similar to the system to be employed by the Contractor under his own control.

Components to be cast in with concrete shall be preserved - prior to their being cast in - by means of the galvanization or equal of all their surfaces that will lie external to the concrete or internal to the concrete up to a depth of approx. 100 mm; surfaces internal to concrete shall never be painted.

Components that must remain uncovered in order to function properly shall be either carefully smeared with water-repellent, acid free grease or, if necessary, coated with preservation lacquer.

All plain steel fasteners, bolts, nuts, washers etc. that are to be employed in humid atmospheres should be hot dip galvanized.

The coating thickness referred to in the specifications relating to preservation apply to dried paint. Total coating thickness includes any galvanizing or equal layers applied.

Temporary Jigs, fixtures and other auxiliary structures are not to be preserved.

Following coating specifications may be changed to equal alternatives according to coating supplier’s recommendations.

Specifications

A) Cleaning

Before cleaning begins, steel components should be brought as far as possible into their final forms.

Steel components that would otherwise be rendered inaccessible (and therefore incapable of being cleaned) as a result of welding operations shall be first cleaned, directly thereafter welded, and as soon as possible preserved.

The number and dimensions of spaces that will be inaccessible after the completion of components should be reduced to a minimum by appropriate design.

Cleaning of steel components shall incorporate thorough stripping off of grease, good drying and subsequent thorough de-rusting and abrasive-blast or pickle cleaning; accompanied with hot dip galvanizing.

Blast-cleaning should be carried out with steel shot of maximum grain diameter 0.7 mm, or a mixture of similarly sized steel shot and chopped steel wire in equal proportions, or an inert medium.

The degree of cleanliness after blasting, as defined by relevant ISO standard, shall be:

degree Sa 2 for red-lead primer etc.;

degree Sa 2½ for zinc-epoxy and zinc-polyurethane coatings;

degree Sa 3 for metallized coatings.

After cleaning, all free surface slag and scale shall be chipped off, the rough surfaces shall be abraded, and then the components shall once again be thoroughly cleaned.

Cast-iron components shall be thoroughly de-rusted and blast-cleaned until bright.

B) Metallizing and hot dip galvanizing

In cases where stainless steel is not chosen, and where technically and structurally possible, steel components shall be hot dip galvanized.

If hot dip galvanizing is not possible, steel components shall be blast-cleaned and subsequently metallized or metal sprayed for the purpose of the ensuing preservation.

Components may only be galvanized once they have been fully finished.

If a paint system is to be applied to a galvanized component, all zinc drainage spikes and flux residues shall be removed from the zinc coating and the surfaces shall then be dried, cleaned and allowed to cool. The first coat of paint should be applied on the same day as galvanization: however, if that proves to be impossible, large components shall be lightly blast-cleaned and small components shall be painted with etch primer; thereafter, all components must be thoroughly rinsed and dried before being painted. The light blast cleaning should be performed with an inert medium, from a distance of approx. 2 m and with a spraying pressure of 1.5 to 3.0 bar.

The zinc coating to be applied by metallization must be homogeneous and uniform in thickness, with a coating mass of at least 350 g/m^2 (=50 microns).

The first coat of paint shall be applied to metallized steel components immediately after they have been thoroughly dusted down subsequent to metallization, and no later than on the same day as metallization.

C) Surface coating

For:

Surfaces continuously or frequently in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

C1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Coat-tar based epoxy coating, 2 coats (250 microns) Total coating thickness: 300 microns

On surfaces that are exposed to abrasion, for example by impinging fluid flows, an additional coat of coal tar based epoxy (100 microns) shall be applied.

Total coating thickness: 400 microns

C2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating, 2 coats (300 microns) Total coating thickness: 380 microns

On surfaces that are exposed to abrasion, for example by impinging fluid flows, an additional coat of coal tar based epoxy (100 microns) shall be applied.

Total coating thickness: 480 microns

C3) Cast-iron

Coal tar based epoxy coating 2 coats (250 microns)

On surfaces that are exposed to abrasion, for example by impinging fluid flows, an additional coat of coal tar based epoxy (100 microns) shall be applied.

Total coating thickness: 350 microns

In departure from the systems prescribed in clause C.3, small submersible pumps, cast- iron pipe work and fittings, of nominal diameter less than 250 mm, may be internally and externally coated with hot asphalt.

D) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

Surfaces seldom or

Outdoor installation

D1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating (200 microns)

Total coating thickness: 250 microns

D2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating, 2 coats (250 microns) Total coating thickness: 330 microns

D3) Cast-iron

Coal tar based epoxy coating (200 microns)

E) Surface coating

For:

Surfaces seldom or never in contact with lechate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

Outdoor installation

E1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (60 microns)

Finish polyurethane-based lacquer coating (50 microns) Total coating thickness: 160 microns

E2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (75 microns)

Finish polyurethane-based lacquer coating (50 microns)

Total coating thickness: 205 microns

E3) Cast-iron

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (75 microns)

Finish polyurethane-based lacquer (50 microns) Total coating thickness: 175 microns

F) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

Inside buildings, humid/corrosive atmosphere

F1) Hot Dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Finish epoxy coating (110 microns)

Total coating thickness: 160 microns

F2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (75 microns) Finish epoxy coating (100 microns)

Total coating thickness: 205 microns

F3) Cast-iron

Micaceous iron oxide coating (40 microns) Finish epoxy coating (100 microns)

Total coating thickness: 140 microns

G) Surface coating

For:

Surfaces continuously or frequently in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

High salt content

Colour: black

G1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating, 3 coats (375 microns) Total coating thickness: 425 microns

On surfaces that are exposed to abrasion, for example by impinging fluid flow, an additional coat of coal tar based epoxy (100 microns) shall be applied. Total coating thickness: 525 microns

G2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating, 3 coats (375 microns) Total coating thickness: 455 microns

On surfaces that are exposed to abrasion, for example by impinging fluid flows, an additional coat of coal tar based epoxy (100 microns) shall be applied

Total coating thickness: 555 microns

G3) Cast-iron

Coal tar based epoxy coating, 2 coats (250 microns)

On surface that is exposed to abrasion, for example by impinging fluid flows, an additional coat of coal tar based epoxy (100 microns) shall be applied.

Total coating thickness: 350 microns

In departure from the systems prescribed in clause G.3; small submersible pumps, cast- iron pipe work and fittings, of nominal diameter less than 250 mm, may be internally and externally coated with hot asphalt.

H) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

High salt content in air

Outdoor installation, corrosive atmosphere

H1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Coal tar based epoxy coating, 2 coats (300 microns) Total coating thickness: 350 microns

H2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (70 microns) Coal tar based epoxy coating, 2 coats (300 microns) Total coating thickness: 400 microns

H3) Cast-iron

Coal tar based epoxy coating (200 microns)

I) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

High salt content in outdoor air

Inside buildings, corrosive and often humid atmosphere

I1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (50 microns)

Finish epoxy coating (85 microns) Total coating thickness: 185 microns

I2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (70 microns)

Finish epoxy coating (85 microns) Total coating thickness: 235 microns

I3) Cast-iron

Micaceous iron oxide epoxy coating (40 microns) Finish epoxy coating (105 microns)

Total coating thickness: 145 microns

J) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Epoxy-based paints

High salt content in outdoor air

Outdoor installation, corrosive atmosphere

J1) Hot dip galvanized or metallized steel

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (75 microns)

Finish polyurethane-based lacquer, coating (60 microns) Total coating thickness: 185 microns

J2) Non-galvanized steel

Zinc epoxy coating (30 microns)

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (75 microns)

Finish polyurethane-based lacquer (80 microns) Total coating thickness: 235 microns

J3) Cast-iron

Micaceous iron oxide epoxy coating (50 microns) Primer epoxy lacquer coating (75 microns)

Finish polyurethane-based lacquer (80 microns) Total coating thickness: 205 microns

K) Surface coating

For:

Steel switchboard/panels/desks;

Indoor installation

K1) General

Before preservation of components begins they must be finished in all other respects; once preserved, no further working of components may take place.

The preservation processes shall be executed in a covered space, prior to the despatch of components to the site of their installation. The temperature, relative humidity and drying times, as prescribed by the paint supplier, shall be strictly maintained during preservation.

Paint spraying is permissible, provided it is performed with high pressure apparatus in an enclosed space.

No two coats of paint may be applied in the same colour. The paintwork must be free of drips, runs and blisters.

Any areas of damaged paintwork, once discovered, shall be de-rusted and directly thereafter retouched with the same paint as present on the surrounding surfaces.

K2) Preliminary treatment

The components shall be thoroughly cleaned and degreased.

K3) Preservation treatment

Alkyd-based primer

Finish surfaces straight and flat with filler

Abrasive rubdown

Finish alkyd-based lacquer

Abrasive rubdown

Finish alkyd-based lacquer

K4) Fasteners

All bolts, nut, washers etc. shall be supplied in hot dip galvanized steel or stainless steel EN1.4301.

L) Surface coating

For:

Steel switch/equipment boxes

Outdoor installation

L1) General

Before preservation of components begins they must be finished in all other respects; once preserved, no further working of components may take place.

The preservation processes shall be executed in a covered space, prior to the dispatch of components to the site of their installation. The temperature, relative humidity and drying times, as prescribed by the paint supplier, shall be strictly maintained during preservation.

Paint spraying is permissibly, provided it is performed with high pressure apparatus in an enclosed space.

No two coats of paint may be applied in the same colour. The paintwork must be free of drips, runs and blisters.

Any areas of damaged paintwork, once discovered, shall be derusted and directly thereafter retouched with the same paint as present on the surrounding surfaces.

L2) Preliminary treatment

As an initial treatment, degreasing and steel shot-blasting processes shall clean all components.

Shot-blasting should be carried out with steel shot of maximum grain diameter 0.7 mm, or a mixture of similarly sized steel shot and chopped steel wire in equal proportions, or an inert medium.

The required degree of cleanliness after blasting, as defined by relevant ISO standard.

degree Sa 2½ for zinc-dust compound painting;

degree Sa 3 for metallization.

After cleaning, zinc coating shall be applied by means of metallization or painting with a zinc-dust compound paint.

The zinc coating to be applied by metallization must be homogeneous and uniform in thickness, with a coating mass of at least 350 g/m^2 (= 50 microns).

The zinc-dust compound paint to be employed shall be epoxy-based, with a coating thickness of 25-30 microns.

L3) Preservation treatment

L3.1) Epoxy-based coating

Micaceous iron oxide epoxy-based coating (50 microns) Primer epoxy-based lacquer (70 microns)

Finish polyurethane-based lacquer (40 microns)

L3.2) Polyurethane-based coating

On metallized steel:

Micaceous iron oxide epoxy-based coating (60 microns) Primer epoxy-based lacquer (60 microns)

Finish polyurethane-based lacquer (50 microns)

On zinc-dust compound painted steel: Primer epoxy-based lacquer (75 microns)

Finish polyurethane-based lacquer (60 microns)

L4) Fasteners

All bolts, nuts, washers etc. up to size M16 shall be supplied in EN1.4301 stainless steel. All bolts nuts, washer's etc. bigger than M16 shall be supplied in either EN1.4301 stainless steel or hot-dip galvanized steel.

M) Surface coating

For:

Steel support/attachment structures;

Cable sleeves

M1) General

Before preservation of components begins they must be finished in all other respects; once preserved, no further working of components may take place.

The preservation processes shall be executed in a covered space, prior to the dispatch of components to the site of their installation. The temperature, relative humidity and drying times, as prescribed by the paint supplier, shall be strictly maintained during preservation.

Paint spraying is permissible, provided it is performed with high-pressure apparatus in an enclosed space.

No two coats of paint may be applied in the same colour. The paintwork must be free of drips, runs and blisters.

Any areas of damaged paintwork, once discovered, shall be de-rusted and directly thereafter retouched with the same paint as present on the surrounding surfaces.

M2) Galvanization

All steel components that are not of stainless steel shall be hot dip galvanized.

After galvanization, all sharp discontinuities in the zinc coating - such as zinc drainage spikes and flux residues - shall be removed.

Before paint coatings are applied, the surface shall be lightly blast-cleaned with an inert medium or painted with etch primer, and then thoroughly rinsed and allowed to dry.

If the type of paint to be employed is suitable for immediate application to galvanized surfaces, then - in departure from clause 2 - the primer coating shall be applied as soon as the component has cooled down to a temperature of approx. 50°C

M3) Preservation of components for dry, non-corrosive atmosphere

M3.1) Epoxy-based coating

Micaceous iron oxide epoxy-based coating (60 microns) Finish polyurethane -based lacquer (60 microns)

M3.2) Polyurethane-based coating

Primer epoxy lacquer coating (75 microns)

Finish polyurethane -based lacquer (40 microns)

M4) Preservation of components for outdoors and humid atmosphere

M4.1) Epoxy-based coating

Micaceous iron oxide epoxy-based coating (50 microns) Primer epoxy-based lacquer (70 microns)

Finish polyurethane-based lacquer (40 microns)

M4.2) Polyurethane-based coating

Primer epoxy-based lacquer (75 microns)

Finish polyurethane-based lacquer (40 microns)

M5) Preservation of components not finished in colour

High build bitumen coating (75 microns)

M6) Fasteners

All bolts, nuts, washer's etc. not greater than size M16 shall be supplied in EN1.4301 stainless steel.

All bolts nuts, washer's etc. greater than size M16 shall be supplied in either EN1.4301 stainless steel or hot dip galvanized steel.

N) Surface coating

For:

Surfaces seldom or never in contact with leachate, effluent, and/or the ground

Steel and cast-iron parts

Alkyd-based paints

Inside buildings; dry, non-corrosive atmosphere

N1) Non galvanized steel

Alkyd-based zinc phosphate primer, 2 coats (35 microns) Finish alkyd-based lacquer, 2 coats (35 microns)

Total coating thickness: 140 microns

N2) Cast-iron

Primer alkyd-based lacquer (35 microns)

Finish alkyd-based lacquer, 2 coats (70 microns) Total coating thickness: 105 microns

Lubrication

In case of grease lubricated roller type bearing for electric motors lithium base grease is preferred.

Where lubrication is effected by means of grease, preference shall be given to a pressure system, which does not require adjustment or recharging more than once weekly.

For accessibility grease nipples shall be placed at the end of extension piping, and when a number of such points can be grouped the nipples shall be brought to a conveniently mounted battery plate. "Hydraulic" Button head nipples in accordance with ISO standards shall be used for normal grease. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.

Oil filling/emptying plugs shall be situated so that maintenance can be done from ground level or gangway.

The Contractor shall supply permanently labeled grease guns for each type of nipple and type of grease provided.

Oil containers shall be supplied complete with oil level indicators of the sight glass type, or, where these are not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The normal maximum and minimum levels shall be clearly visible in sight glass type indicator from the normal access floor to the particular item of plant, and the indicators shall be easily dismantled for cleaning.

The Contractor shall supply flushing oil for each lubrication system when an item of plant is ready, together with sufficient quantity of the approved lubricants for the commercial operation of the plant.

Silicon based shall not be used in areas where gas detection is installed.

Oil Systems

Areas where an oil leak can occur shall be provided with leak collection.

If the oil can ignite, protection by an appropriate extinguishing / mitigation system shall be installed.

Erection

Protection and Packing for Dispatch

Before dispatch from the manufacturer all equipment shall be adequately protected by painting or by other approved means for the whole period of transit, storage and erection, against corrosion and accidental damage.

The flanges of pipes, valves and fittings shall be protected. Pipe openings shall be covered during installation and storage.

The sleeves and flanges of flexible couplings shall be secured.

Erection of Pipes and Valves

Care shall be taken during the erection of pipe work and valves that no loads of any description are transmitted through the pump flanges or parts of any other equipment.

The Contractor shall use end caps or plugs to prevent the entrance of dirt, water and other foreign matter into pipes, valves or fittings. Plates, plugs or caps may not be attached to the pipes by means of welding or any other method, which will damage the pipe ends. The caps or plugs shall be installed after finishing daily work or whenever work is interrupted for other than very short duration.

Joints shall be made strictly in accordance with the manufacturer instructions. The Contractor shall make use of the technical advisory services offered by manufacturers for instructing pipe jointers in the method of assembling joints. Where manufacturers recommend the use of special jointing the Contractor shall use these for the assembly of all joints to pipes.

Before making any joints all jointing surfaces shall be thoroughly cleaned, dried and maintained in such condition until the joints have been completely made or assembled, using joint lubricant if recommended by the pipe manufacturer.

Notwithstanding the flexibility provided in the pipe joints, pipes must be securely positioned to prevent avoidable moments during and after making the joint.

The space between the end of the spigot and the shoulder of the socket of flexibly jointed pipes shall be as recommended by the manufacturer. All pipes of 600 mm diameter or less shall be accurately marked prior to assembly ensuring that the correct gap is left in the joint. Deflection at joints shall not exceed 50 % of manufacturer's recommend maximum. Synthetic material pipes with continuous joints may be jointed on the trench top prior to lying in the trench.

The flanges or flanged joints shall be correctly positioned and the component parts including any insertion ring cleaned and dried. Insertion rings shall be fitted smoothly to the flange without folds or wrinkles. The faces and boltholes shall be brought fairly together and the joints shall be made gradually and evenly tightening bolts in diametrically opposed positions. Only standard length spanners shall be used to tighten the bolts. The protective coating, if any, of the flange shall be made right when the joint is completed.

When installing piped services the following clearances shall be provided:

Walls 100mm

Ceilings 100mm

Floors 150mm

Adjacent 50mm

Cables and conduits 150mm

No joint of any type shall be made in the thickness of walls, solid floors etc. of any other position where access for maintenance is difficult.

Pumping Equipment

General

All pumps shall be equipped with motors with sufficient power rating to operate the pump throughout the whole operating range of the pump. The manufacturer shall have Certificate of ISO 9001:2008 and ISO 14001:2004.

Pumps shall have CE marking of conformity to European Directives.

Warranty period of pump units must be not less than 24 months from the date of commissioning.

The offered pump equipment and engine shall be standard (there should not be an individual manufacturing of each pump unit).

The operating point of the pump shall be in an operating interval with maximum efficiency.

Pumps for leachate treatment

General

Pumps and motors should be centered in the satin-steel sleeve and both sleeve ends could be connected to the piping be means of Victaulic couplings and shall be suitable for continuous running under wholly or partially submerged conditions. They shall be specifically designed to handle leachate. The pump shall be complete with integral stainless steel strainer.

Casing

The casing shall be fine-grained cast iron free from blowholes or imperfections, of ample proportions throughout, with all internal passages finished smooth.

Impeller

The impeller shall be single or statically and dynamical balanced, with internal passages finished smooth. Back vanes shall be provided on the discharge side shroud to minimize the ingress of abrasive matter to the shaft seal. The impeller, manufactured of stainless steel 1.4401 or 1.4539 or better, shall be keyed to the shaft and secured by locking screws.

Shaft

The shaft shall be designed with ample stiffness and be manufactured from stainless steel EN 1.4462 or better.

Drive

Integrally coupled squirrel cage induction motors shall drive the pumps suitable for 3 x 400 V-50 Hz. The motor shall have a CI stator housing and where applicable comply with the Specification for induction motors. Stator windings shall be insulated to Class "B" and shall incorporate protection against moisture and overheating. Pumps should be energy-optimised and comply with the EuP Directive (Commissioning Regulation (EC) No 547/2012) and should meet Minimum Efficiency Index (MEI) according to EU regulations.

Sound pressure level

The sound pressure level of the pumps should be below 90 dB (A).

Automatic and control devices

To protect the pumps against dry running and to ensure a minimum flow of cooling water past the motors, the system must be fitted with flow and pressure control devices. All discharged connections to the system should be fitted with flow switches which will stop the system at the set minimum flows. The pumps should be equipped by the sensors which will control next parameters: flow, starting frequency, control and protective devices, liquid temperature, minimum flow through modules during operation.

Service Water Pumps

Pumps for heating, hot and cold water shall be directly drive, close coupled, end suction type.

The casing, pedestal and base plate shall be constructed from cast iron. The impeller shall be constructed from high-grade gunmetal or cast iron, accurately balanced and shall run in renewable phosphor bronze sealing rings. Shafts shall be of EN 1.4021 stainless steel or better.

Bearings shall be heavy type ball bearing externally sealed for life with an additional phosphor bronze sleeve bearing internally or heavy-duty ball and roller bearings.

Couplings shall be of the flexible type and all pumps shall be complete with mechanical seals.

Valves

General

All similar types of valves shall be supplied from the same manufacturer.

Control shall be possible to do from above floor or catwalk. Valve located underneath floor structure shall be provided with lengthened spindle. Valve key shall be included.

Valves shall comply with EN standards.

Gate Valves

Gate valves shall be double flanged wedge gate type supplied by an approved manufacturer with non-rising spindles conforming generally to EN standards with gunmetal or synthetic rubber covered seals. They shall have cast iron bodies and wedges to EN 1561 with spindles, spindle nuts and facings on the wedge and body of solid forged bronze or synthetic rubber.

Valves shall be arranged for clockwise closing by cast iron hand wheel on which the direction of closing shall be indicated, valves shall also be provided with a suitable drain plug, and shall have flanges faced and drilled PN10. Overhead valves shall be provided with chain wheels to enable the valves to be operated from the working level.

Mains isolating valves sited within external valve chambers shall be flange coupled to the rising main in order to retain the static healing within the main. Valves of 500 mm diameter and greater installed in horizontal pipe runs shall be provided with their own supports and shall not be supported by the pipe work.

Butterfly Valves

Each valve disc shall rotate through an angle of 90 degrees from the fully opened to the fully closed position. When the disc is in the closed position, a plan through the axis of the valve shaft and through the seating surfaces shall be normal to the axis of the pipe. The axis of rotation of valve disc shall be horizontal.

The operating mechanism shall be attached to the valve body and shall comply with EN 593. Each operating mechanism shall be removable for inspection and repair. Provision shall be made of locking the disc in the fully opened or tightly shut position when the operating mechanism is removed.

All butterfly valves up to shall be suitable for manual operation unless otherwise mentioned.

Each valve shall be provided with a hand wheel, and, if, larger than 200mm diameter, also a gearbox.

The valve bodies and flanges shall be of cast iron, EN 1561 or ductile iron.

Valves of 400mm diameter or larger shall be double flanged to EN 1092-1. Valve smaller than 400mm diameter may be clamped between pipe flanges.

Butterfly valves shall not contain any brasses containing more than 5 % zinc.

Gunmetal complying with EN 1982, aluminum bronze or nickel components may be used for internal components.

Mechanical indication of disc position shall be standard on the operation equipment (handwheel or any actuator). When operation of valve by hand lever, lever shall be in line with disc position.

Membrane Valves

Membrane valves shall be of the full-bore type with a minimum diameter of 25 mm. The valve bodies and flanges shall be of cast iron EN 1561 conforming to the specifications for grey iron for valves, flanges and pipefittings or ductile iron and shall be double flanged to EN 1092-1 (alternative execution: plastic). The valve membrane shall be made of material according to handled media.

Pressure Reducing Valves

Valves shall be capable of maintaining a constant downstream pressure from a higher constant or variable upstream pressure and they shall be drops tight under no flow conditions.

The valve operation shall be achieved by the interaction of the inlet pressure, outlet pressure and an intermediate pressure produced by a pilot valve or relay system acting on the upper side of the main valve.

The pilot valve or relay system shall be actuated by a diaphragm connected to the outlet pressure on its underside and a constant pressure on its upper side derived either from weights or from a spring. Nominal pressure will be PN 16. Body ends shall be flanged and drilled to EN 1092-1.

The materials for the valves shall be as follows:

Cast iron bodies and covers. Internal valve, gunmetal with bronze liner, cups and facing rings in leather. Relay valve, bronze with stainless steel spindle and nylon valve face. Diaphragm reinforced synthetic rubber. Loading spring, if employed, spring-steel. Cylinder and weights, if employed - cast iron. Lever, steel with gunmetal pins and links. Connecting pipe work to cylinder - copper. Cylinder, mild steel epoxy lined with internal working parts gunmetal bushed.

Check Valves

These shall be of the reflux type manufactured to EN standards and shall be fitted with an external operating lever and weight to assist in the closing of the valve. Where necessary, soft closing devices shall be fitted.

The body shall be manufactured from cast iron to EN 1561 and shall have gunmetal seating provided on both the flap and body. The spindle shall be manufactured from stainless steel Enr 1.4301, be carried on bronze bearings and be sealed by means of packed gland.

Air Valves

Airlines shall be provided at all high points in pipe work to vent air during Air pipeline filling and for release of gases, which may collect during normal operation. Single small orifice, large orifice, or double air valves shall be provided as appropriate. Pressure ratings shall be appropriate to the maximum test pressure on the main.

Valve bodies cores and cowls shall be of meehanite cast iron to EN 1561. The floats, float guides, levers and seat rings shall be manufactured from ABS plastic, nylon or other synthetic materials. Orifices shall be stainless steel or a synthetic material. The sealing faces shall be in EPDM rubber. Unless otherwise stated valves shall be supplied complete with isolating butterfly or sluice valves.

Double Acting Air Valves

These shall combine both large and small orifices within one valve. The large orifice shall be sealed with a buoyant rigid ball and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. The small orifice shall be sealed with a buoyant ball at all pressures above atmospheric except when air accumulates in the valve chamber.

Single Air Valves

These include a small orifice only, operating in a manner identical with the small orifice in a double acting valve.

Actuators

Two different types of actuators are required:

Actuator for open / close duty: It has two defined position (OPEN and CLOSE).

Actuator for modulating duty: The position of the valve can be adjusted by the control by means of an analogue signal.

Each actuator shall be fully weatherproof (IP67) and fitted with anti-condensation heater. All local controls shall be protected by a lockable cover.

Power supply shall be 400/230 V AC.

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required.

The gearbox shall be oil or grease filled, and capable of installation in any position. Alternative local by hand operation shall be possible, and the hand wheel together with a suitable reduction gearbox if necessary, shall be of adequate dimensions for easy operation. The motor drive shall be automatically disengaged when under manual operation. Hand wheels shall be rotated clockwise to close the valves, and shall be clearly marked with the words “OPEN” and “CLOSE” and arrows in the appropriate directions. The rims of handwheels shall have a smooth finish.

All operating spindles, gears and headstocks shall be provided with adequate points for lubrication.

Local control:

Actuators shall have facilities for local control:

Selector for local-off-remote.

Control for operation of the actuator. Electrical interface:

Power supply 400 or 230 V AC.

Digital input signals (on/off duty type actuator): open, close

Digital output signals: open, close, fault, remote

Analogue input signals (modulating duty type actuator): position set points

Analogue output signals (modulating duty type actuator): position feed back

Process Instrumentation

General

Power supply to transmitters shall be 230V AC and 50Hz. Analogue output signal shall be 4-20mA. Instruments shall mainly be supplied with 24V DC with 4-20mA output signal.

All instruments and transmitters shall be equipped with a local display for visual reading. All displays shall be mounted for easy reading. In cases where the instrument or transmitter lacks a display or in cases where the display on the transmitter is mounted in a way so that it is difficult to read, in these cases an external local display shall be installed. External display shall be of the two-thread type for 4-20mA.

Switches shall have potential-free make-and-break contacts. Measuring gauges in contact with liquids shall be from stainless steel.

Level Meters

Level meters shall have an accuracy of less than or equal to 0.3%.

Pressure Meters

Pressure meters and differential pressure meters shall have an accuracy of less than or equal to 0.5%.

Flow Meters

Flow meters for leachate and effluent shall be electromagnetic flow meters. Flow meter sensors shall be flanged and with enclosure rating minimum IP67. Flow meters shall have an accuracy of less than or equal to 0.3%. Flow meters shall have backflow indication, meters shall be equipped with a potential-free relay for indication of flow direction.

Flow meters for gas shall be of the thermal gas mass flow meter or venturi meter type.

Level Switches

Level limit switches shall measure by means of contact electrodes, vibration level switches or float switches. The signal shall be a universal current 24 VDC or 230 VAC with a potential-free change over contact.

All housing shall be plastic housing and shall have IP 65 protection degree. It shall be a switching 2-pol contact for electrical connection to 230 VAC or 24 VDC.

Contact electrodes

The electrodes must be fabricated from stainless steel and the face from gold, and shall be insulated except for the last 50 mm of the electrode tip.

The electrodes must be held in position with a stainless steel bracket with a facility for adjustment of electrode height.

The electrode voltage must be an alternating supply from 230 VAC or 24 VDC.

Vibration level switches

The vibrating fork and socket shall be of stainless steel and without movement parts and shall be free of wear and maintenance.

The sensor shall not be connected to a supply of voltage from 230 VAC or 24 VDC.

Float switches

The construction of their suspension structures shall facilitate the simple height adjustment of the float switches. The positions of the float switches shall be allocated in such a way that there is no possibility of the float being trapped or caught by other moving parts.

The float switches shall not be connected to a supply of voltage from 230 VAC or 24 VDC.

Ancillary Mechanical Equipment

Gear Reduction Units

Units shall utilize level and helical gears (worm gearing shall not be acceptable) and be designed to EN standards, or other approved standard.

Each reduction unit shall be designed to withstand all internal loading developed at the full load power of the motor (including motor starting torque up to 250 % motor running torque), and the reverse torque produced upon stopping the prime mover together with any external loading produced by thrust, unbalance and vibration resulting from operating conditions.

Gears, pinions and shafting shall be made out of wrought and alloy steels. The gear teeth shall be through hardened, contour induction hardened or carbonized. All gears shall be manufactured to EN standards.

Housings shall be constructed of high-test grey cast iron to EN 1561 or fabricated mild steel and shall have adequate strength and rigidity to withstand all loads imposed by the operation of the equipment. Lifting lugs shall be provided.

All bearings incorporated in the gear reduction units shall be of the anti- friction type having a life expectancy of 100,000 hours based on the relevant EN standard.

Foundations and Embedment in Concrete

Parts to be embedded in Concrete

Surface of steel and cast iron parts, which are permanently in contact with concrete, being embedded in concrete, are not coated. These surfaces shall be thoroughly cleaned and degreased. There is no objection to hot dip-galvanized coating on these surfaces. Plastic parts shall be provided with glue and sand.

Foundations

Surface pump units, etc. shall be placed on the floor, but should always have a raised footing (support), which will distribute the weight more evenly and avoid damage. Height of footings shall be minimum 100 mm above surrounding floor. The footing should be made of reinforced concrete and should form one part with the floor. Reinforcing should be at least 10 mm and the pitch 150 mm. After installing, the steel foundation/base plate of the units have to be grouted, thickness 15-30 mm.

The design of the base-plates shall be such that:

the stability of the equipment is guaranteed

vibrations do not occur

the units easily can be dismantled without removing the base-plates

Threaded fasteners:

material: hot dip galvanized steel or stainless steel

anchor-bolts shall be placed in the concrete structure

For the purpose of leveling the machine, no use shall be made of the anchor bolts; only set bolts shall be used

for grouting only a resin based mortar shall be used; the use of cement mortar is not allowable. The grouting of the base-plates are included in this contract

after the grout has cured the set-bolts shall be removed and the anchor-bolt shall be tightened

Test and Inspection

General

The Contractor shall be responsible for all arrangements in connection with the testing and inspection of all equipment before the commissioning test and shall give Employer at least 7 days notice of the date when it is proposed to carry out any inspection or site tests. Full details of equipment to be tested and the proposed test procedures shall be given to Employer not later than the notification of the test date. The Contractor shall be responsible for the supply of all water, power and materials required for carrying out the tests.

In the event of any part of the equipment failing to meet the Specification, the Contractor shall immediately take steps to substitute other equipment capable for complying with the Specification.

The results of each works and site test shall be noted on appropriate test certificate, which shall be signed by the senior representative of the Contractor responsible for conducting the test. A report on the tests together with subsequent calculation, curves etc. shall be sent to Employer within 14 days after the tests.

All tests made by the Contractor shall be at the risk and expense of the Contractor.

Inspection

Inspection shall be carried out according to a schedule provided by the Contractor and shall be attended by Employer or its representative upon request.

The installed pipe works and equipment shall be erected according to approved installation drawings and manufacturer recommendation.

The Contractor shall present the guaranteed figures of output, kilowatt input, overall efficiency, capacity, etc., given in the Specifications and the Schedules to Employer.

He shall also satisfy Employer as to the mechanical reliability of the Plant and its ability to fulfill the whole of requirements.

The Contractor shall satisfy Employer as to the accuracy of all test instruments and shall produce recent calibration tests or have them calibrated at his own expense by an independent authority.

The purpose of inspection is to have installation complete before commissioning tests.

Hydraulic Pressure Tests

All castings, valves, pipe work and any other part of the equipment liable to be subjected to pressure shall be hydraulically works tested to the requirements of the relevant standard. Valves shall be tested to ensure they are drop tight.

Pipe work shall be tested according to ISO standard for pressure test before installation of pumps or other relevant equipment included in pipe system to avoid damage if necessary to re-erect pipe work tested.

Factory Test

Equipment for factory test shall be tested at the manufacturer's works. Upon request tests shall be under supervision by Employer or its representative.

The Contractor shall provide test certificates of tests that they have been satisfactorily carried out. Employer and/or its representatives shall be pre-notified three weeks before factory test to be able to visit the test.

The tests include:

visual inspection

measurements

capacities

welding

coating

numbers of delivery

noise

vibrations

current

Pump Testing

All pumps shall be tested after installation as follows:

Complete with all shaft bearings, thrust bearings and directly driven auxiliaries or, where this is impracticable, the Contractor shall state what allowances shall be made for losses incurred by these items, and shall demonstrate the accuracy of these allowances to the satisfaction of Employer.

The pumps shall be tested in the factory of origin; test certificates have to be handed over to Employer. The pumps shall be tested according to ISO 9906.

The pumps shall be tested under the following conditions:

a) The pumps shall be driven by their own electric driven motor.

b) During testing also the power absorbed by the motor shall be measured.

c) Each required set of observations should at least have observations of four duty points of each pump. These 4 points are:

nominal capacity;

maximum allowable load capacity;

minimum allowable load capacity;

zero capacity.

d) In the event that pumps have to operate in duty-points where the available NPSH is less than 3 mwc more than the required NPSH, the required NPSH curve shall be tested in several extra duty-points.

Motor Testing

All motors shall be type-tested in accordance with the relevant parts of IEC standards

For motors rated above 50 kW copies of the type-test certificates shall be submitted for approval within six weeks of starting the Contract and before ordering, and the routine test certificate in respect of every such motor shall be submitted before delivery to site. Facilities shall be made available for Employer if required to witness routine tests.

Copies of type-test certificates of motors below 50 kW shall be submitted.

Electrical & Automation Specifications

General

These Requirements specification on electrical and automation works are to be understood as minimum requirements.

Standards

The latest edition/issue with amendments of:

1) Ukrainian Standard,
2) EN, European Norm,
3) HD, Harmonization Document (issued by CENELEC, European Committee for Electrotechnical Standardization),
4) IEC, International Electrotechnical Commission,
5) IEEE, Institute of Electrical and Electronics Engineers.

Existing Power Transformation and Distribution System

The Electrical substation (TP) is located at a distance of 2.2 m from the road, close to production / administrative buildings; at the entrance to the landfill.

System frequency

The system frequency for all AC-voltages is 50 Hz.

Voltages

Medium Voltage (AC)

3-phase, 6 kV, neutral point impedance earthed.

Low Voltage (AC)

3-phase 380 V / 1-phase 220 V, TN-S, neutral point directly earthed.

Electrical System Characteristics for New Systems

Short-Circuit Rating

The systems shall be dimensioned to withstand the prospective short-circuit current for the duration of the fault. Switching devices which are part of protective circuits, or which make an active part in the selectivity plan, shall remain fully operational after making and breaking any over-current up to and including the prospective short-circuit current. The short-circuit rating shall be the same for all equipment of the same voltage level within the Power transformation and distribution system.

System Frequency, Voltage Characteristics and Voltages

System frequency for all AC voltages: 50 Hz.

Voltage characteristics

At the connection points to the existing power transformation and distribution system, the voltage change caused by a load change within the new transformation and distribution system must not exceed 3 %.

Within the new transformation and distribution system, the voltage drop measured at the switchgear's busbar must not exceed 2 % from the voltage at the connection point when the cables are loaded with the system's design load including the installed spare capacity.

Voltages

Low Voltage (AC)

The same voltage levels and neutral point arrangement as those used in the existing system shall be used.

Control Circuits (AC)

1-phase 220 V, neutral point directly earthed.

Signal Circuits

1-phase 220 V AC, neutral point directly earthed,

24 V DC, negative pole directly earthed.

Rooms

Rooms for Switchgear and Control Gear Assemblies and Cables

These requirements apply for new rooms.

Requirements Related to Building Design

General

The rooms shall be located indoors. The rooms shall be horizontally divided into an equipment compartment and a cable compartment under the equipment compartment.

Dimensioning of the rooms and placing of doors and other passages must not be done until the configuration and space requirements of the systems that are going to be installed in the rooms are known.

The rooms shall be located in such a way that they are easily accessible. Frameworks and other supporting structures shall be made of fire-resistant material.

Separating walls, paneling and enclosures shall be made of fire-retardant material and resist fire for 60 minutes.

Rooms shall be separate fire cells. Cable compartments, except for those that are made with raised floors, shall be separate fire cells.

The rooms shall be designed and placed in such a way that penetration of water and the like is prevented and condensation is minimised. They shall be placed above the adjacent ground and floor levels.

Materials which are used for walls, roof/ceiling and floors shall withstand water penetration and leaks.

Walls, ceilings and floors shall have surfaces that do not peel off. Dust emitting surfaces shall be treated with dust-laying agent.

The mechanical loads and eventual changes in the pressure that may occur in case of arcing shall be considered in the design.

Systems, equipment, pipes etc which are not part of any electrical system must not be located to these structures.

On the outside of doors there shall be an area, 2 x 1.5 m, to allow for taking care of lying injured persons. The area shall be level with the floor of the compartment to which it provides access. Further evacuation from this area without having to re-enter the room shall be possible.

Doors

Doors shall be equipped with a locking device that requires a key to unlock it from the outside.

Doors shall open outwards from the room.

Doors shall be made of fire-retardant material and resist fire for 60 minutes.

Doors shall be equipped with an emergency opening bar, that, when operated, unlocks and opens the door. The emergency opening bar shall be installed in such a way that a person can easily operate it irrespective of whether he or she is standing up or lying on the floor. Doors must not have automatic closing devices.

Doors shall be at least 2 000 mm high and the free width shall be at least 750 mm. At least one door in each room, or more as necessary with respect to the placing of the equipment within the room, shall be enough wide and high to allow for in- and out transportation of the installed equipment.

Doors shall be sealed in such a way that entry of dust, small animals, rain, snow etc is prevented.

The bottom of the door shall be level with the floor of the compartment to which it provides access.

Walls

The structure shall have sufficient mechanical strength to withstand all static and dynamic loads that may arise during normal operational conditions.

The laying of pipes, ducts and cable laying systems must not affect the functionality of the walls.

Materials in outside paneling shall withstand the effects caused by the environment (rainfall, sunshine, corrosive atmosphere etc).

Windows

The rooms must not have any windows.

Roof/ceiling

Roof/ceiling shall be anchored to the walls in an efficient way.

Floors

Floors shall be level and stable and be able to carry the occurring static and dynamic loads. The surface shall be pressure resistant, easy to clean, abrasion-proof and not slippery.

Raised floors

Raised floors shall be level and stable and be able to carry the occurring static and dynamic loads. The floor-boards shall be pressure resistant, easy to clean, abrasion-proof and not slippery and be arranged in such a way that fire is prevented from spreading.

The framework shall be made from zinc-plated steel beams that are bolted together and the framework shall be standing by itself, that is, it shall not be depending on the floor-boards for stability.

Lifting tools for the floor-boards shall be provided for each room.

Heating, Cooling and Ventilation

The heating, cooling and ventilation system shall be dimensioned in such a way that the temperature in the room does not fall below + 5 °C and does not rise above + 40 °C. The 24 hour average temperature shall not exceed + 35 °C. The system shall be capable of keeping the humidity at such levels that condensation does not occur in the room.

The ventilation system shall treat the intake air in such a way that it is dry and clean from dust, particles and aggressive gases. The ventilation arrangements shall be made in such a way that the room is always put under a positive air-pressure.

The system shall be installed in such a way that it is possible to safely inspect and do maintenance on the system even when the switchgear etc is energized.

The openings shall be constructed in such a way that entry of dust, small animals, rain, snow etc is prevented.

Rooms for Switchgear and Control Gear Assemblies and Cables

The minimum depth for cable compartments is 0.8 m. Cable compartments that are not deeper than the minimum depth shall be constructed with raised floors. Cable compartments that are deeper may be constructed with raised floors or as a separate room (cable cellar). Cable compartment that are deeper than 1.2 m shall have separate access doors.

Decompression openings shall be dimensioned according to instructions from the manufacturer of the switchgear assembly. The openings shall be located in such a way that, when they come into operation (for instance in case of arcing), no person or property is exposed to danger or damage. The openings shall be constructed in such a way that entry of dust, insects, small animals, rain, snow etc is prevented.

Service Areas

Service areas are accessible areas, walkways and service walkways and emergency exit routes.

Walkways, service walkways and accessible areas shall be sufficiently dimensioned as to allow for maintenance works and manoeuvring, as well as in- and out transport, of the equipment.

Walkways, service walkways, accessible areas that are intended for maintenance purposes and emergency exit routes shall have a free height of at least 2000 mm.

Walkways shall be at minimum 800 mm wide.

Service walkways shall have the below given minimum widths for low voltage:

Switchgear or control gear assembly on one side only: 1 200 mm,

Switchgear or control gear assemblies on both sides: 1 500 mm.

Any protruding permanently installed gear: control handles, withdrawable circuit breakers that are in isolated position etc. must not reduce the width to less than 800 mm.

If access to the backside of switchgear or control gear assembly is required for any reason, the distance to the wall shall be minimum 500 mm.

Emergency exit routes must not be longer than 10 m. There shall always be at least 500 mm wide space in emergency exit routes, even in cases when detached parts or open doors have an influence on the emergency exit route, and the route shall allow for transportation of a person laying on a stretcher.

Information and Warning Signs

On the outside of doors, there shall be information and warning signs with shape and colours according to local regulations. On the inside of doors, and where needed to clearly be able to see the emergency exit route from any point in the room, there shall be fluorescent information signs indicating the emergency exit route.

Systems

Power Transformation and Distribution System

These requirements apply for new systems.

System

The main components of the system are: Switchgear and controlgear assemblies and cables.

The system shall be dimensioned to withstand the prospective short-circuit current for the duration of the fault. Switching devices which are part of protective circuits, or which make an active part in the selectivity plan, shall remain fully operational after making and breaking any over-current up to and including the prospective short-circuit current.

The system shall be designed taking into consideration that variations in the system voltage must not result in fault or failure in any connected load. Irrespective, however, of whether the requirements of the connected loads are lower, the system shall at minimum, meet the requirements of EN 50160, during normal operation of the plant.

The system shall be connected to the existing power transformation and distribution system at the delivery limit. The connection shall be by two of each other independent feeders (single fault tolerance) for each connection.

The system shall be dimensioned based on the assumption that power is available at only one of (either one of) the connection points. The availability of power at the other connection point, or the operational status of that connection point must not have any influence on (reduce) the system's capabilities to distribute any required power from any one of the connection points to the connected load.

The power transformation and distribution system, from the connection point down to and including the incoming circuit breakers in low voltage switchgear assemblies shall be single fault tolerant by means of installed stand-by equipment, busbars and cables to such an extent that the fault can be isolated and by-passed.

Low voltage switchgear assemblies shall be divided in two sections over a sectionalising circuit breaker, and have separate incoming circuit breaker for each section. In cases of process equipment with installed stand-by or redundancy, the duty equipment shall be connected to one section and the stand-by equipment shall be connected to the other section of the switchgear assembly. The two incoming circuit breakers and the sectionalising circuit breaker shall have 2oo3 (two out of three) configuration and shall be configured for automatic switching operation. An incoming circuit breaker shall open in case of power outage for the related feeder cable and, provided that the sectionalising circuit breaker is not closed, close when power returns for that feeder cable. The sectionalising circuit breaker shall be interlocked open when both the incoming circuit breakers are closed. The sectionalising circuit breaker shall close when only one of the incoming circuit breaker are closed and shall open in all other cases.

The system shall be designed in such a way, and the protective devices shall be coordinated in such a way, that selectivity exists between protective devices.

Parts of the system that are exposed to over-voltage shall be protected by over-voltage protection devices.

Auxiliary power supply system

The Auxiliary power supply system (UPS) shall supply power to the system. The voltage level shall be 230 V AC.

Communication with the Process Control System

The system and the associated auxiliary systems shall communicate their operational status and fault status to the Process Control System.

The below listed signals shall be communicated:

Busbars:

Busbar voltage level (signal type: analogue),

Incoming functional units:

Operational status (in operation, open, closed, fault, tripped) (signal types: digital),

Active power (signal type: analogue),

Reactive power (signal type: analogue),

Active energy (signal type: digital: pulse),

Reactive energy (signal type: digital: pulse),

Phase currents (separate for each phase) (signal type: analogue),

Voltage level (signal type: analogue),

Outgoing functional units, LV-level:

Motor starters: Please refer to the description for Motor drive systems,

Auxiliary systems: Operational status (for example: in operation, fault, tripped) (signal type: digital).

System Dimensioning with Respect to Installed Spare Capacity

The System shall, with respect to installed spare capacity, be dimensioned for an additional load of 30 % on top of the load that is installed at the respective switchgear assembly within this contract.

Switchgear and Controlgear Assemblies

The cubicles shall be aligned and installed in accordance with instructions from the manufacturer.

Lighting and Non-Process Power System

These requirements apply for outdoor areas for new plants and for new buildings and rooms.

Lighting

Lighting in accordance with EN 12464-1 shall be arranged indoors. Table 5.1-Traffic zones inside buildings, tables 5.2 through 5.5-General areas inside buildings and table 5.26-Offices apply generally, however, the specific table below specifies minimum requirements for specific areas.

Type of area, task or activity	**Em lx**	**UGRL**	**U0**	**Ra**
Control rooms (Specific requirements for DSE- work (Display Screen Equipment) apply. Please refer to section 4.9 of the standard.)	500	19	0,60	80
Rooms with process equipment	200	25	0,40	80

Rooms for electrical equipment	200	25	0,40	60
Workshops	300	25	0,60	80

Lighting in accordance with EN 12464-2 shall be arranged outdoors. Table 5.1-General circulation areas at outdoor work places, table 5.7 Industrial sites and storage areas, table 5.11-Power, electricity, gas and heat plants and table 5.15-Water treatment plants apply.

Emergency lighting

Lighting in accordance with EN 1838 shall be arranged. The system shall have built-in energy storage capacity so that can withstand power outage for period of 3 hours while maintaining full functionality.

Guide lighting in rooms for switchgear and control gear assemblies and cables

Guide lighting by portable battery operated hand lamps shall be installed nearby the doors, on the same side as the emergency opening bar and not higher than 0.5 m above floor level.

Lighting control

Control of the emergency lighting shall be automatic, based on the presence of electrical power.

Control of indoor lighting shall be manual, by switches.

Control of outdoors lighting according to table 5.1 of EN 12464-2 shall be by dusk to dawn sensor with the possibility to manually override the automatic function. Control of other outdoor lighting shall be manual, by switches.

Location of lighting switches

In rooms there shall be a lighting switch from which it is possible to switch on and switch off all lighting within the room next to each access door.

Lighting switch for control of outdoors lighting according to table 5.1 of EN 12464-2 shall be located at the respective distribution board. Lighting switches for control of other outdoors lighting shall be located adjacent to the area which they control, and so that they are easily accessible when approaching the area in question. Each area shall have its separate switch.

Non-Process Power

Location of power sockets

In rooms there shall be two single-phase sockets at each lighting switch.

In rooms where there is process equipment there shall be three-phase sockets to such an extent that the complete volume of the room can be reached with a 15 m long extension cord when the equipment is installed.

Outdoors there shall be two single-phase sockets at each lighting switch.

Motor Drive System

System

Electrical equipment of machinery shall with respect to safety meet the requirements of EN 60204-1.

A motor drive system shall be constructed either as a constant speed drive with Direct On-Line (DOL) motor starter or as a variable speed drive with frequency converter. In cases where there is safety related interlock, the switching device has to be chosen based on the required safety level. In such cases, there has also to be a switching device in the main circuit before the frequency converter.

A motor drive system shall be suitable for the driven object. Special attention shall be given to motor drive systems that include a frequency converter and the co-ordination of converter and machine (motor).

The protective function of the short-circuit protection shall be suitable for both the starting device (incl. frequency converters) and for the motor.

The motor current shall be measured for all variable speed drive systems as well as for constant speed drive systems with rated power of 18.5 kW or more.

A low voltage motor drive system shall have a safety switch in the main circuit. The auxiliary, early opening, contact shall be included in the control circuit of the switching device (or be directly connected to an input in the frequency converter in case of variable speed drive systems). The safety switch shall be placed: adjacent to the motor, off floor or ground level, where it is not exposed to flushing or water etc flows and where it is easily accessible without the need for ladders etc.

In case there is safety interlock, for example emergency stop, or pressure or temperature supervision, these shall be included in the control circuit of the switching device, and in cases of variable speed drive systems, also be connected to an input in the frequency converter.

Motors shall have heaters as specified in chapter "Rotating electrical machines" of this specification. For heaters there shall be a power circuit with a switching device and a control circuit. The control circuit shall switch off power to the heater when the system starts, and switches it on when the system stops.

Field cabling shall be object-oriented, with separate cables for each process object.

Motor drive system protection

Once activated, a protective device shall always require manual reset.

All motors shall have protection for short-circuit, overload and under voltage.

Motors which are rated 11-90 kW shall have protection for short-circuit, overload, under voltage and unbalance.

Motors which are rated 90-400 kW shall have protection for short-circuit, overload, under voltage, unbalance, and earth fault.

Variable speed motor drive systems shall in addition, irrespective of the motor rating, use the thermal protection that is built into the frequency converter.

Other monitoring and protection circuitry shall be included for motors as specified in chapter "Rotating electrical machines" of this specification.

Control modes

A motor drive system shall have two of each other independent control modes: Local and Remote. Local control means control using local controls and instruments. Remote control means control from the Process control system.

Local controls and instruments

For constant speed motor drive systems, the local controls shall be placed in the front door of the switchgear assembly in which the system shall be installed. For variable speed motor drive systems, the local controls shall be placed in the front door of the switchgear assembly in which the system is installed, or in case of the frequency converter is installed on a separate framework, on, or adjacent to, the frequency converter. With the controls it shall be possible: to start (over a self-holding circuit) and stop the drive and to reset protective devices. There shall be a separate, bi-stable, control pushbutton "Emergency stop", by which it shall be possible to stop the motor drive system irrespective of the selected control mode. There shall be LED-indicator lights to indicate "in operation", "power available", "motor protection" and "control mode Local", and, where applicable, an analogue instrument to indicate the momentary motor current. Adjacent to each control and instrument there shall be a text label that clearly explains the function. For variable speed drive systems there shall also be a device that makes it possible for the operator to see and change the current setting of the local speed set point. In case of frequency converters, an integrated local control panel may replace the above described controls and instruments, provided that it has the same capabilities, and provided that each frequency converter has its own permanently installed panel.

Communication with the Process Control System

The motor drive system shall communicate with the Process Control System. The below listed signals shall be communicated for each motor drive system:

Control signals:

Start (digital),

Start in reverse direction (digital, where applicable)

Speed set point (analogue, variable speed drives),

Feedback signals:

Remote (the local-remote switch is in remote position) (digital)

Ready for operation (MCCB closed and MCB for control power closed / frequency converter / soft starter ready for operation, safety switch closed) (digital)

Protection trip-N / Fault-N (digital, constant speed motor types / variable speed motor types)

In operation (digital)

In operation in reverse direction (digital, where applicable)

Motor current (analogue, where applicable)

Connection to the Power Transformation and Distribution System

Motor drive systems for process equipment in duty/stand-by configuration or similar shall be connected one to each section of busbar of the power transformation system.

Auxiliary Power Supply System (UPS)

System

The system shall be built up with of each other independent units. Each room for, or location of, switchgear and/or Process control system shall have its special UPS which shall supply UPS-power to systems which perform measuring, control, monitoring and/or safeguarding functions within in the concerned area of the plant.

Each unit shall have capacity to supply power to the connected load for a duration of minimum 2 hours.

Communication with the Process Control System

The system shall communicate with the Process Control System. The below listed signals shall be communicated for each UPS unit:

Operational status (in operation, fault) (signal types: digital),

Power supply failure (signal type: digital)

System Dimensioning with Respect to Installed Spare Capacity

The System shall, with respect to installed spare capacity, be dimensioned for an additional load of 30 % on top of the installed load at each UPS unit within this contract.

Fire Alarm System

The system shall be designed and installed in accordance with Ukrainian regulations.

Process Control System

System

The main components of the system are: Operator system, communication networks, process controllers and process interface (I/O). To the system belongs also the control circuitry and the, mainly safety-related, necessary hardware interlock logic. The system shall be connected to the existing control network at the delivery limit and shall use the existing operator system (SCADA) for monitoring and manual control. The communication between the system and the existing operator system (SCADA) shall use the existing communication protocol.

The process interface shall be based on traditional analogue and digital I/O technique.

The system components shall be power supplied from the Auxiliary Power Supply System (UPS).

The Process control system shall be designed in such a way that the integrity and function of each subsystem (process controller, I/O-module etc) is maintained irrespective of the state of any other subsystem.

Such parts of the system which are exposed to over-voltage shall be protected by over- voltage protection devices.

Field cabling shall be object-oriented, with separate cables for each process object.

Level of automation

The principle shall be that the Process control system shall be designed in such a way that it is capable of maintaining normal operating condition for the process without requiring any intervention from the operators. Limited operator intervention is acceptable during start-up and shut-down of the complete process and also during start-up and shut- down of a process section unless such start-up and shut-down is part of the normal operation of the process. In the latter case, the start-up and shut-down shall not require any intervention from the operator.

Where there is duty and stand-by or redundant process equipment, the stand-by equipment shall be switched in, activated, etc. automatically in case of fault or failure of the duty equipment. The system shall be capable of taking the process from the exceptional operating condition that may result as a consequence of the fault or failure of the duty equipment and back to the normal operation condition, without any operator intervention. Duty and stand-by rotation shall be automatic. The basic principle for the rotation shall be based on accumulated time in operation, such that the equipment with the shortest accumulated time in operation amongst those not in operation and available for remote control will be the next to be start and the equipment with the longest accumulated time in operation amongst those in operation and available for remote control will be the next to stop. However, there shall also be a superior function which automatically, provided that both the equipment in operation and the equipment not in operation are available for remote control, shall initiate rotation of duty and stand-by equipment if the difference in accumulated time in operation between the equipment in operation and the equipment not in operation equals to, or exceeds, one week. Whether the rotation sequence shall be carried out as “stop then start”, or as “start then stop”, will have to be determined specific for each process function.

Where two or more pieces of process equipment are process-wise installed in parallel, but controlled in sequence, the basic principle shall be that the priority order to start and stop shall be based on accumulated time in operation such that the equipment with the shortest accumulated time in operation amongst those not in operation and available for remote control will be the next to start and the equipment with the longest accumulated running time amongst those in operation and available for automatic operation will be the next to stop. However, there shall also be a superior function which automatically, provided that both at least one of the equipment in operation and at least one of the equipment not in operation are available for remote control, shall initiate change of the priority order if the difference in accumulated time in operation between the equipment in operation and the equipment not in operation equals to, or exceeds, one week. Whether the rotation sequence shall be carried out as “stop then start”, or as “start then stop”, will have to be determined specific for each process function. In addition, it shall be possible for the operator to, manually and persistent until manually reset, input the priority-order and override both the basic principle and the superior function.

Any condition in the process or in the system itself, which lead to that the process will leave, or has left, the normal operating condition shall generate an alarm event at the operator workplace in order to notify the operator that manual intervention may be required.

Hardware-implemented interlock circuits or control circuits shall be mirrored in the control software application.

Operator’s interface

The process graphics shall enable the operator to supervise and interact with the process and the process equipment as with the system via process overview displays, process displays and object faceplates, as well as parameter displays, trend displays, event and alarm lists and system displays.

The system shall have, in number and types, the displays that are required for clear understanding of the process and of the process control system.

Engineer’s interface

The Project Managering tools shall make it possible to configure, make faultfinding of, program, download and make backup of any configurable or programmable component within the system, by simple commands.

Process Interface

All physical process objects shall be interfaced to the Process control system with the specified signals (refer to separate chapter in this specification). In the Process control system, they shall be represented by a type solution (refer to separate chapter in this specification).

Software objects, for instance PID-controllers, sequences and aggregates shall be configured wherever appropriate for good and user-friendly automatic control of the process. The principles for the control function shall be based on communication between objects realized as type solutions and intermediate logic- and arithmetic functions as necessary.

Historian

The existing logs and log intervals shall be used.

Events

The existing event lists shall be used.

Report template

The report template shall comprise the variables listed below. It shall be possible to select the report period: Day (24 h, resolution 1 hour), month (resolution 1 day), six-month (resolution 1 week), annual (resolution 1 month), and it shall be possible to order generation and printout of the report from the operator workplace.

The report template shall, in addition to the variables and their respective reference designation and description, also comprise information on: Which plant and process section the reported variables refer to, the title of the report, the reported period, the date when the report was generated, the page number of each page and total number of pages in the report.

Variables:

The volumes that have passed through the flow meters, sum for each type of media, sum as logically grouped per process unit for each media and separate for each flow meter,

Each measured analyses variable (e.g. conductivity, pH, SS, NH4-N, NO3-N, etc.), min, max, average

Consumption of electrical energy, active and reactive (separate figures for each energy meter)

Equipment operation

Motors' running time and number of starts

Actuators' number of operations

Date and time: Setting and synchronization

The Process control system shall be able to set system date and time based on date and time information that is received over the existing control network. .

System configuration and software application programming

The requirements on the software applications are described in a separate chapter of this specification.

System supervision

The operational status and the fault status of the system components and subsystems shall be monitored. The status shall be made available at the signal interface to the existing operator system.

Media for data communication

Communication between units that are physically located within the same room, and which are tightly bonded to the same electrical potential using at least 35 mm² multiple conductor copper cable or equal, and are fed from the same power supply board may use electrical media. Other communication shall use optical fibre media.

Circuitry and Interface to Equipment for Measurement and Analysis

Equipment that requires separate power supply shall be power supplied from the power transformation and distribution system. Equipment that is used in duty/stand-by configuration or similar shall be connected one equipment to each section of busbar of the power transformation system.

The equipment shall be interfaced with those signals that are defined in separate chapter in this specification. In case that a process signal is part a hardware interlock circuit, the circuit, once activated, shall latch in the active position until manually released. The latched signal shall be interfaced to the process control system. In the front door of the cubicle in which the latch-circuit is realized, there shall be an LED-indicator light and a latch-release control arrangement and a text label which clearly describes the function.

Communication with Other Systems

The system shall be interfaced to the other systems that are described in this specification as described for the respective system.

The signal objects and process objects shall be configured as type solutions using the appropriate type for each signal object and process object.

Signals that are part of a hardware-implemented interlock circuit or control circuit shall also be interfaced to the I/O-system.

System Dimensioning with Respect to Performance and Installed Spare Capacity

Process controller and I/O-system

On completion of commissioning, each one controller and I/O-system shall have the below stated spare capacity (minimum requirements):

System software and software licences: 50 % addition to the number of objects (e.g. transmitters, motors, valves etc.) that are installed within this contract shall be possible without having to upgrade any system software or licence,

Primary memory spare capacity: 50 % (capacity which is required to perform on- line changes must not to be included),

Processor load: 50 % (10 s average value),

Communication interface for the signal exchange with the existing SCADA system: 75 % of available bandwidth when all signals are updated 1 time per each 6 second over the same communication port,

Communications buses load: 50 %,

Installed I/O: 30 % spare channels for each installed type of I/O,

Power supplies: 50 % power spare for each power supply.

On completion of commissioning, the system has to meet the below stated performance requirements:

Analogue and digital I/O

Time from when a change of signal level at an I/O-terminal is made, and until the change is available for the application program: Digital inputs: 50 ms. Analogue Inputs: 250 ms.

Time from when a change of value is made by an application program, and until the change may be observed at an I/O-terminal: Digital outputs: 20 ms. Analogue outputs: 50 ms.

Applications:

Motors and valves are generally to be executed each 200 ms.

Other object types, e.g. PID-controllers and sequences are generally to be executed each 500 ms.

The system shall allow for shorter execution intervals (>=50 ms) for individuals of all object types.

Cable-Laying System

System

The in-ground cable laying system shall be constructed with trenches, except for where cables run under hard made surfaces or crosses a road. In these cases, the cables shall be laid in concrete duct banks with draw pits at each end of the duct bank.

Above ground in process areas and process buildings, the cable laying system shall be based on cable ladders. For site lighting, the cable laying system may, as an alternative, be based on wires. Conduits may be used only for single cable. In process areas and process buildings there shall be no hidden installations. In office-type environments, cables shall be laid in closed cable trunking, or in hidden installations in conduits.

System Dimensioning with Respect to Installed Spare Capacity

The System shall, with respect to installed spare capacity, be dimensioned for an additional number of cables of 30 % on top of the number of cables (for each category of cable) that is installed in the respective cable route within this contract.

In Ground Cable Routing System and Cable Draw Pits

Requirements related to Civil Engineering

General

Dimensioning of the system must not be done until the types and the number of cables in each route in known.

When the work is finished, and before any cables are laid, the system shall be cleaned.

Concrete encased pipe duct banks

Concrete encased pipe duct banks shall be constructed with straight sections only. There shall be cable draw pits at every 30 m of length, at any changes in direction and at the ends of the duct bank.

Concrete encased pipe duct banks shall be resistant to a load of 40 tons.

The pipes in the duct banks shall be HDPE type 110 mm or 160 mm diameter. The pipe section joints shall be solvent welded. The pipes shall be laid in straight runs and be firmly kept in position using suitable spacers and fixation devices.

Cable draw pits

Cable draw pits shall be made from concrete.

Cable draw pits shall be resistant to a load of 40 tons.

Cable draw pits shall have minimum 1200 mm inner height. The width and length must not be less than 800 mm x 800 mm. Larger dimensions shall be used if so is required by the number of cables or in order to maintain minimum cable bending radii.

Cable draw pits shall have arrangements for collection and drainage of in-leaking and condensation water.

Cable draw pits shall have access manholes and ladders. The inner diameter of the manholes must not be less than 800 mm. The manholes shall have a flanged, sealed, cover. The flange and the cover shall be made from heavy duty cast iron.

Openings, for instance where pipes run between concrete encased pipe duct banks and cable draw pit, shall be sealed after the pipe etc has been laid in its permanent position.

Trenches

The installation shall comply with the following requirements:

- Turf and topsoil shall be removed carefully and be preserved for reinstatement in their original positions,
- Before cables are laid, the bottom of the trench shall be evenly graded and cleared of loose of protruding stoned etc. The bottom of the trench shall then be covered with at minimum 75 mm of sand,
- Backfilling shall be commenced by covering the cables with 100 mm sand, than placing interlocking cable covers of plastic overlapping the cable(s) by at least 75 mm,
- The remaining backfill shall be completed in 100 mm layers, each layer being compacted. The first two layers shall be compacted by hand, and the remaining layers shall be compacted by machine,
- 300 mm below finished surface level, a yellow plastic marker with the text "Electrical cable" or the like continuous marked on the marker shall be laid. The marker shall cover the complete width of cables,
- The route of buried cables shall be marked every 50 m and at changes of direction by means of concrete slabs 300 mm x 300 mm in length and width and 100 mm thick with the (countersunk) text (3 mm deep and 50 mm high) "MV Cables" or "LV Cables" as appropriate. The slabs shall be laid flat projecting 10 mm above finished ground level.
- Where a trench ends and cable route continues in ground into a structure or a cable draw pit, the last 1 meter closest to and through the wall of the structure or cable draw pit shall consist of HDPE type pipe.

Grounding and Potential Equalization System

The system shall be designed and installed in accordance with Ukrainian regulations. The system shall be assembled with standardized, prefabricated components and accessories that are intended for the purpose and suitable for the environment in which the system is installed.

Lightning Protection System

System

The system shall be designed and installed in accordance with Ukrainian regulations and standards.

The system shall protect the new buildings and structures along with the equipment and installations within or on those buildings and structures.

The system shall be connected to the grounding system.

A down-conductor shall have a disconnector in order to make it possible to measure the resistance of the grounding system.

All incoming electrically conductive pipe, cable etc. shall be connected to the grounding system via a grounding bar. All electrically conductive pipe, cable etc. which are exposed to lightning strike shall be connected to the grounding system via a grounding bar. Pipes and cable screens shall be directly connected. Conductors in cables shall be connected via surge protection devices. The surge protection devises shall be chosen based on the requirements of the protected circuitry, apparatus etc.

Apparatus, Equipment, Cables etc.

Assemblies, Apparatus, Equipment etc. must be certified for use in Ukraine.

Assemblies, Apparatus, Equipment etc. that are subject to CE-marking under one or more directives issued by the European Union shall meet the applicable requirements for CE-marking.

Assemblies, Apparatus, Equipment etc. that meets the applicable requirements for CE- marking shall be CE-marked, shall carry the CE mark and have enclosed the declaration of conformity.

Assemblies, Apparatus, Equipment, cables etc shall be chosen from manufacturers that are well established manufacturers of the type of product in question.

Assemblies, Apparatus, Equipment, cables etc shall be new and of types and models which are still in the active production and sales phases from the manufacturer.

Assemblies, Apparatus, Equipment, cables etc. shall be selected so that it is suitable to function and operate reliably and over time in the environment in which it is installed.

Manufacturers' instructions and guidelines, for instance installation instructions and dimensioning guidelines, shall be followed.

Voltage variations

All equipment shall have the rating required to withstand over time and to function correctly within the occurring voltage variations.

Tools

Such accessories and special tools that are necessary in order to operate, do maintenance, parameterize, program or document the apparatus, equipment and assemblies shall be supplied.

Materials for Installations, Cable laying, etc

Cable Ladders

Materials

Cable ladders shall have accessories that are adapted for installation and lengthening of the system.

Cable ladders shall, as far as possible, be of uniform style.

Support devices, accessories etc shall have the same corrosion protection as the cable ladders.

Accessories shall be made in such a way that cables can be laid on the ladder without any risk of damage to the cable. At changes of direction and at branches, special angular sections and branching sections shall be used, such that the cables are always kept within the cable ladder.

Outdoors, cable ladders shall have protective covers.

Design load

Cable ladders shall allow for the rated load without being permanently deformed. They shall withstand 1.7 times the rated load without collapsing.

Lateral rigidity

Ladders and support devices shall be made in such a way that the lateral force to which they may be exposed at during installation and cable laying does not cause permanent deformation.

Deflection

The deflection of ladders must not exceed 1 % of the distance between support devices at the rated load.

Tilting of support devices

Deflection of support devices must not be more than 5 mm per 100 mm ladder width.

Rungs

The center distance must not be more than 250 mm.

The part of the width of the rung that is in contact with the cable must not be less than 8 mm. The edges shall be rounded.

The area covered by rungs must not be more than 10 % of the total area of the ladder.

Support devices

Pendants and cantilevers shall be mounted such that laying of cables can be done from the side, without having to thread the cable.

Surface treatment

Ladders, accessories and support devices shall be made from hot-dip galvanized steel (corrosivity class C 4 according to EN ISO 12944-2, with an expected lifetime of 20 years).

Finish and workmanship

Erection

Cable ladders shall be mounted in such a way that threading of cable during cable laying is avoided.

Cable ladders shall be arranged such that the number of changes in direction is minimized.

Cable ladders shall be arranged such that the overall route length is minimized.

Cable ladders shall be arranged such that there is only one cable route (with one or more cable ladders) to each piece of equipment.

Cable ladders shall be arranged in horizontal or vertical runs, except where some obvious feature of the structure renders a sloped arrangement.

Cable ladders shall be run such that they are not in the way of access to machinery, equipment etc or during maintenance and in- and out transport of machinery, equipment etc. Typically the ladders shall run at high level. They must not run at levels below 2 m from floor level. The free distance between the top of ladders and ceilings, pipes etc shall be 300 mm or more.

The free distance between ladders that run in parallel on top of each other shall be 200 mm or more, measured from the top of the lower ladder to the bottom of the higher ladder.

Where ladder are mounted adjacent to walls, the distance between ladder and wall shall be large enough to allow for a cable to be laid between the ladder and the wall, but minimum 20 mm.

Cable ladder must not run through a structural part that separates different fire cells, but shall be terminated on both sides of the structural part.

Sharp edges, tips on screws on ladder shall be removed before the laying of cable. Expansion-shell anchor bolts which are used for fastening of support devices shall have minimum 6 mm diameter.

Support devices shall be mounted at such distances that the rated load of the ladder is not exceeded.

Where protective covers are used, they shall be fixed to the cable ladder. The fixing arrangement shall be such that dismantling and reassembling of the cover is easy to do.

The requirements in chapter "Cables"-"Laying of cable" of this specification shall be observed when installing the cable ladders.

Cable ladder

Cable ladders shall be dimensioned for a rated spread load of not less than 600 N per 1 m length and 100 mm width of cable ladder at 6 m between supports. It shall also withstand, without permanent deformation, a temporary load of 1000 N between supports number 3 and 4 when mounted on 6 supports.

Boxes: Junction Boxes, Connection Boxes, etc

Materials

Boxes which are intended for the same purpose shall be of uniform appearance. Boxes shall have devices for mechanical stress-relieving of the cables. Cable glands may be used for stress-relieving if they are designed for the purpose.

Finish and workmanship

Boxes within the same room shall, provided that there is space available, be placed at the same height.

A box shall, with respect to any equipment, pipe etc, be placed such that it is easily accessible.

Where two or more boxes are placed adjacent to each other, they shall be horizontally and vertically aligned.

Boxes for recessed installation shall be fastened such that it is parallel and flush with the finished surface.

Openings that are not used shall be sealed.

Covers of connection boxes shall be fastened by screws. Degree of protection (except for hidden installations):

Outdoors and process areas: IP 65

Elsewhere: IP 55

Cable Trunking

Trunking shall be made from metallic material. Trunking shall meet the requirements of corrosivity class C 4 according to EN ISO 12944-2, with an expected lifetime of 20 years.

Trunking shall be built from a trunking system of purpose-made lengths, covers, angles, sleeves, tees, joints and other accessories.

The complete trunking system shall be electrically continuous and each length of trunking shall be bonded to the adjacent lengths and to equipment, by an efficient copper bonding strip and brass screws, nuts with serrated lock washers.

All trunking shall be of an adequate size to suit the number of cables passing through it, but as a minimum, the size shall be 50 mm. by 50 mm. The trunking shall be securely and permanently fastened using purpose-made fasteners.

The trunking installation shall be complete, cleaned and fixed in position before any cables are drawn in.

Fasteners for Apparatus, Cable, etc

Fastener shall be resistant to corrosion and adapted to the environment in which it is used.

Cable ties

Cable–ties shall be of self-locking, UV-resistant, nylon type.

Cable clamps

Groups of cable with approximately the same diameter may be fastened with a common cable clamp. Maximum five cables in the same clamp.

Cable Protection

Cable protection shall be made from hot dip galvanized steel (corrosivity class C 4 according to EN ISO 12944 2, with an expected lifetime of 20 years) or from acid-proof stainless steel.

Conduit System

Conduit shall be built from a system of purpose-made lengths, flexible lengths, angles, sleeves, joints, ends and other accessories. In other environments than office-type environments, the system shall be made from hot dip galvanized steel (corrosivity class C 4 according to EN ISO 12944 2, with an expected lifetime of 20 years) or from acid-proof stainless steel.

Where conduit is used in other environments than office-type environments, the installation shall be water tight.

Cable etc.

Laying Of Cables

Cables shall be laid in such a way that:

The arrangement is clear and adapted to its purpose with respect to operation of the equipment, the machinery and the plant as well as to inspection, testing, cleaning and risk of damage to the cables

Maintenance of adjacent equipment, machinery, pipes etc. is not obstructed and can be done without any risk of damage to the cables

Cooling of the cables is satisfactory

The cables does not cause spreading of fire

Cables shall be laid in horizontal or vertical runs, except where some obvious feature of the structure renders a sloped arrangement.

At changes from direct buried laying to other types of laying, the cables shall be laid in an “S”-shape.

Cables which run through a construction joint shall be laid in such a way that the normal movements in the construction joint does not damage the cables by stretching, crushing etc.

At wall channels, cables shall be separated and as far as possible run in parallel.

Sealing against water and dust penetration shall be done wherever a cable runs between structures or where it emerges from a pipe or cable draw pit. The sealing shall be done with a fire-retardant material taking into consideration the type of cable.

Fire sealing shall be done where a cable runs between different fire cells.

Sealing against water and dust penetration shall also be done for all empty pipes etc. The sealing shall be done with a fire-retardant material.

Where cable enters a cubicle, box, apparatus etc., it shall be laid straight for minimum

100 mm prior to the entry point. The degree of protection for the cubicle, junction-box, apparatus shall be retained by using cable glands or other purpose-made components.

Cables that run at a closer distance than 1.5 m from adjacent floor, platform, ground or elsewhere where there is a risk that it may be damaged or kicked at, shall have cable protection. Cables that run into the ground shall have protection until minimum 200 mm depth.

Cables must not be laid on or adjacent to heated pipes or surfaces etc in such a way that there is a risk of damage due to heating-up.

Cables which are not associated with a machinery, an equipment etc, must not be laid on the machinery or equipment.

Cables shall be fastened by cable ties or cable clamps. For cables that are not laid on cable ladder, shelf etc or in pipe the distance between fasteners shall be maximum:

25 cm for cable with conductor area up to 2.5 mm²

35 cm for cable with conductor area between 4 mm² and 10 mm²

50 cm for cable with conductor area from 16 mm² and up.

For cable that is laid on ladder, the distance between fasteners shall be maximum:

In horizontal runs: 50 cm.

In other cases: The same distances apply as for cable which is not laid on ladder, shelf etc.

Special attention shall be given to single core cables with respect to the forces that occurs in case of short-circuit.

Cable shall be laid in such a way that cold-floating due to high spot-pressure does not occur.

Cable shall be fastened in such a way that cold-floating due to high spot-pressure does not occur.

Inside junction-boxes, apparatus, etc, the ends of a cable shall have such length that reconnection within the same box etc. is possible.

Low voltage power cable must not be laid in more than two layers. Low voltage power cables shall not be laid at closer distance than:

300 mm from other cable outside of cabinets

50 mm from other cable inside of cabinets

Signal cables shall not be laid at closer distance than:

100 mm from other cable outside of cabinets

50 mm from other cable inside of cabinets

Communication cable (except for optical fibre cable) shall not be laid at closer distance than:

100 mm from other cable outside of cabinets

50 mm from other cable inside of cabinets

Cables which belong to safety-related systems such as fire alarm systems or gas alarm systems shall be laid separate for each system and separate from cables belonging to other systems while still respecting the above indicated distances for each cable type.

Cable crossings shall be right angled. A cable must not be spliced.

Cable and Wire

Copper and aluminum conductor cable and wire shall meet the requirements of the CENELEC harmonization documents for the respective type and voltage level. Optical fibre cable shall meet the requirements of EN 60794.

Manufacturer's test certificates shall be supplied with each drum.

Cable and wire shall be self-extinguishing.

Cable and wire for outdoor use shall be of UV-resistant type. Soft soldering of conductor ends must not be done.

Conductor identification

Conductor identification marking shall be done throughout the complete length of the conductor.

Fibre optic cable

Cable shall have 50 % spare pairs. Cable shall have at minimum eight pairs in total. Cable ends shall be sealed.

Splices, Connectors, Terminal Blocks, etc

Splices

Cable splices shall be carried out in accordance with the instructions from the manufacturer of the connector.

Terminal blocks

Terminal blocks shall be placed in cubicles, junction boxes etc. The degree of protection shall be IP 2X.

The contacts members shall be adapted to the cables that are going to be connected.

It shall be possible to mark the terminal blocks with a commercially available marking system.

Terminal blocks that belong to different voltage systems shall, by position or by shielding, be kept separate from each other in accordance with the requirements of the highest of the voltages.

Not more than three internal conductors shall be connected to the same side of the terminal block.

Not more than one external conductor shall be connected to the same side of the terminal block.

Bridging shall be made on the same side of the terminal block as the one to which the internal conductors are connected.

Protection Relays, Other Protective Devices and Apparatus for Measuring and Supervision

The degree of protection shall be IP 65 for the front of the apparatus and for the sealing against the enclosure in which it is installed, and IP 2X for other parts. For installations in rooms for switchgear and controlgear assemblies and cables, IP 5X is acceptable for the front and sealing.

Protection Relays

Protection relays shall be selected from the standard production of a single internationally recognised manufacturer of protection relays.

The relays shall be flush-mounted type. The relays shall have trip indicators that require manual reset. Indicators on protective relays shall be visible and setting and resetting devices shall be easily accessible. The design shall be such that testing is easy to do and can be done without having to take the protected circuits out of service. Short-circuiting of the secondary of current-transformer circuits shall be easy to carry out. Protection relays that are connected to current transformers shall be connected to such current transformers which are intended for protection relays.

Fuses and Miniature Circuit Breakers

Protective devices for outgoing cables shall be installed in switchgear assemblies or control panels.

Earth Fault Breakers

Earth fault breakers with time delay must not be used for protection of persons.

Panel Meters

Panel meters shall be of accuracy class 1.5 or better. Size shall not be less than 48 x 48 mm. The scale length shall not be less than 65 mm. Panel meters shall be flush-mounted.

The scale shall be selected such that the deflection does not exceed 125 % of the full range signal value. Panel meters for motor current shall in addition have a compressed overload scale up to 6 times the motor's nominal current.

Apparatus and Equipment for Storage, Transformation, Power Factor Correction, Conversion, etc.

Transformers

Power Transformers

The transformers shall be chosen from one single manufacturer, and be the standard versions from that manufacturer.

The transformers' power rating shall be chosen from the series of preferred values of rated power in EN 60076 1.

The no-load losses must not be higher than 0.15-0.19 % and the load losses 0.7-1.0 %. The figures shall however be seen as guideline values that are aimed at pointing to the importance of high efficiency. For small transformers (150 kVA-315 kVA) slightly higher values are accepted. With the same reasoning, the corresponding figures for the load- losses are 0.8 %-1.3 %.

The vector group shall be Dyn 11 for the MV / LV transformers.

Transformers shall have an off-load type tap changer by which the voltage can be regulated in at minimum + / - 2 steps of 2.5 % each.

Transformers shall be designed for outdoor installation without protection from the weather conditions. They shall be oil-filled type, naturally cooled, ONAN.

Transformers shall have terminals enclosures over bushings and connection terminals. The degree of protection for the enclosure shall be IP 23.

The noise level must not exceed 60 dB (A) at full load. Transformers shall have the following accessories:

Rotary wheels,

Pressure gauge (hermetically sealed type transformers) or Buchholtz relay (breathing type transformers). Both types shall have two signal contacts: alarm and trip,

Magnetic type oil level indicator (breathing type transformers) with one signal contact,

Dial type thermometer with two signal contacts: alarm and trip,

Valves for connection of oil filtering equipment,

Lugs for lifting of the complete transformer and for lifting the core and tank top,

Steel tank,

Earthing terminals.

The thermometer shall be placed in such a way that it is readable without having to enter the transformer compartment.

Painting and surface treatment

The paint shall have the same colour for all transformers. The transformer shall be shot- blasted prior to painting. Painting shall comprise one primer and two final coatings. The dry film thickness for coating shall not be less than 35 micrometers. The overall dry film thickness shall not be less than 105 micrometers.

Measuring Transformers

The transformers shall be installed in switchgear and control-gear assemblies.

Current transformers

Current transformers shall be cast resin insulation types.

Current transformers that are used in protection circuits shall be from accuracy class 5P. Current transformers that are used in energy-measuring circuits shall be from accuracy class 0.5. Current transformers that are used in other measuring circuits shall be from accuracy class 3.

The accuracy limit factor shall be chosen according to the specific requirements of each circuit, but shall not be below 10.

Secondary circuits that are not used shall be short-circuited.

Voltage transformers

Voltage transformers shall be cast resin insulation types.

Voltage transformers that are used in protection circuits shall be from accuracy class 3P. Other voltage transformers shall be from accuracy class 0.5.

The secondary circuit shall be protected from short-circuiting and overloading by means of separate protection for each functional unit that is connected to that secondary circuit.

Auxiliary Power Supply Units (UPS)

All units shall be from the same manufacturer and be of the same type. Degree of protection shall be IP 2X.

The units shall meet the requirements of the EN 62040 standard series.

AC-units shall be of on-line type. By-pass shall be possible to switch on and off manually. In case of fault in the unit, the by-pass shall be switched in automatically. By-pass switching must not cause any interruption at the power outputs.

Batteries shall be of maintenance-free type. The batteries shall be installed in cabinets, and stand in trays which are capable of accumulating the complete volume of liquid.

Local control panel

The panel shall have:

Selector for local/automatic control mode

Controls for start / stop of the unit

Controls for manual operation of the by-pass.

Instrument for load indication

Indicators for the operational status

Fault indicators

Cabinets

The cabinets shall be factory built. They shall be floor-standing full height type (ca 2-2.2 m) with hinged (minimum 3 hinges) doors. They shall have skirting (ca. 100 mm high). All cabinets shall have the same width (ca 0.8-1 m) and depth (inner depth ca 0.4 m).

Degree of protection shall be IP 2X.

Cabinets shall be made from galvanized sheet steel: The frame not less than 2 mm thick and other parts not less than 1.5 mm thick. Doors and end panels shall be made from painted sheet steel, not less than 1.5 mm thick.

Cabinets shall have permanently installed lifting eyebolts.

Cabinets shall have arrangements for fastening it to the floor. Cabinets shall be firmly fastened to the floor with minimum 4 bolts.

Cabinets shall have locking device that requires a key to unlock.

The location of the entry point for cable shall be adapted to the conditions where the cabinet is placed.

All cabinets shall have the same colour of the paint. The choice of colour shall be co- ordinated with the colour of the switchgear assemblies.

Mounting planes shall be galvanized and have good galvanic contact with each other and with the cabinet frame.

Cabinets shall have arrangements for effective potential equalization of the cabinet and the mounting planes and for grounding of cable shields and protective conductors.

Cabinets shall have arrangements for fastening of external cables throughout the complete length of the cables.

Assemblies

The assemblies shall be factory built.

Cables shall be run in cable channels. The cable channels shall be fastened, by screws, to the mounting planes.

The assemblies shall be made in such a way that apparatus etc is easily accessible for installation, fault finding and dismantling of the apparatus etc through the open front doors, without having to enter into the cabinet.

Degree of protection shall be IP 2X.

Converters

Frequency converters

All frequency converters shall be from the same manufacturer. All frequency converters of the same size shall be of the same type.

Degree of protection shall be IP 2X.

Frequency converters shall meet the requirements of EN 61800-3. Frequency converters which are connected to distribution networks which, without intermediate transformers, also serves administration buildings and other office buildings, shall meet the EMC- requirements for the 1:st environment.

The efficiency of the converter must not be lower than 98 % at nominal power. Also refer to the system description for Motor Drive Systems.

Tools

Each frequency converter shall be equipped with the tools (e.g. operator panel) which are required for parameterization and fault-finding.

Switching Equipment and Switching Devices

Switchgear and Controlgear Assemblies

Cubicles, with the exception of cubicles that are made from acid-proof stainless steel, shall have painted doors and end-panels. The paint shall have the same colour for all cubicles.

On the front of an cubicle there shall be a mimic diagram which shall show the single-line representation of the system, or part of the system, that is installed in that enclosure along with the incoming and outgoing busbars. The mimic shall be made from a marking system that is commercially available on the open market, and that is intended for the purpose.

Tools

The tools and accessories that are necessary in order to do maintenance, or to dismantle and install withdrawable or removable equipment shall be supplied with one set at each location of equipment.

Low voltage switchgear and controlgear assemblies

All switchgear assemblies shall be cubicle-type, of the same type and selected from the standard production of a single internationally recognised manufacturer of switchgear assemblies.

Design and construction

General

The assemblies shall be factory-assembled and meet the requirements of EN 60439-1. Controls and instruments must not be placed above 1.8 m above floor level, and not below 0.6 m from floor level.

Connection of external cable shall be arranged in blocks of connection terminals that shall be grouped in a logical way, and be easily accessible. The connection terminal blocks must not be placed below 0.4 m from floor level.

Form of internal separation shall be form 3b or 4a or 4b.

Incoming functional units shall be withdrawable circuit breaker type. Outgoing functional units shall be removable type or withdrawable type. Removable and withdrawable parts shall have insertion interlock.

The location of the entry point for cable shall be adapted to the conditions where the cabinet is placed.

Panel meters and indicator lights

A switchgear assembly shall have the following meters and indicators:

Busbars:

- voltage level (meter and selector switch),

Incoming functional units:

- Operational status (in operation, open, closed, warning, (separate for each source), tripped (separate for each source), interlocked(separate for each source)) (LED-indicator lights),
- Active power (panel meter),
- Reactive power (penal meter),
- Active energy (panel meter),
- Reactive energy (panel meter),
- Phase currents (separate for each phase) (panel meters),
- Voltage level (panel meter and selector switch),

Outgoing functional units

- Motor starters: Please refer to the description for Motor drive systems,
- Other outgoing functional units: Phase current (for nominal loads 30 A or higher) (L2 phase) (panel meter),

Degree of protection

Cubicle (with closed doors): IP 3X. With open doors: IP 2X.

With open doors, removed withdrawable or removable part: IP 2X.

Accessibility with respect to operation, routine inspection, maintenance etc.

All switching activities and resetting of protection relays shall be possible to do while the doors are still closed. Panel meters and indicator lights shall be placed in such a way that they can be seen while the doors are still closed.

Visual inspection of external conductors, with respect to connections and cable and conductor marking, and of settings and indicators for protection relays shall be possible to carry out in a safe way when the switchgear is live and in operation.

Setting of protection relays, change of fuses and indicator lights and fault finding such as measuring of voltages and phase currents shall be possible to carry out in a safe way when the switchgear is live and in operation.

It shall be possible to safely install and connect new feeders and signal cables while the switchgear is still live and in operation.

Cubicles

Cubicles shall be made from galvanized sheet steel: The frame not less than 2 mm thick and other parts not less than 1.5 mm thick. Doors and end panels shall be made from painted sheet steel, not less than 1.5 mm thick.

Switching Devices in Switchgear and Controlgear Assemblies etc

Circuit Breakers

Low voltage circuit breakers

Circuit breakers shall be 4-pole type in circuits where the neutral is distributed.

Circuit breakers shall be arranged for stored energy operation with energy storage in springs or weights and have motor charging and manual charging as backup.

Circuit breakers shall have mechanical closing and opening push-buttons and shunt closing and shunt opening release. Circuit breakers that are used for motor control shall also have under voltage release.

The circuit breakers shall have integrated protection device.

Circuit breakers shall have the following signal contacts for remote indication:

Operational status (in operation, open, closed),

Status for the protection device (warning, tripped, interlocked).

Moulded case circuit breakers (MCCB)

MCCBs shall be 4-pole type in circuits where the neutral is distributed.

MCCBs shall be manoeuvrable from the front of the cubicle in which it is installed when the door is closed. The original degree of protection for the cubicle shall be maintained.

Disconnectors

Low voltage Switch disconnectors

The disconnectors shall be 4-pole type in circuits where the neutral is distributed. The disconnectors shall be manoeuvrable from the front of the cubicle in which it is installed when the door is closed. The original degree of protection for the cubicle shall be maintained.

Motor Starters

Low voltage motor starters

Motor starters shall be electromechanical type. The utilization category shall be AC3 and coordination shall be type 2.

The overload protection shall be set to the same value as the nominal motor current. Also refer to the system description for Motor Drive Systems.

Contactors

Low voltage contactors

Contactors shall operate on all distributed phases for the circuit in question and on the neutral in circuits where the neutral is distributed.

Coordination shall be type 2. The utilization category shall suitable the connected type of load. Contactors in motor starters shall have utilization category AC3.

Safety Switches

Low voltage safety switches

Safety switches shall meet the requirements of EN 60947-3 on a switch-disconnector. Safety switches shall have degree of protection IP 65.

Safety switches shall be equipped with an early breaking auxiliary contact.

Safety switches shall have reliable, mechanical position indication, and the design shall be such that switching handle, front plate or cover and switch can only be assembled in such a way that the position indication is visible and true.

The safety switch shall be possible lock, in the off-position only, with three separate padlocks at the same time. The locking device shall be an integral part of the safety switch, and it shall not be possible to remove it from the switch without the use of tools.

Cable entry shall be from the bottom.

Apparatus and Equipment for Maneuvering

Lighting Switches

Lighting switches shall be placed 1000 mm above the adjacent floor or ground level at the same side as the door handle and 100 mm from the door frame.

Where two or more lighting switches are installed adjacent to each other they shall be horizontally or vertically aligned.

Degree or protection: Indoors in dry environment (except process rooms): IP 20. In other environments: IP 44.

In outdoor installations and in process areas protection from the weather conditions and water flushing shall be arranged.

Control Switches

Controls such as wheels, knobs, handles and push-buttons shall, with respect to operating directions, follow the principles in EN 60447.

Controls shall, with respect to colour coding, follow the principles described in EN 60073. The degree of protection shall be IP 65 for the front of the apparatus and for the sealing against the enclosure in which it is installed, and IP 2X for other pasts. For installations in rooms for switchgear and controlgear assemblies and cables, IP 5X is acceptable for the front and sealing.

In outdoor installations and in process areas protection from the weather conditions and water flushing shall be arranged.

Sockets

Sockets shall be placed at 1500 mm above the adjacent floor or ground level.

Sockets, which are installed in the same room, shall the same colour, and the colour shall be co-ordinated with the lighting switches.

Degree or protection: Indoors in dry environment (except process rooms): IP 20. In other environments: IP 44.

Sockets for 230 V AC shall be grounded type (two poles and earth), rated for 16 A. Sockets for 400 V AC shall meet the requirements of EN 60309. They shall be grounded type (four poles and earth), rated 32 A.

In outdoor installations and in process areas protection from the weather conditions and water flushing shall be arranged.

Lighting Fittings, Sources of Light, etc

Light Fittings

Light fittings shall be type-tested. The fitting shall, as regards safety, meet the requirements of EN 60598-1.

Degree or protection: Indoors in dry environment (except process rooms): IP 20. Indoors in other environments: IP 44, Outdoors: IP 65.

Lighting fittings for discharge type sources of light must not emit any noise. Emergency lighting fittings shall meet the requirements of EN 60598-2-22.

Battery operated hand lamps for emergency lighting or for guide lighting shall meet the requirements of EN 60598-2-8.

Indicator Lights

Indicator lights shall, with respect to colour coding follow the principles in EN 60073. The degree of protection shall be IP 65 for the front of the indicator light and for the

sealing against the enclosure in which it is installed, and IP 2X for other pasts. For installations in rooms for switchgear and controlgear assemblies and cables, IP 5X is acceptable for the front and sealing.

Apparatus and Equipment for Process Control and Supervision

Process Controllers and I/O-System and Assemblies of Process Controllers aI/O-System

The process controller and the I/O-system shall come from the same manufacturer. All CPU: s shall be of the same model.

All supervision signals (for instance: operational status, fault status, channel fault, abnormal signal level) shall be interfaced such that they can be read by the Process controller software.

I/O-channels which are part of I/O-circuits which are partially or fully located in areas which are not protected by a Lightning protection system shall have over-voltage protection.

Power supply circuits

Power supply circuits shall be designed in accordance with the demands and recommendations from the manufacturer of the process controller and I/O-system, however power supplies and –circuits which supply power to Process controllers and communication devices shall be separate from those which feed I/O-stations and I/O-modules.

Power supply circuits shall be designed and coordinated in such a way that selectivity exists between protective devices.

Media for data communication

Communication between units that are physically located within the same room, and which are tightly bonded to the same electrical potential, using at least 35 mm2 multiple conductor copper cable or equal, and that are fed from the same power supply may use electrical media. Other communication shall use optical fibre media.

Process controller

The process controller has to comprise function libraries for digital as well as analogue (floating point, minimum 32 bits, single precision) control. In addition to basic arithmetic calculating functions, the analogue control function library has also to include composite functions for instance: PID-controller, integration, differentiation, linear ramp, first order filter, limiter, comparator and function generator.

The process controller shall have indicators for the operational status and the fault status. In addition, in the Process controller there shall be indicators for the supervision of memory, program execution (watchdog) and status for communication links.

The Process controller shall have the capabilities to, automatically and in a controlled way, shut down in case of risk of malfunction or fatal error.

In case of power failure, all memory contents, including dynamic variables, shall be retained for minimum 12 hours. When power returns, the system shall start up and resume normal program execution using the saved dynamic variables. In case of longer periods of power failure, the system shall automatically start up from a non-volatile memory and resume normal program execution.

Degree of protection shall be IP 2X.

I/O-system

Components shall have diagnostics indicator.

I/O-modules shall be possible to exchange “on-line”, without having to shut down power or disconnect any cables, and without interfering with the functionality of other I/O- modules.

Degree of protection shall be IP 2X.

Digital inputs

Digital inputs I/O shall be designed for 24 V DC signal level, and shall be current-sinking type. Each channel shall have noise suppression circuits. Each channel shall have indication of the signal state. There shall be galvanic separation between field signals and the backplane bus.

Digital outputs

Digital outputs I/O shall be designed for 24 V DC signal level, minimum 0.5 A continuous current. The outputs shall be short-circuit proof. Each channel has to have indication of signal state. There shall be galvanic separation between field signals and the backplane bus.

Analogue inputs and outputs

Analogue inputs and outputs I/O shall be individually configurable for each channel: 0..20 mA or 4..20 mA. There shall be galvanic separation between field signals and the backplane bus. Resolution shall be 12 bits or higher. Each input channel shall have interference suppression and surge suppression circuits.

Power supplies

Power supplies shall have diagnostics indicator.

The output power circuit shall be insulated from the input power circuit. Power supplies shall be protected by over-voltage protection.

Degree of protection shall be IP 2X.

Interface relays

Interface relays shall have position indication.

Signal contacts shall be suitable for the occurring currents. Degree of protection shall be IP 2X.

Cabinets

The cabinets shall be factory built. They shall be floor-standing full height type (ca. 2-2.2 m) with hinged (minimum 3 hinges) doors. They shall have skirting (ca. 100 mm high). All cabinets shall have the same width (ca. 0.8-1 m) and depth (inner depth ca 0.4 m).

Degree of protection shall be IP 2X.

Cabinets shall be made from galvanized sheet steel; The frame not less than 2 mm thick and other parts not less than 1.5 mm thick. Doors and end panels shall be made from painted sheet, not less than 1.5 mm thick.

Cabinets shall have permanently installed lifting eye bolts.

Cabinets shall have arrangements for fastening it to the floor. Cabinets shall be firmly fastened to the floor with minimum 4 bolts.

Cabinets shall have locking device which requires a key to unlock.

The location of the entry point for cable shall be adapted to the conditions where the cabinet is placed.

All cabinets shall have the same colour of the paint. The choice of colour shall be co- ordinated with the colour of the switchgear assemblies.

Mounting planes shall be galvanized and have good galvanic contact with each other and with the cabinet frame.

Cabinets shall have arrangements for effective potential equalization of the cabinet and the mounting planes and for grounding of cable shields and protective conductors.

Cabinets shall have arrangements for fastening of external cables throughout the complete length of the cables.

Cabinets shall have lighting by a light bulb, or other light source from which there is no UV-radiation. The lighting fixture shall be installed in the top inside the cabinet, and shall turn on automatically when the doors are opened.

Assemblies

The assemblies shall be factory built.

Apparatus, equipment etc. shall be installed on DIN-rails. The DIN-rails shall be fastened, by screws, on mounting planes.

Cables shall be run in cable channels. The cable channels shall be fastened, by screws, to the mounting planes.

The assemblies shall be made in such a way that apparatus etc is easily accessible for installation, fault finding and dismantling of the apparatus etc through the open front doors, without having to enter into the cabinet.

Interface relays, terminal blocks etc shall be arranged in separate object-oriented groups, each group being related to a single process object.

Degree of protection shall be IP 2X.

Engineering tool

The Project Management tool shall comply with the EN 61131-3 programming language standard. The Project Managering tool shall comprise a laptop type computer with colour monitor, qwerty- type keyboard (Ukrainian layout) with numerical keypad and mouse with optical reader. The monitor shall be flat panel type with screen size 15.6 inch diagonal (16:9), resolution 1600 x 900.

Language

The Project Managering tool shall use English language or Ukrainian language.

Network Components

Network components shall have indicators for the operational status. Network components shall be industrial-type.

Degree of protection shall be IP 2X.

The component shall be installed in cabinets. The network components may be installed in the same cabinets as Process controllers.

If the components require any management, the tools shall be installed in or accessible from the Project Managering tool.

Cabinets and Assemblies for Machines, Local Control, etc

This text refers to cabinets that are produced and intended for a specific purpose, for instance to control a single machine or to serve as a local control panel.

Cabinets

The cabinets shall be factory built. Floor-standing cabinets shall have skirting (ca. 100 mm high).

Cabinets shall have arrangements for fastening it. Cabinets shall be firmly fastened with minimum 4 bolts.

Cabinets shall have locking device which requires a key to unlock.

Mounting frames and mounting planes shall be galvanized and have good galvanic contact with each other and with the cabinet frame.

Cabinets shall have arrangements for effective potential equalization of the cabinet and the mounting planes and for grounding of cable shields and protective conductors.

Cabinets shall have arrangements for fastening of external cables. From where the cable enters the cabinet and throughout the complete length of the cable within the cabinet.

Cabinets of heights 800 mm or more shall have lighting by a light bulb, or other light source from which there is no UV-radiation. The lighting fixture shall be installed in the top inside the cabinet, and shall turn on automatically when the doors are opened.

Cabinets for installation indoors in dry rooms

Cabinets shall be made from galvanized sheet steel: The frame not less than 2 mm thick and other parts not less than 1.5 mm thick. Doors and end panels shall be made from painted sheet steel, not less than 1.5 mm thick.

Degree of protection shall be IP 2X.

The location of the entry point for cable shall be adapted to the conditions where the cabinet is placed.

Cabinets for installation indoors in process rooms and outdoors

Cabinets shall be made from acid-proof stainless steel. Degree of protection shall be IP 65.

Cable entry shall be from the bottom.

Cabinets for installation outdoors, shall have transparent weather protection (IP 3X) over all apparatus (meters, push-buttons, indicator lights etc) which break through a cabinet wall.

Cabinets for installation outdoors, and which contains other equipment than switches and indicator lights shall have self-contained anti-freeze and anti-condensation heater.

Assemblies

The assemblies shall be factory built.

Apparatus, equipment etc. shall be installed on DIN-rails. The DIN-rails shall be fastened, by screws, on mounting planes.

Cables shall be run in cable channels. The Cable channels shall be fastened, by screws, to the mounting planes.

The assemblies shall be made in such a way that apparatus etc is easily accessible for installation, fault finding and dismantling of the apparatus etc through the open front doors, without having to enter into the cabinet.

Degree of protection shall be IP 2X.

Applications in Process Control Systems

Introduction

This chapter describes general requirements on software applications in the Process control system.

The term “application” refers to program functions and characteristics, independent of whether a program function or characteristic, in a specific make or model of system, belongs to the system software, or if the function or characteristic has to be developed by the application engineer during the project implementation period.

As a general rule, this document does not specify in which part of the Process control system a specific program function or characteristic is to be realized, but focuses mainly on describing the requirements of the program function or characteristic.

In order to establish reliable and uniform control functions and operators interfaces, representations of ordinary physical process objects, e.g. electrical motor drives, valves, transmitters, as well as ordinary logical objects e.g. controllers and sequences, shall be based on type solutions. Type solutions are described in a separate subsection of this chapter.

Language

Texts shall be in Ukrainian language.

General

Variables of data type “Real” shall be treated in their corresponding engineering unit. Analogue inputs I/O are to be scaled to engineering units as they are being read from the input channel, before the value is used by any function in the system. Analogue outputs I/O shall be scaled from engineering unit as the value is being written to the output channel. In cases where communication protocols that do not support transmission of variables of data type “Real” are used, these variables shall be transmitted as integers or double integers and in this case the decimal point shall temporarily be adjusted in order to make all significant numbers fit into the chosen format during transmission.

Applications shall be designed in such a way that control functions, settings and selected control modes will not be affected by changes of state in other units than the one where the respective function is implemented.

Whenever the system starts for instance when power returns after power failure, the applications has to be reset-executed before any writing to outputs is made. Special consideration has to be given to circuits for which outputs have been configured for fault control in order to make sure that the start-up of the system is made bumpless.

User Authority Levels

The existing authority levels in the existing SCADA system are used.

Event Handling

The existing event handling system in the existing SCADA system is used. Event texts and alarm event texts are constructed in the same way as for existing events and alarm events of corresponding type.

Types of event

System alarm event

System alarm events are generated by the system and indicate a fault or failure in the

Process control system, for instance:

• Fault or failure of a communications link

• Fault or failure in a network unit

• Fault or failure in a central unit

• Fault or failure in a Process controller

• Fault or failure in an I/O-module

Process alarm events and process events

Process alarm events and process events are generally generated by process objects.

Controller Program Structure

The program structure has to follow the plant's functional structure.

Plant
- Process section #1
  - Common code
  - Object #1
  - Object #2
  - Object #n
- Process section #2
  - Common code
  - Object #1
  - Object #2
  - Object #n
- Process section #n
  - Common code
  - Object #1
  - Object #2
  - Object #n

Each part of code has to be separate from other parts of code.

It has to be easy to distinguish between code that belongs to type solutions and other code.

Display Structure

The display structure shall follow the existing structure in the existing SCADA system.

Display Screen Layout

The display screen layout shall follow that of the existing displays in the existing SCADA system.

Display Types And Contents

General

The display name and description shall always be shown in the top center of the display.

Overview displays

Overview displays shall be built from information in the process flow diagrams. It shall offer navigation possibilities to other displays.

Process displays

Process displays shall be built from information in the process flow diagrams. They shall offer the same degree of detail as the diagram, but also contain dynamic information on each process object. The general presentation symbol for real (analogue and integer) values shall be “numeric value”. Values which indicate levels (e.g. in tanks) shall also to be presented with a bar graph. The bar graph shall be located inside the symbol of the object concerned (e.g. tank), adjacent to the “numeric value”. Navigation facilities to, in respect to the process flow, preceding and subsequent displays shall be provided at each process flow line, where the flow line enters or leaves the display.

Trend displays

Traces in trend displays shall be grouped according to correlation of variables. As a rule, a trend display shall not contain more than 8 traces.

System displays: Process control system

The main purpose of system displays is to present information which is related to the process control system and to facilitate fault tracing of the system.

System displays shall contain a schematic representation of the Process control system , complete with dynamic information to indicate run and fault status for units and communication links.

System displays: Other systems which communicates with the process control system

The displays shall be based on information in overview diagrams. The scope of dynamic information to be presented in the displays is the same as the information which is specified for communication with the Process control system for the respective system.

Other displays

Displays containing parameter sets and other settings which the operator may need to change.

Texts, Lines, Symbols and Colours

Texts, lines, symbols and colours shall follow that used in the existing SCADA system.

Display Design Guidelines

The displays shall be designed similar to the existing displays in the existing SCADA system.

Display Presentation, Dialogue and Maneuvering

The means and methods used for presentation and for dialogue and maneuvering shall follow those used in the existing SCADA system.

Display Names And Descriptions

The displays names and descriptions shall be designed similar to that of existing displays in the existing SCADA system.

System Supervision

The system shall comprise functions for supervision of all units, communication links, power supplies and fuses. Faults shall be indicated as system alarm events.

Type Solutions

General Properties for Type Solutions

General

In order to establish reliable and uniform control functions and operators interfaces, representations of ordinary physical process objects, for instance electrical motor drives, valves, transmitters, as well as ordinary logical objects such as controllers and sequences, shall be based on type solutions. A type solution comprises control code, process

I/O-interface and operator's interface, including alarm event handling. Adding complementary logic and functions without disrupting the integrity of the type solution makes adaptations to each object individual.

An attribute which is common to more than one object type shall have the same representation (e.g. text, signal description) for all object types.

The objective of this description is to describe the required attributes of each object type but without specifying each solution in detail. The purpose of this approach is to make it possible for the system integrator to base the design on existing "system standard object types libraries". Therefore the description focuses on describing the interfaces of the object types:

1. The operator's interface,
2. The process interface,
3. The program interface.

The functions described support one or more of these aspects.

Texts in subsections of this general section are valid for all object types. For each object type there is a corresponding subsection. Texts in these sections are, unless otherwise is explicitly stated, complementary. The priority order between subsections is:

1. Texts in the object type specific subsection
2. Texts in the general subsection.

Process interface

The process interface is specific to each object type.

Control modes

Existing control modes are, in order of priority:

1. Local; The object is controlled from a local control panel, separate to the Process control system.
2. Tracking; The object is tracking an external signal source.
3. Manual; The object is controlled from the operator workplace via the signal interface to the existing operator system.
4. External; The object use set points from other objects or signal sources.
5. Auto; The object is controlled from, other objects or signal sources

Object types which have "Local" control mode, have functions for blocking of alarm events which are inappropriate in "Local" control mode.

Changes of control modes are persistent i.e. the object remains in the last selected control mode until a new change is ordered.

Supervision

0/4..20 mA signals are supervised for overflow. 4..20 mA signals are also supervised for underflow. The supervision function output goes active when there is an underflow or an overflow.

A supervision function has the same effect on the object independent of which is the selected control mode, except for when "Local" control mode is selected for the object concerned.

Interlock

Interlock exists for all object types except analogue transmitter and analogue output and digital switch and digital output.

Interlock is separate from control orders.

For object interaction reasons, objects which can be interlocked has an output status variable indicating whether the object is interlocked or not.

Three types of interlock are identified:

1. Protection trip, Fault and (not) Ready for operation (e.g. MCCB tripped, power failure, safety switch open)
2. Safety interlock (e.g. emergency stop or pressure switch)

3. Process interlock.

Process interlock are separated in two classes:

a. Class A: Interlock conditions which normally are de-activated prior to operation of the interlocked object, as part of orders given by a superior automatic sequence which operates on both the object causing the interlock and on the interlocked object. Class A interlock conditions are for this reason not included in the output variable which indicates that the object is ready for operation.

b. Class B: Other interlock conditions which are related to the process. Interlock has the same effect on the interlocked object, irrespective of its control mode. The operator has the possibility to override all interlock, except for safety interlock.

Functions

For object types which have blocking functions, there are possibilities to de-block via program controlled de blocking order.

For object types which have control mode "Local", a change from control mode "Local"

generates a de-blocking order.

Presentation

General

This subsection describes how static and dynamic information shall be presented in displays.

Symbols

Real values (in the following called "analogue" values) and integer values shall be presented as (for each dynamic point individually):

Numeric value, scalable size, and configurable total number of figures and number of decimals

Bar graph, scalable size, including indication of alarm limits

Boolean values (in the following called "digital" values) are to be presented as (for each dynamic point individually):

Rectangle, scalable size, configurable to be filled in the "on" state, or in the "off" state

Circle, scalable size, configurable to be filled in the "on" state, or in the "off" state

Text, scalable size, configurable to be displayed in the "on" state, or in the "off" state

Motor symbols: General motor, pump and fan, scalable size, configurable direction, filled in the "in operation" state

Additional symbols to all object types:

"Control mode". The symbol for each control mode has to be unique amongst other symbols and uniform for all object types

Additional symbols to variable speed motor drives:

Selected source for the set point. The symbol has to be unique amongst other symbols and uniform for all object types

Additional symbols to objects which have supervision functions, blocking functions or interlock functions:

Supervision function active. The symbol has to be unique amongst other symbols and uniform for all object types

Interlock active. It has to be possible to distinguish process interlock class A from class B. Each symbol has to be unique amongst other symbols and uniform for all object types.

"Interlock overridden". The symbol has to be unique amongst other symbols and uniform for all object types

Blocking function is active. The symbol has to be unique amongst other symbols and uniform for all object types

Additional symbols to objects which have alarm event functions:

One or more active or unacknowledged alarm events. The symbol has to be unique amongst other symbols and uniform for all object types

Additional symbols to objects which have alarm event blocking functions:

The alarm event blocking function is active. The symbol has to be unique amongst other symbols and uniform for all object types

Dialogue and maneuvering

A click on the desired dynamic object in a display shall open the object's face plate and start the object dialog. The face plate shall be updated dynamically, and shall always contain:

Reference designation

Description

Dynamic variables (as applicable for each object type: on, off, open, closed, process value, alarm limit status (each limit), blocking function, interlock (each interlock), alarm limit (each limit) and hysteresis, set point, output signal, control modes, control order). For each variable:

Descriptive text

Presentation of effective status or value complete with engineering unit for real and integer values and class and priority for alarm event limits

Possibility to modify the changeable variables

Alarm event acknowledge button.

Trim curve display (update interval: 1 s, length: 6 min) (if necessary in separate window, accessible via open button)

Trend display window open button

Face plate close button

The Y-range for traces in trim curve displays and in trend displays shall use the value range of the presented variable.

Manoeuvring rights for the same one object individual shall be granted to only one operator workplace at the time. There shall be functions that enable the operator to request for permission to manoeuvre as well as to cancel the granted rights. If there has been no operator activity within a set time (few minutes), the rights shall be automatically cancelled.

Event handling

Texts in the subsections below are applicable to all object types.

Alarm events

An analogue value shall trigger an alarm event when it goes below each one of two independent low limit values and when it goes above each one of two independent high limit values. For each analogue value there shall be an adjustable alarm event delay time. The delay time may be common to all alarm event limits which refers to the same value. The alarm event priorities shall be assigned similar to the priority used for similar alarm events in the existing SCADA system.

Digital values shall trigger an alarm event when it leaves the normal state. Each digital value shall have an adjustable delay time. The alarm event prioritiy shall be assigned similar to the priority used for similar alarm events in the existing SCADA system. For each value there shall be the option to disable the generation of the alarm event. As a rule, feedback signals (e.g. contactor feedback, open and close limit switches) that do not have a defined normal position, shall not generate any alarm event.

Alarm event blocking functions shall be possible to activate from a program. Output signals shall generally not have any alarm event handling.

Alarm event indication

Once triggered, an alarm event shall always indicate until the operator acknowledges the alarm event. After having been acknowledged, the alarm event shall indicate as long as it is still active.

object level, whereas in lists and face plates each individual alarm event shall be indicated separately.

Events

Generally, the return of a signal from the active alarm state shall trigger an event. Generally, each operator action shall trigger an event.

Historian

Historian is specific to each object type.

Analogue Transmitter

General

The Analogue transmitter type uses a value from the process, but may also use a value calculated by the system. Process signals are converted to engineering unit before they are being used in the system. Except for the conversion, process values and values which are calculated by the system are treated in the same way.

Process interface

Signal description	Signal type and direction
Process value	Analogue input variable from I/O-channel
Transmitter fault as applicable)	Digital input variable from I/O-channel
Protection trip-N (as applicable)	Digital input variable from I/O-channel

Control modes

- Manual (use simulation value)
- Auto

Supervision

According to information in the general section.

Transmitter fault

The supervision function goes active when the related digital input becomes active.

Protection trip-N

The supervision function goes active when the related digital input becomes active.

Interlock

Not applicable.

Functions

Change of control mode to “MANUAL” is bumpless with respect to the process value.

Presentation

According to information in the general section.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

Alarm events limits: status and settings for limit values. It shall be possible to modify the limit values

Alarm events blocking: status. It shall be possible to activate and de-activate operator controlled alarm event blocking

Process value:

status for signal supervision

current value. It shall be possible to modify the value (modification shall be possible only if the effective control mode is "MANUAL")

range (min and max values)

Transmitter fault: status

Protection trip-N: status

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for the process value.

Event handling

According to information in the general section. Alarm event handled variables:

Process value

Process value signal supervision

Transmitter fault

Protection trip-N

Historian

Logged variables:

Process value

Digital Switch

General

Digital switch use values from the process, but may also use a value calculated by the system. Process values and values which are calculated by the system are treated in the same way.

Process interface

Signal description	**Signal type and direction**
Process value	Digital input variable from I/O-channel
Protection trip-N (as applicable)	Digital input variable from I/O-channel

Control modes

Manual (use simulation value)

Auto

Supervision

Protection trip-N

The supervision function goes active when the related digital input becomes active.

Interlock

Not applicable.

Functions

Change of control mode to “MANUAL” is bumpless with respect to the process value.

Presentation

According to information in the general section.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

Alarm event status (deviation from the normal position).

Alarm event blocking: status. It shall be possible to activate and de-activate operator controlled alarm event blocking

Process value:

current value. It shall be possible to modify the value (modification shall be possible only if the effective control mode is "MANUAL")

Protection trip-N: status

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for the process value.

Event handling

According to information in the general section. Alarm event handled variables:

Process value

Protection trip-N

Historian

Logged variables:

Process value

Pulse Counter

General

The source signal for the pulse counter is typically a process value, which is read via a digital input channel, but it may also be a value which is calculated by the system. Process values and values which are calculated by the system are treated in the same way.

Process interface

Signal description	**Signal type and direction**
Process value source	Digital input variable from I/O-channel
Protection trip-N (as applicable)	Digital input variable from I/O-channel

Control modes

Manual (use simulation value)

Auto

Supervision

Protection trip-N

The supervision function goes active when the related digital input becomes active.

Interlock

Not applicable.

Functions

Change of control mode is bumpless with respect to the counted value.

The pulse increment is set using the Project Managering tool. The increment is entered in engineering units, where one increment corresponds to one pulse in the source signal. The pulse counter output is the sum of the increments. It is possible to set the pulse counter output to a pre-set value from a control program.

A separate function summarizes, on a continuous minute-to-minute basis, the number of pulses. At each change of minute, the summarized value for the finished minute is multiplied by the pulse increment and stored, on a rolling basis, for yet another minute for logging purposes.

Presentation

According to information in the general section. The format is similar to “Analogue transmitter”. The pulse counter output is presented.

Dialog and manoeuvring

According to information in the general section. The format is similar to “Analogue transmitter”. In control mode “MANUAL”, the operator can set the counted value.

Dynamic variables are:

- Alarm events limits: status and settings for limit values. It shall be possible to modify the limit values
- Alarm events blocking: status. It shall be possible to activate and de-activate operator controlled alarm event blocking
- Pulse counter output value:
  - Current value. It shall be possible to modify the value (modification shall be possible only if the effective control mode is "MANUAL")
  - range (min and max values)
- Protection trip-N: status
- Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for the counted value.

Event handling

According to information in the general section. Alarm event handled variables:

- Pulse counter output value
- Protection trip-N

The pulse counter has two high limit alarm events, but no low limit alarm events.

Historian

Logged variables:

- Stored minute-to-minute value

Motor

General

The type solution is a functional unit for single speed motor drives as well as for continuously variable speed motor drives.

Process interface

All object individuals have:

Signal description	**Signal type and direction**

Remote (the local-remote selector switch is in remote position)	Digital input variable from I/O channel
Ready for operation (MCCB closed and MCB for control power closed/frequency converter/soft starter ready for operation, safety switch closed)	Digital input variable from I/O channel
Protection trip-N (single speed motors) / Fault-N (variable speed motors)	Digital input variable from I/O channel
In operation	Digital input variable from I/O channel
Start-order	Digital output variable to I/O channel

Two-direction single speed motor drives also have:

Signal description	**Signal type and direction**
In operation in reverse direction	Digital input variable from I/O channel
Signal description	Signal type and direction
Start-order in reverse direction	Digital output variable to I/O channel

Continuously variable speed motor drives also have:

Signal description	**Signal type and direction**
Speed set point(engineering unit "%")	Analogue output variable to I/O cha nnel
Reverse direction order	Digital output variable to I/O channel
Motor current(engineering unit "A")	Analogue input variable from I/O channel

Control modes

Local

Manual

Auto

Continuously variable speed motor drives have a separate selection of control mode for the source for the speed reference:

Local speed reference, the speed reference is set locally

Manual speed reference, the speed reference is set by the operator

Auto speed reference, the speed reference is set from a program

On change from "Local" control mode, the previous control mode is reselected by the control logic.

Supervision

According to information in the general section.

Start order discrepancy

The supervision function goes active when there has been a discrepancy between the start control-order and the "in operation" feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

High and low motor current

The supervision function goes active if the effective motor current exceeds the set limit (preselected: the object individual nominal current) for more than a, per object individual, set delay time (pre-selected to 5 s).

The supervision function goes active if the effective motor current falls below the set limit (preselected: 0) for more than a, per object individual, set delay time (pre-selected to 5 s), under the condition that there is a start-order for the object.

Interlock

According to information in the general section.

Functions

Start-order discrepancy supervision

The supervision function stops the object individual and blocks further start-orders until a de-block order is given.

Interlock

Interlock stops the object individual. Start-order is inhibited for as long as there is an active interlock.

Start and stop

Start and stop orders are subordinate to the selected control mode. Stop-order is superior to start-order.

Orders that are given by the operator are not persistent; Orders which are not executed at the time when they are given, are reset.

Change of control mode

Change of control mode to “MANUAL” is bumpless with respect to control orders.

Change of control mode, speed reference

Change of control mode to “MANUAL” is bumpless.

Change of directions

Change of directions orders are subordinate to the selected control mode. Single speed motor drives

If the object individual is in operation when the change of directions is being ordered, the control logic stops the object. Operation of the object individual is then be inhibited for a set delay time (pre-selected to 10 s), after which the control logic issues a start-order in the selected direction.

Continuously variable speed motor drives

If the object individual is in operation when the change of directions is being ordered, the speed reference decreases following a linear ramp function, the slope being configurable per object individual, until the effective speed reference is zero, after which the control logic orders stop of the object. Operation of the object individual is then inhibited for a set delay time (pre-selected to 10 s), after which the control logic issues a start-order in the selected direction, and increase the speed reference, following the same ramp slope, until the set speed reference is reached.

Speed reference

In control mode "AUTO speed reference", the manual speed reference tracks the auto speed reference.

“In operation” time measuring

The function summarizes, on a continuous minute-to-minute basis, with resolution 1 s, the time “in operation”. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Number of starts counting

The function summarizes, on a continuous minute-to-minute basis, the number of starts. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Presentation

According to information in the general section.

The effective direction of speed shall be indicated with an arrow.

Continuously variable speed motor drives also indicate the value for the effective speed reference, and the selected control mode for the speed reference.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

- Alarm events limits: status and settings for limit values. It shall be possible to modify the motor current limit values
- Supervisions: status
- Motor current (where applicable)
  - status for signal supervision
  - Current value
  - range (min and max values, adapted to each object individual)
- Interlock: status. Interlock override: status. Descriptive texts are to be adapted to each object individual interlock signal. It shall be possible to modify the override order
- Blocking: status
- De-block order
- “In operation” feedback: status
- Direction of speed feedback: status
- Start, stop and direction of rotation-orders. It shall be possible to modify the control order (modification shall be possible only if the effective control mode is "MANUAL")
- Effective speed reference: current value. It shall be possible to modify the speed reference (modification shall be possible only if the effective control mode is "Manual speed reference")
- Speed reference range (min and max values)
- Control mode: status. It shall be possible to modify the control mode
- Control mode for speed reference: status. It shall be possible to modify the control mode for speed reference

The trim curve display and the trend display shall have traces for “In operation” and for the motor current (where applicable).

Event handling

According to information in the general section. Alarm event handled variables:

- Motor current signal supervision
- Motor current high and low limits supervision
- Speed reference signal supervision
- Start order discrepancy supervision
- Ready for operation
- Protection trip-N

Historian

Logged variables:

- “In operation” feedback
- Motor current (where applicable)
- Effective speed reference
- “In operation” time
- Number of starts

Shut-Off Valve including Solenoid Valve

General

The type solution is a functional unit for shut-off valves and for solenoid valves.

A valve has a fail position. For a solenoid valve, this position is normally the position that the valve takes when there is no power applied to the actuator. Interlock and monitoring functions orders the valve to the fail position. The fail position is configurable for each object individual.

Process interface

All object individuals have:

Signal description	**Signal type and direction**
Protection trip-N (solenoid valve)/Fault-N (valve with electrical motor actuator)	Digital input variable from I/O channel
Remote (the local-remote selector switch is in remote position)	Digital input variable from I/O channel
Open (open-order)	Digital output variable to I/O channel

Bistable solenoid valves also has:

Signal description	**Signal type and direction**
Close (close-order)	Digital output variable to I/O channel

Valves which are operated by electrical motor actuators also have:

Signal description	**Signal type and direction**
Ready for operation	Digital input variable from I/O channel
Open	Digital input variable from I/O channel
Closed	Digital input variable from I/O channel
Torque-switch opening direction	Digital input variable from I/O channel
Torque-switch closing direction	Digital input variable from I/O channel
Close (close-order)	Digital output variable to I/O channel
Stop (stop-order)	Digital output variable to I/O channel

Valves which are operated by electrical motor actuators, and which do not have an integrated positioner, also has:

Signal description	**Signal type and direction**
In operation in opening direction	Digital output variable to I/O channel
In operation in closing direction	Digital output variable to I/O channel

Control modes

Local

Manual

Auto

On change from "Local" control mode, the previous control mode is reselected by the control logic.

Supervision

According to information in the general section.

Position discrepancy

The supervision function goes active when there has been a discrepancy between the position control-order and the position feedback signal ("Opened" and "Closed" respectively) for more than a, per object individual, set delay time (pre- selected to 10 s).

Open-order discrepancy (only objects which are operated by electrical motor actuators, and which do not have an integrated motor starter)

The supervision function goes active when there has been a discrepancy between the open-order and the "in operation in opening direction" feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

Close-order discrepancy (only objects which are operated by electrical motor actuators, and which do not have an integrated motor starter)

The supervision function goes active when there has been a discrepancy between the close-order and the "in operation in closing direction" feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

Actuator opening torque high

The supervision function goes active if the torque-switch, opening direction becomes active.

Actuator closing torque high

The supervision function goes active if the torque-switch, closing direction becomes active.

Interlock

According to information in the general section.

Functions

Position discrepancy

The supervision function orders the object to the fail position, and blocks further control orders, until a de-block order is given.

Open-order discrepancy supervision (only objects which are operated by electrical motor actuators, and which do not have an integrated motor starter)

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Close-order discrepancy supervision (only objects which are operated by electrical motor actuators, and which do not have an integrated motor starter)

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Actuator opening torque high supervision

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Actuator closing torque high supervision

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Interlock

All interlock orders the object individual to the fail position. Control orders are inhibited for as long as there is an active interlock.

Open and close

<u>All valves</u>

Open and close-orders are subordinate to the selected control mode. Orders towards the fail position are superior to other orders.

Orders which are given by the operator are not persistent; Orders which are not executed at the time when they are given, are reset.

Object individuals which do not have one or any of the position feedback-signals, uses the respective control-order as position-feedback signal to indicate the position.

Bistable solenoid valves:

The related control order is de-activated when the respective position feedback signal becomes active.

Valves which are operated by electrical motor actuators:

The open and close control orders are de-activated when the respective position feedback signal becomes active. The stop order is activated when there is no open or close control order and is de-activated when there is an open or close control order.

Change of control mode

Change of control mode to “MANUAL” is bumpless with respect to control orders.

Number of operations counting

The number of operations is summed up and increased by 1 every time the “Opened” feedback signal or the “Closed” feedback signal goes active for the object.

The function summarizes, on a continuous minute-to-minute basis, the number of operations. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Presentation

According to information in the general section.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

Alarm events: status

Supervisions: status

Interlock: status. Interlock override: status. Descriptive texts are to be adapted to each object individual interlock signal. It shall be possible to modify the override order

Blocking: status

De-block order

“Open” and “Closed” feedback: status

Open and Close-orders. It shall be possible to modify the control order(modification shall be possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have a trace for “open” feedback.

Event handling

According to information in the general section. Alarm event handled variables:

Position discrepancy supervision

Open-order discrepancy supervision

Close-order discrepancy supervision

Actuator opening torque high supervision

Actuator closing torque high supervision

Ready for operation

Protection trip-N

Fault-N

Historian

Logged variables:

"Open" feedback

"Closed" feedback

Number of operations

Control Valve

General

The type solution is a functional unit for control valves. The text covers valves with integrated positioner and analogue position reference signal as well as electrical motor actuator operated valves with three state control that do or do not have an integrated motor starter.

Process interface

All object individuals have:

Signal description	**Signal type and direction**
Protection trip-N (valve with electrical motor actuator without integrated positioner) (control power is available and the actuator is ready for operation) / Fault-N (valve with integrated positioner)	Digital input variable from I/O channel
Ready for operation	Digital input variable from I/O channel
Remote (the local-remote selector switch is in remote position)	Digital input variable from I/O channel
Open (as applicable)	Digital input variable from I/O channel
Closed (as applicable)	Digital input variable from I/O channel
Torque-switch opening direction	Digital input variable from I/O channel
Torque-switch closing direction	Digital input variable from I/O channel
Position (feedback)	Analogue input variable from I/O-channel

Objects which do not have one or some of the listed physical I/O interfaces, use:

To indicate "Remote": Constant "true"

To indicate "Open" and "Closed": Comparison to input position feedback (>= 98 % = "Open", <= 2 % = "Closed") or, if this signal does not exist: output position reference (100 % ="Open", 0 % = "Closed")

To indicate "Position" feedback:

Objects with integrated positioner shall use the output reference

Objects without integrated positioner shall use the calculated value from the actuator control logic, as described below

Control valves with integrated positioner and analogue control signal shall also have:

Signal description	**Signal type and direction**
(control order)	Analogue output variable to I/O-channel

Control valves with three state control shall also have:

Signal description	Signal type and direction
Open (open-order)	Digital output variable to I/O-channel
Close (close-order)	Digital output variable to I/O-channel
Stop (stop-order)	Digital output variable to I/O-channel

Control valves three state control but without integrated positioner shall also have:

Signal description	Signal type and direction
In operation in opening direction	Digital input variable from I/O channel
In operation in closing direction	Digital input variable from I/O channel

Control modes

Local

Manual

Auto

On change from "Local" control mode, the previous control mode is reselected by the control logic.

Supervision

According to information in the general section.

Position discrepancy

The supervision function goes active when the discrepancy between the ordered position and the position feedback signal is larger than a, per object individual, set value (pre- selected to 2 %) for more than a, per object individual, set delay time (pre-selected to 10 s).

End-position discrepancy

The supervision function goes active if the “Opened” or “Closed” feedback signals respectively has not become active even though the effective position reference has been = 0 % or 100 % respectively for more than a, per object individual, set delay time (pre- selected to 300 s).

Open-order discrepancy (only objects which are operated by electrical motor actuators, and which do not have an integrated positioner)

The supervision function goes active when there has been a discrepancy between the open-order and the “in operation in opening direction” feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

Close-order discrepancy (only objects which are operated by electrical motor actuators, and which do not have an integrated positioner)

The supervision function goes active when there has been a discrepancy between the close-order and the “in operation in closing direction” feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

Actuator opening torque high

The supervision function goes active if the torque-switch, opening direction becomes active.

Actuator closing torque high

The supervision function goes active if the torque-switch, closing direction becomes active.

Interlock

According to information in the general section.

Functions

Position discrepancy

The supervision function has no functional influence on the object.

End-position discrepancy

The supervision function has no functional influence on the object.

Open-order discrepancy supervision (only objects which are operated by electrical motor actuators, and which do not have an integrated positioner)

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Close-order discrepancy supervision (only objects which are operated by electrical motor actuators, and which do not have an integrated positioner)

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Actuator opening torque high supervision

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Actuator closing torque high supervision

The supervision function de-activates the control order, and blocks further control orders, until a de-block order is given.

Interlock

Control orders are inhibited for as long as there is an active interlock.

Positioning

All valves

Position-orders are subordinate to the selected control mode.

The position reference is always limited to the, per object individual, set low and high limit values (pre-selected to 0 % and 100 % respectively).

Objects with integrated positioner and analogue control signal

The effective position reference signal controls the object, within set limits.

Objects with three state control, with or without integrated positioner

The effective position reference is continuously compared to the actual position. If the two values differs more than a, per object individual, set dead-zone value (pre-selected to 1 %), an open-, or a close-order respectively is activated for a time which is calculated as described below. For the object to be able to position correctly, the estimated time that is required by the actuator in order for it to reach the correct position is calculated as ([actual position difference (%)]/[maximum position difference (100 %)] * [actuator travel time between end positions (s)] + [actuator motor excitation time (s)]). These parameters is set for each object individual.

To allow for stabilization after a change of position, consecutive control orders in the same direction are blocked for a, per object individual set time (pre-selected to 0 s), and control orders in the opposite directions are blocked for a, per object individual set time (pre-selected to 0 s).

For object individuals that do not have any position feedback signal, the position feedback signal is calculated. The calculation integrates the calculated value by ([maximum position difference (100 %)]/[actuator travel time between end positions (s)]*[order activation time (s)]-[actuator motor excitation time (s)]) in positive direction for "Open-orders", and in negative direction for "Close-orders". Every time an end-position feedback signal becomes activated, the calculated value is set to the value which corresponds to the respective end-position.

N.B. The formulas and parameters described above are general. Some systems feature more sophisticated formulas for these types of calculation. If so, these formulas are used instead.

Change of control mode

Change of control mode to "MANUAL" is bumpless with respect to control orders.

Number of operations counting

General

The function summarizes, on a continuous minute-to-minute basis, the number of operations. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Objects without integrated positioner

The number of operations is summed up and increased by 1 every time the “In operation, in opening direction” or the “in operation, in closing direction” feedback signal goes active for the object.

Objects with integrated positioner or with three state control and integrated positioner

The number of operations is summed up and increased by 1 every time the absolute difference between the “Position” feedback signal and a comparison value (described below) is larger than a, per object individual set value (pre-selected to 1 %).

The source signal for the comparison value is the position feedback value, which is latched every time there is an increase of sum of operations.

Presentation

According to information in the general section.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

Alarm events limits: status and setting for limit values. It shall be possible to modify the position discrepancy limit value

Supervisions: status

Interlock: status. Interlock override: status. Descriptive texts are to be adapted to each object individual interlock signal. It shall be possible to modify the override order

Blocking: status

De-block order

“Open” and “Closed” feedback: status

Position feedback: current value

Position reference low and high limits: status and settings for limit values. It shall be possible to modify the low and high limit values

Position reference-position feedback deviation dead-zone limit value: setting. It shall be possible to modify the dead-zone limit value

Effective position reference: current value. It shall be possible to modify the position reference (modification shall be possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for effective position reference and position feedback.

Event handling

According to information in the general section. Alarm event handled variables:

Position feedback signal supervision

Position reference signal supervision

Position discrepancy supervision

End-position discrepancy supervision

Open-order discrepancy supervision

Close-order discrepancy supervision

Actuator opening torque high supervision

Actuator closing torque high supervision

Ready for operation

Protection trip-N

Fault-N

Historian

Logged variables:

Effective position reference

Position feedback

Number of operations

General Machine

General

The “General machine” type solution is used to interface process objects which have their own control panel. All machines are unique individuals. The type solution states general attributes.

Process interface

The interface is unique for each type of machine. At minimum all object individuals shall have:

Signal description	**Signal type and direction**
Remote (the local-remote selector switch is in remote position)	Digital input variable from I/O channel
Ready for operation (MCCB closed and MCB for control power closed, safety switch closed)	Digital input variable from I/O channel
Protection trip-N	Digital input variable from I/O channel
In operation	Digital input variable from I/O channel
Start-order	Digital output variable to I/O channel

Control modes

Local

Manual

Auto

On change from "Local" control mode, the previous control mode is reselected by the control logic.

Supervision

According to information in the general section.

Start order discrepancy

The supervision function goes active when there has been a discrepancy between the start control-order and the “in operation” feedback signal for more than a, per object individual, set delay time (pre-selected to 5 s).

Interlock

According to information in the general section.

Functions

Start-order discrepancy supervision

The supervision function stops the object individual and blocks further start-orders until a de-block order is given.

Interlock

All interlock stops the object individual. Start-order is inhibited for as long as there is an active interlock.

Start and stop

Start and stop orders are subordinate to the selected control mode. Stop-order is superior to start-order.

Orders which are given by the operator are not persistent; Orders which are not executed at the time when they are given, are reset.

Change of control mode

Change of control mode to “MANUAL” is bumpless with respect to control orders.

“In operation” time measuring

The function summarizes, on a continuous minute-to-minute basis, with resolution 1 s, the time “in operation”. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Number of starts counting

The function summarizes, on a continuous minute-to-minute basis, the number of starts. At each change of minute, the summarized value for the finished minute is stored, on a rolling basis, for yet another minute for logging purposes.

Presentation

According to information in the general section.

Objects are presented with a digital symbol. The symbol reflects the status of the “in operation” signal.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

Alarm events limits: status

Supervisions: status

Interlock: status. Interlock override: status. Descriptive texts are to be adapted to each object individual interlock signal. It shall be possible to modify the override order

Blocking: status

De-block order

“In operation” feedback: status

Direction of speed feedback: status

Start and stop orders. It shall be possible to modify the control order (modification shall be possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

If an object individual has any feedback signals, their current value or status is shown with a descriptive text next to it. Analogue feedback signals have monitoring of the signal status and adjustable signal range and high and low alarm limits. Adjustable parameters such as setpoint signals, are shown with a descriptive text next to it. The information may be implemented directly in the faceplate, or in a separate window. In the latter case, there is a control button in the face-plate which, when activated, calls up the window.

The trim curve display and the trend display shall have trace for “In operation” feedback and for analogue feedback signals.

Event handling

According to information in the general section. Alarm event handled variables:

Generic monitors

Start order discrepancy supervision

Ready for operation

Protection trip-N

Historian

Logged variables:

"In operation" feedback

"In operation" time

Number of starts

PID-Controller

General

The type solution is a functional unit for PID-controllers. The text covers stand-alone controllers and cascade controllers (master-slave).

The controller is a software function that normally interacts with the process via other object individuals.

Process interface

The object does not have any hardware I/O. Typically, unless it is part of a more complex control strategy, it reads the process value from an object of "Analogue transmitter" type, and writes the output to an object of "Control valve" type or "Motor" (variable speed) type.

Control modes

Tracking

Manual

External

Auto

Supervision

According to information in the general section.

Process signal supervision

The supervision function goes active if any one or both of the signal supervision functions for the associated process signal or the associated output signal becomes active.

Control deviation

The supervision function goes active if the absolute value of the difference between the effective set point and the process value is larger than a, per object individual, set value (pre selected to 10 %) for more than a, per object individual, set delay time (pre selected to 10 s).

The supervision function is blocked if the object individual is interlocked.

The supervision function is blocked if the effective control mode is other than "AUTO" or "EXTERNAL".

Interlock

According to information in the general section.

Functions

Process signal supervision

The supervision function forces the control mode to "MANUAL". When the supervision function is active, the control logic tracks the control mode selections and applies the last selected control mode as soon as the supervision function is no longer active.

Control deviation

The supervision function has no functional influence on the object. Priority between orders on restriction of the controller's output value The priority order is:

1. Interlocked
2. Output limit values

Interlock

All interlock forces the interlock reference value on the controller output. The control algorithm is blocked.

Control functions

Each controller individual is possible to configure for P, PI, PD or PID characteristics. Anti-windup functions is automatically activated at all times when a controller output has reached a restriction value, or when the control algorithm is inactive or blocked.

The operator has the possibility to select between two different output bias values: a value which is set by himself, or a value which is set by a program. The selected bias value is added to the controller output before limiting functions are applied.

From the control program it is possible to select between two different sets of output limitation value sets (low and high limit): one set of values which are set by the operator, and one set of values which are set from a program.

In control mode "TRACKING", the "Track reference value" is forced on the controller output. The control algorithm is blocked.

In control mode "MANUAL", the operator sets the value of the controller output. The control algorithm is blocked.

The operator always has the possibility to set and change the "auto set point".

There are functions for permanently disabling the selection of one or more control modes for each object individual.

Change of control mode

Change of control mode between "MANUAL", EXTERNAL" and "AUTO" and on change from "TRACKING" are bumpless with respect to the controller output value.

Presentation

According to information in the general section.

Objects shall be presented with an "analogue value" (Real value) symbol. For each dynamic point in a display, any one of the process value, the effective set point or the controller output value can be selected for presentation. The effective set point is the default value for presentation.

Dialog and maneuvering

According to information in the general section. Dynamic variables are:

- Alarm events limits: status and settings for limit values. It shall be possible to modify the for limit values
- Supervisions: status. It shall be possible to modify the "control deviation" limit value and delay time and for operator set controller output limit values
- Control deviation: current value
- Interlock: status. Descriptive texts are to be adapted to each object individual interlock signal
- Controller characteristics and tuning parameters: values. It shall be possible to modify the tuning parameters
- Reference value for value range, and limit values. It shall be possible to modify the limit values
- Direction of control action: direct, reverse
- Controller output restrictions status. Effective limit values. Operator set limit values. Effective source of limit values. It shall be possible to modify the operator set limit values
- Limit values for the "AUTO" set point. It shall be possible to modify the limit values
- Bias: effective bias value, operator set bias value, effective source of bias. It shall be possible to modify the operator set bias value and selection of source

Process value, effective set point, “AUTO” set point, “EXTERNAL” set point, and effective controller output. It shall be possible to modify the “AUTO” set point. It shall be possible to modify the controller output (modification shall be possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for all historian logged variables.

Event handling

According to information in the general section. Event handled signals are:

Controller output in max limit

Controller output in min limit

Alarm event handled variables:

Control deviation supervision

Historian

Logged variables:

Process value

Effective set point

Controller output

Control deviation

Ratio Station

General

The type solution is a functional unit for ratio stations.

The ratio station is a software function which normally interacts with the process via other object individuals.

Process interface

The object does not have any hardware I/O. Typically, unless it is part of a more complex control strategy, it reads the process value from an object of “Analogue transmitter” type, and writes the output to an object of “PID-Controller” type.

Control modes

Manual

External

Auto

Supervision

According to information in the general section.

Process signal supervision

The supervision function goes active if the signal supervision function for the associated process signal becomes active.

Interlock

-

Functions

Process signal supervision

The supervision function forces the control mode to “MANUAL”. When the supervision function is active, the control logic tracks the control mode selections and apply the last selected control mode as soon as the supervision function is no longer active.

Ratio functions

The ratio station output is calculated as [Process value] * [effective ratio] * [conversion factor]+ [effective output bias]. The “conversion factor” is set for each object individual (pre-selected to 1).

The operator has the possibility to select between two different output bias values: a value which is set by himself, or a value which is set by a program. The selected bias value is added to the controller output before limiting functions are applied.

From the control program it is possible to select between two different sets of output limitation value sets (low and high limit): one set of values which are set by the operator, and one set of values which are set from a program.

In control mode “MANUAL” the operator sets the value of the ratio station output.

The operator always has the possibility to set and change the “AUTO ratio reference”.

There are functions for permanently disabling the selection of one or more control modes for each object individual.

Change of control mode

Change of control mode is bumpless with respect to the ratio station output value.

Presentation

According to information in the general section.

Objects are presented with an “analogue value” (Real value) symbol. For each dynamic point in a display, any one of the process value, the effective ratio or the ratio station output value are possible to use for presentation. The effective ratio is the default value for presentation.

Dialog and maneuvering

According to information in the general section.

Dynamic variables are:

Supervisions: status.

Ratio station output restrictions status. Effective limit values. Operator set limit values. Effective source of limit values. It shall be possible to modify the operator set limit values

Limit values for the “AUTO” ratio. It shall be possible to modify the limit values

Bias: effective bias value, operator set bias value, effective source of bias. It shall be possible to modify the operator set bias value and selection of source

Process value, effective ratio, “AUTO” ratio, “EXTERNAL” ratio, and effective ratio station output. It shall be possible to modify the “AUTO” ratio. It shall be possible to modify the ratio station output (modification shall be possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

The trim curve display and the trend display shall have traces for all historian logged variables.

Event handling

Alarm event handled variables:

Process signal supervision

Historian

Logged variables:

Effective ratio

Ratio station output

Sequence

General

All sequences are designed as individuals. The type solution states general attributes.

Process interface

The object does not have any hardware I/O. Typically, it communicates only with other object types via software signals.

Control modes

Manual

Auto

Supervision

According to information in the general section.

Max time in step exceeded

For each step there is a supervision function which goes active if the sequence remains

in the same step for a longer time than a, for each step, specified time. The conditions for the function to go active, and the delay time is to be configured for each sequence and each step individual.

Interlock

According to information in the general section.

Functions

Max time in step exceeded

The function is unique per object individual and step individual and is not possible to describe in general terms.

Interlock

All interlock cancels the object individual. Start-orders are inhibited for as long as there is an active interlock.

Sequence functions

Sequences are normally built in such a way that they do not require operator interaction, other than operations in control mode “MANUAL”.

Each sequence individual may be configured to run continuously as long as no stop, hold, or cancel-order is given, or to run through to the last step once and then stop.

Stop-order means that the sequence continues to execute the normal sequence of activities, step transitions and jumps, until the last step is reached, and then it shall stop.

Cancel/order means that the sequence is cancelled, and all activities are aborted. Further operation is blocked until a de-block order is given.

“Hold” means that the sequence remains in the current step, until it is ordered to continue. Once the sequence is started, there is no difference, from a functional point of view, between the control mode ”AUTO” and ”MANUAL”, except that in control mode “MANUAL”, the operator has also the option to select “manual step and jump control”:

Order manual transition of steps. This means that the operator, manually, can force transition of steps, independent on if the conditions for transition are fulfilled or not.

Order manual jump of steps. The operator enters the desired step-number, and orders the jump. The sequence executes the jump to the desired step.

In control mode “MANUAL”, “Step and jump control” are persistent until the control mode is changed, or until “cancel” or “Hold”-orders becomes active.

Start and stop orders are subordinate to the selected control mode.

Stop order is superior to start-order.

Hold and cancel-orders are superior to the control mode. Cancel-order is superior to hold-order.

Orders given by the operator, with the exception of “manual step and jump control” are not persistent; Orders which are not executed as they are given are reset.

Change of control mode

Changes between control modes are bumpless with respect to the operation of the sequence and to the activities.

Presentation

According to information in the general section.

Objects are presented with a digital symbol. The symbol is filled when the sequence is started. The effective step number is indicated.

Status for “Hold” is indicated.

Status for “Manual step and jump control” is indicated.

Dialog and manoeuvring

According to information in the general section. Dynamic variables are:

Alarm events: status

Supervisions: status

“Hold”: status

Effective step number

Interlock: status. Interlock override: status. Descriptive texts are to be adapted to each object individual interlock signal. It shall be possible to modify the override order

“In operation” feedback: status

Summation status for the current step transition conditions

Start, stop, hold and cancel orders. It shall be possible to modify the control orders (modification shall be possible only if the effective control mode is "MANUAL”)

“Manual step and jump control” status. It shall be possible to activate and deactivate manual step and jump control (only if the effective control mode is “MANUAL”). Step: order, jump: order and desired step number It shall be possible to modify the control orders(if “Manual step and jump control” is active)

Control mode: status. It shall be possible to modify the control mode

The face-plats also show a graphical representation of the sequence, inclusive static information: branches and jumps, and dynamic information: activities and transition conditions status, and descriptive texts as well as adjustable parameters and descriptive texts. The representation may be implemented directly in the faceplate, or in a separate window. In the latter case, there is a control button in the face-plate which, when activated, calls up the window.

The trim curve display and the trend display shall have traces for all historian logged variables.

Event handling

According to information in the general section. Event handled variables:

“Hold”-order

“Cancel” order

Alarm event handled variables:

Max time in step exceeded

“Hold”-order

“Cancel” order

Historian

Logged variables:

- Step number

Aggregate

General

Aggregates are used to implement a superior control function, in cases where a sequence is not suitable. All aggregates are designed as individuals. The type solution states general attributes.

Process interface

The object does not have any hardware I/O. Typically, it communicates only with other object types via software signals.

Control modes

Manual

Auto

Supervision

According to information in the general section.

Interlock

According to information in the general section.

Functions

Interlock

All interlock cancels the object individual. Start-orders are inhibited for as long as there is an active interlock.

Aggregate functions

Aggregates are normally built in such a way that they do not require operator interaction, other than operations in control mode “MANUAL”.

The normal operation of an aggregate is to run continuously until a stop order is given. Cancel means that the aggregate is cancelled, and all control orders are aborted. Further operation are blocked until a de-block order is given.

Once the aggregate is started, there is no difference, from a functional point of view, between control mode ”AUTO” and ”MANUAL”.

Start and stop orders are subordinate to the selected control mode. Stop order is superior to start-order.

Cancel-orders are superior to the control mode.

Orders given by the operator are not persistent; Orders which are not executed as they are given are reset.

Change of control mode

Changes between control modes are bumpless with respect to the operation of the aggregate and to control orders.

Presentation

According to information in the general section.

Objects are presented with a digital symbol. The symbol is filled when the aggregate is started.

Dialog and maneuvering

According to information in the general section.

Dynamic variables are:

Alarm events: status

Supervisions: status

Interlock: status. Interlock override: status. Descriptive texts are adapted to each object individual interlock signal. It shall be possible to modify the override order

"In operation" feedback: status

Start, stop, and cancel orders. It shall be possible to modify the control orders (modification is possible only if the effective control mode is "MANUAL")

Control mode: status. It shall be possible to modify the control mode

The face-plats also show information of the controlled objects, inclusive static information and dynamic information: status and descriptive texts. If the aggregate has any adjustable parameters, these are shown with descriptive texts. The information may be implemented directly in the faceplate, or in a separate window. In the latter case, there is an action button in the face-plate which, when activated, calls up the window.

The trim curve display and the trend display shall have traces for all historian logged variables.

Event handling

According to information in the general section. Event handled variables:

"Cancel" order

Alarm event handled variables:

Generic monitors

Historian

Logged variables:

"In operation" status.

Marking, inspection and test, documentation etc

Marking, Inspection and Test etc

The reference designation system is described in the General Requirements.

Marking

General

Reference designations and function descriptive texts shall be uniform and coordinated between marking, control software and operator interface and the technical documentation.

Marking shall be made from materials which are resistant to the environment in which they are placed. The materials shall also be resistant to UV-light and to pollution. Texts shall have the same qualities. Marking shall be made from marking systems which are commercially available on the open market, and which are, for each type of application, intended for the purpose.

Marking of field equipment (motors, instruments, actuators etc) shall be made from acid- proof stainless steel plates on which the information is engraved.

Marking shall be securely fastened.

Marking shall be placed where it can be read. If this is not possible, there shall also be a complementary reference marking.

Language

Texts shall be in Ukrainian language.

Cubicles and cabinets

A cubicle shall be marked with its function oriented reference designation and its location oriented reference designation. The marking shall be placed on the outside of the cubicle, on the front side, at the top.

A cubicle shall also have a sign with information on from where it is being power supplied (switchgear and protective device etc). The marking shall be placed on the outside of the cubicle, at the front side at the bottom.

A functional unit in a switchgear assembly shall be marked with its function oriented reference designation and its location oriented reference designation. The marking shall be placed on the outside of the cubicle, on the door of the functional unit. The functional unit shall also be marked with the function-oriented reference designation of the load. The marking shall be placed on the outside of the cubicle, on the door of the functional unit.

Equipment

A piece of equipment shall be marked with its function oriented reference designation. Inside cubicles, if a product oriented reference designation exists, it may be used instead. Marking must not be placed on such parts of the equipment which are removed during normal operation or maintenance. Inside cubicles, the marking must not be placed on the equipment but it shall be placed adjacent to the associated equipment and, as far as possible, below the equipment.

External Cable

An external cable shall be marked with its cable number in each end of the cable.

Conductors in external cable, internal cable and wire

In cases where there is a risk of mixing conductors between cables, the conductors in external cables shall be marked with the cable number adjacent to the terminal to which it is connected.

A cable or a wire which runs internally within a cubicle, shall be marked with the identity of the terminal to which it is connected.

Inspection and test

Workshop Inspection and Test

The Contractor, or the Contractor's supplier under the responsibility of the Contractor, shall perform Workshop inspections and tests on the equipment, assemblies etc. and the systems.

Workshop inspection and test shall be carried out on a regular routine basis during design and manufacturing in order to ensure that the final product, as ready for shipping or FAT, complies with:

The manufacturers specifications

Law and regulations

The relevant standards

The contract

The procedure and protocol from the final inspection and test shall be delivered with the product.

Factory Acceptance Test (FAT)

The Contractor shall perform Factory Acceptance Tests.

Subject to FAT is equipment, assemblies etc and systems which are not straight "off the shelf" standard products, but are build, assembled, modified etc especially for the purpose of this project.

FAT of the Process control system shall comprise the complete configured and programmed systems.

FAT shall demonstrate compliance with:

Law and regulations

The relevant standards

The contract

FAT of the Process control system

The FAT shall comprise the complete application including the operator's interface, that is: the controller and I/O-system hardware, the control logic and loops, the communication and the signal exchange between the controller and the existing operator system as well as the process displays, alarm- and event lists, object dialogue and

manoeuvring etc. For the purpose of the test, the contractor shall use a clone of the application that he has configured in the existing operator system including the hardware required to run the application. The contractor shall take the lead during the FAT and shall be responsible for the FAT. He shall summon the other parties, he shall prepare the test procedures and the test sheets and he shall keep the inspection and test records.

FAT may be done in steps or parts. The different parts may be carried out at different periods of time:

- Hardware and system functions also including communication between the controller and the clone of the existing operator system
- Software applications
  - Type solutions
  - Control functions
  - Signal interface between the controller and the operator system
  - Process displays, texts, dynamic information in displays and in dialogues and events and alarm events in the operator system.

For the hardware and system functions part of the FAT, the system shall be set up in the final hardware configuration with all components installed in their respective cabinets. During part of the FAT shall be checked the hardware configuration and the assemblies, and the system-related functions, such as system supervision and redundancy functions.

For the two software applications FATs, it is not necessary to have the cabinets or the I/O-system available (except for at the Type solutions FAT, where it is necessary to have sufficient I/O for one each of the type solutions), but only the process controllers, the network components and the operator system. During the Control applications FAT there shall be a basic process simulation program in the controller software: Start-order for a motor shall generate "in operation" feedback, Control output from a PID-controller shall act on the analogue input for the related transmitter etc., such that it is possible to completely run through the control functions and sequences and see the process response.

Site Inspection and Test

The Contractor shall perform site inspections and tests on the equipment, assemblies etc. and the systems.

The scope of inspection and test is:

- Inspection and test etc as required by law or regulation
- Inspection and test according to manufacturer instructions
- Inspection and test according to IEC 60364-6-61, Electrical installations of buildings – Part 6-61: Verification – Initial verification and
  - Amendments to this document and
  - The common modifications according to the harmonization document CENELEC HD 384.6.61 S2:2003
- Inspection and test to demonstrate compliance with the contract

Site Inspection and Test of the Process Control System

The site inspection and test shall comprise the complete control loops including the operator's interface, that is: the equipment for measurement and analysis and other process equipment and the field cables that connects the equipment to the I/O-system, the controller and I/O-system hardware, the control logic and loops, the communication and the signal exchange between the controller and the existing operator system as well as the process displays, alarm- and event lists, object dialogue and manoeuvring etc. The Contractor shall take the lead during the site test and shall be responsible for the site test. He shall summon the other parties, he shall prepare the test procedures and the test sheets and he shall keep the inspection and test records.

Inspection and Test Documentation

The documentation shall comprise procedures and protocols.

The procedures shall be unambiguous and of such degree of detail that it is possible for a person, with the same competence as the tester but who did not participate in the inspection or test, to repeat it and come to the same result.

The procedure shall contain information on:

Which is the inspected or tested (possibly type of) object / equipment / function etc

How the inspection or test is carried out and which is the expected result

How it is checked that the expected result is achieved

Which reference documents (and their revision) that makes the basis for the inspection or test

The protocol shall record:

Identification information for the procedure (and revision) that was used for the inspection or test

Identification information for the equipment that was used for the inspection or test

Comments and remarks which were made during the inspection or test

The result of the inspection or test

The date of the inspection or test

The names of the person and company which were responsible for the inspection or test

Technical Documentation etc

Technical Documentation

The documentation shall meet the requirements of IEC 61082-1.

Please refer to the General Requirements as regards the kinds of documents that shall be supplied.

Language

Texts shall be in Ukrainian language.

Training

The scope of training is described in the General Requirements.

Infrastructure Works Specifications

Roads

Materials

The materials required for the Access Road, Internal Site Road, and Road around Leachate Storage Reservoirs are as follows:

Crushed Stone Aggregate (0-40mm) : 7cm	DSTU B V.2.7-75-98
Crushed Stone Aggregate (40-70mm) : 25cm	DSTU B V.2.7-75-98
Sand : 10cm	DSTU B V.2.7-75-98

Unbound pavement layers

Unbound materials shall meet the requirements of DSTU B V.2.7-75.

All mixing and paving equipment shall be subject to the Engineer's approval. Only such equipment as is suited to trafficking the formation without causing damage shall be used at that level.

Compaction shall be carried out using rubber tyred, steel wheeled, smooth vibrating or static rollers as decided by the Contractor in order to achieve the bearing capacity requirements and surface tolerances given in the following

All aggregate stored on site shall be stored in stockpiles on compacted and well drained subgrade. Handling of materials shall be undertaken in a manner that minimizes segregation. Stockpiles shall also be protected from contamination from any source.

Transport of mixed materials shall be carried out in such a manner as to prevent contamination and segregation. Vehicles shall be chosen that will not cause damage to the subgrade or to partially completed pavements.

Before construction of unbound pavement layers, the subgrade shall be shaped according to the designed longitudinal profile and cross section and compacted. It shall have a surface tolerance of +20mm and –30mm. If the subgrade has any defects in either vertical alignment or condition, these shall be corrected before proceeding further.

The prepared subgrade shall meet the bearing capacity requirements. Bearing capacity shall be checked at a rate of 1 test every 500 m² by plate bearing tests carried out in accordance with with VBN V.2.3-218-186, or equivalent approved by the Engineer.

Unbound materials shall be laid with even thickness, such that the final thickness after compaction shall be equal to the design thickness. The placed layer shall be shaped and compacted to the required profile. Laying of the next course may only commence after the previous course has been approved by the Engineer.

Admissible deviations:

(i) The thickness of each layer shall be within 10% of the designed thickness.

(ii) The finished surface shall be within +10mm and – 20mm of the design value.

(iii) Longitudinal and transverse irregularities shall not be greater than 10mm under a 3m straight edge.

(iv) Crossfall shall be within 0.5% of the design value at every point.

(v) The centre line of the as-laid pavement layer shall be within 30mm of its design position.

(vi) The width of the as-laid pavement layer shall be within +100mm and –50mm of its design value.

Not less than 14 days before commencement of the works, the Contractor shall submit to The Engineer results of the relevant laboratory tests required by this Section of the Specification, together with mix designs for his approval.

Course thickness shall be measured after compaction at three randomly chosen spots for every working day, but not less than one spot for every 400 m² and every 25 m longitudinally.

Longitudinal evenness shall be checked on every lane centre line with a 3 m long straight edge – not less than 150 measurements per every 1km. Transverse evenness shall be checked with a 3 m long straight edge – not less than 150 measurements per every 1km.

Cross-fall shall be checked 10 times every 1km and additionally at the beginning, middle, and end of every horizontal curve.

Vertical alignment shall be checked at the centre line of the carriageway and at the edges every 25m.

The centre line shall be checked not less than every 25 m. Width shall be checked 10 times every 1 km.

Aggregate grading and dust and clay particle contents shall be tested on random samples taken from placed material before compaction. Two samples are to be tested per working day except that no more than 600 m2 shall be covered by one sample.

Moisture content of material shall be controlled after spreading, just before commencement of compaction. The result shall be in accordance with Clause R4.2.6.1 of this Specification. The sampling rate shall be as for aggregate grading and dust and clay particle content.

Compaction tests shall be carried out using the Proctor method according to DSTU B V.2.1-12. It is the responsibility of the Contractor to carry out such control as is necessary to ensure that the bearing capacity requirement is met.

Bearing capacity shall be checked at a rate of 1 test every 500 m2 or as directed by The Engineer using plate-bearing tests carried out in accordance with VBN V.2.3-218-186, unless alternative equipment is permitted by The Engineer.

The bearing capacity on the surface of the compacted sub base layer shall meet the requirements specified in Table R4.3 for Class B material.

Other aggregate tests shall be carried out as required by the Engineer in accordance with DSTU B V.2.7-71.

Geosynthetic Lining System

The geosynthetic lining of the Leachate Storage Reservoirs comprise the following:

- The protection geotextile below the geomembrane
- The smooth 2.0mm HDPE geomembrane

Materials

HDPE Geomembrane

The geomembrane shall be in high density polyethylene (HDPE) and shall have a textured surface to improve adhesion, and have the following characteristics:

Property	**value**	**standard**
Nominal thickness	2.00mm	EN 1849-2
Surface density	>1425 g/mm²	EN 1849-2
Tensile strength at yield	>25kN/m	EN 12311-2
Elongation at break	>10%	EN 12311-2
Puncture resistance	>0,60 kN	NF P 84-507

Protection Geotextile

The protection geotextile beneath the geomembrane shall have following characteristics:

property	value	value	standard
Mass per unit area	300 g/m²	800 g/m²	EN 965
Tensile strength	> 14 KN/m	> 25 KN/m	EN ISO 10319
Elongation at break	> 90%	> 90%	EN ISO 10319
Static puncture resistance	>2,5 kN	>4 kN	EN ISO 12236
UV resistance	no	no	

Installation of the geosynthetics

Placing of the geomembrane

The geomembrane panels shall only be deployed once the underlying protection geocomposite has been placed and inspected; no geomembrane shall be deployed directly onto the soil subgrade layer.

The geomembrane panels shall be welded together using the double-fusion thermal welding method. No welding shall be performed if the temperature of the surface of the geomembrane is below 0°C or above 65°C. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short runs of seams.

Once deployed, the geomembranes shall be quality tested to ensure that all the welds are compliant. The testing of the geomembrane shall include both on-site destructive and non-destructive testing of welds, progressively as the work is performed, and off-site laboratory destructive testing of specimens of the welds. The non-destructive testing shall include air pressure leak testing of seams; the destructive testing shall include both tensile shear and tensile peeling testing of the welds.

The lining material shall be delivered at the site with a datasheet from the producer certifying the characteristics of the material according to the above specifications. The roll width must be minimum 5m. Furthermore the delivery shall be accompanied by a protocol with the results of the producers quality check for the specific batch delivered to the site.

The supplier shall deliver a testing certificate for all welding-seams performed before delivery on site.

The membrane shall be protected against physical damages and soiling during transport to the site and during storage at the site. The installer shall submit an installation plan showing the position of the individual rolls of material and deliver the plan to the Supervising Authority for approval before installation works commence. Installation may only be done by technical staff approved by the producer of the lining material and with equipment approved by the same. All welding-seams shall be double-seam welds with the possibility of testing with pressurized air, or extrusion welds with a spark-leader welded into the seam, enabling full testing of the tightness of the seams with high-voltage spark methods.

At the beginning and end of each day of installation, a welding test shall be performed by each combination of welding equipment and welder in work to ensure the correct adjustments of welding temperature, pressure and speed according to the prevailing weather conditions.

The panels of geomembrane shall be joined using a double-channel fusion weld. The other joints (3-way welds, joints around pipework, repairs, etc.) shall be carried out using extrusion welds.

The welding shall be tested for seam strength (peel and shear) and the results are reported to the Supervising Authority.

The welded joints shall have the following minimum characteristics:

Tensile shear strength:	≥ 90 % × Rt (22.5 kN/m)
Tensile peeling strength (fusion):	≥ 70 % × Rt (17.5 kN/m)
Tensile peeling strength (extrusion):	≥ 60 % × Rt (15 kN/m)

The welding test shall be repeated after any interruption of the installation works during the day, caused by e g. changes in weather conditions or equivalent. Before welding, each lane of material shall be laid out without wrinkles, but with sufficient material and overlapping to ensure, that no significant problems arise during the welding due to temperature variations.

All edges of the lining material shall be protected against folding until the time of welding. The Contractor decides the method for protection and submits the description to the Supervising Authority for approval. Overlapping shall be done with overlaps in the direction of the slope of the liner, i.e. roof-tile like. The seam between the membrane at any near-horizontal areas and the membrane at a slope shall be positioned at the near-horizontal plane and no closer to the toe of the slope than 1.0 m. No machinery of any kind is allowed to operate directly on top of the installed liner. At all times sufficient protection of the liner shall be ensured before any machinery is allowed to enter. Sufficient protection can be e.g. min. 1.0 m of soil not containing stones larger than 0.1 m.

On the spot welds should be checked according to the specifications presented in the following table. The quality control process of the membrane placement and especially of the welding of the sealing membranes can be performed by the Contractor at the discretion of the relevant department with one or more of the following methods.

Before and during the installation of the membrane the following checks by the contractor or the Employer must be done, without excluding the invitation by the employer of an independent quality audit body:

Checking of membranes delivery documents to confirm that the rolls delivered to the project site are those agreed and have undergone the relevant factory testing. Checking of overlapping of the membrane sheets. An overlap of 10 cm is desirable, but each welding machine has its own requirements that must be adhered to at the project site. Checking of seams made at the laboratory or on site and immediate reinstatement where necessary, by the contractor.

Visual inspection of the membrane surface before coverage for possible damage. Immediate reinstatement and checking.

Until the membrane has been checked and approved, the lining material shall be anchored using sandbags or any other equivalent system ensuring, that the installed liner material is not moved by wind or down slope by gravity.

The Contractor shall cover the installed liner with geotextile immediately upon check and approval by the Supervising Authority. At slopes the drainage or cover material shall be installed starting from the toe of the slope taking any slack in the liner material to the top of the slope. At the top of the slope the liner shall be anchored in an anchoring trench after the drainage material / cover at the slopes has been installed.

Where the polymer liner in the future shall be connected to coming stages of the landfill, the polymer liner shall be finalized with a loop of min. 1.0 m. i.e. the liner shall be folded back and welded in order to preserve a 1.0 m wide lane along the edge from damages and weathering. A soil cover of min 0.5 m shall protect the fold.

The check of the installation works shall be based on a check plan set up by the Contractor and approved by the Supervising Authority. The check plan shall describe who has the responsibility for performing each check, the extent of the check and when the check shall be performed. Further the plan shall indicate whether the works may proceed or shall wait pending the results of the tests and checks.

Anchoring of geosynthetics

The anchorage of geosynthetic materials is done at crest of the plateau of the old landfill and at a sufficient distance (approximately 1.5m) from it, in a specially constructed anchor trench.

The anchorage ensures the retention of the geosynthetic materials to prevent them sliding. The walls of the trench should be smoothed in order to avoid any damage to the materials.

The anchor trench is backfilled with the excavation soils, followed by compaction of these materials. The walls of the trench will be normalized in order to avoid damage of the materials. Within the anchoring trench the geosynthetic materials will be positioned so they will be abuts in the two sides (the one vertical side and the bottom of the trench).

The minimum dimensions of the trench will be 1.0m x 0.8m, while the adequacy of the trench is to be proven through geotechnical calculations.

Placing of geotextiles

Geotextiles shall be delivered to the site in packaging, which will protect the product from damage during handling and storage. Packaging must be suitable to protect the product from Ultra-violet (UV) degradation. The product must be kept in appropriate packaging until such time that it is required for installation and shall be clearly labelled for identification on site.

The geotextile manufacturer shall provide production test certificates on mechanical properties at the rate of one set of tests per 6,000 m2 delivered to site and a minimum of one set per contract. Test methods employed shall be in accordance with the above specification. Certificates relevant to a full delivery of geotextile, identifying each roll, shall be furnished to the Engineer prior to that batch of Geotextile being incorporated in the works.

The rolls of geotextile shall be stored at ground level. It is suggested that they are stacked not more than five rolls high and no other materials shall be stacked on top of the geotextiles.

The geotextile shall be laid and installed in the positions and to the line and levels described on the drawings. Construction plant must not operate directly on the geotextile. When placing drainage material, delivery and excavation plant shall operate on a minimum layer of 1m of drainage material.

Joints shall be formed by overlapping by a minimum of 300mm (500mm on downslope overlaps). The contractor should satisfy the Engineer that no material can migrate between layers at the overlap. Alternatively the joint may be reduced to a minimum of 100mm and continuously jointed by the use of an approved jointing technique.

On-site quality control should be performed in accordance with CEN/TR 15019. Test specimens should be taken every 6,000 m² with a minimum of 1 test above 1,000 m². For sampling EN ISO 9862 should be applied, except that samples should be taken not less than 5m from the end of the roll in machine direction and over the whole width in the cross machine direction. The location of the sample should be described exactly. For evaluation of conformity, statistical procedure should be used.

Pipes

Pipes

The pumping header pipes for leachate will be according to DSTU B V.2.7-151:2008.

The leachate pumping header shall comprise a HDPE pipe with the following properties:

property	value	standard
nominal diameter	To be determined by the Contractor	-
Pressure rating	PN10	
Density	> 0,95 g/cm^3	ISO 1183
Creep resistance	>20 MPa	EN ISO 527
Elongation at break	>600 %	EN ISO 527
Long term elastic modulus at 20°C	120 N/mm²	

Welding of HDPE pipes

Pipes received at site shall be inspected and stored according to manufacturer recommendations. Material shall be stored in a covered and dry space. During the unloading of the HDPE pipes adequate manpower shal be used to

unload the pipes, and the piping and accessories shall be protected and covered with polythene sheets before installation.

Tools required for HDPE piping installation:

- Mechanical hand tool
- Cutting tools
- Drilling machine
- HDPE butt fusion and welding machine

Smaller diameter HDPE pipes, i.e. up to 75 mm will be joined using the hot plate welding, while the pipes above 75 mm shall be joined using a butt fusion machine and as recommended by butt welding machine supplier.

For HDPE electro-fusion welding, HDPE accessories are provided with spigot ends. The spigot ends are provided with low irregularities and the welding sleeve has projections to allow their exact distance apart to be determined.

The HDPE electro-weld sleeve is provided with 2 socket ends which can be welded in a single operation.

The welding equipment sends current through the resistence wires in the electro-weld socket for a set period. Both electro-weld sockets are welded at the same time.

The electro-weld socket has stops on the interior. The socket has two contact pins on the outside for the connection of the welding equipment.

There are two welding indicators which appear during and after the welding operation. These indicate that the welding has been reached and that the welding pressure has been applied.

The connector cables from the welding equipment should be connected to electro-weld socket.

This will illuminate connection indicator lamp.

The weld indicators should have emerged by around 2 mm.

In butt welding both pipe ends are placed against a hot plate at a constant temperature and pressure. The plastic pipe ends are now pressed together so that the molecules of the materiál are transferred between them. Before starting hot plate welding the equipment shall be checked for the following items:

The hot plate temperature must be 210 C.

The hot plate must be clean and free of grease.

Ensure that the two pipe brackets and the two pipe supports are correctly aligned.

Both pipe clamps must be adjusted so that they hold the pipe tightly enough to withstand the force of the welding progress.

Hold the welding pressure steady and allow the weld to cool.

Installation of pipes or drains

Trenches for drains in waste

The trenches shall be carried out using the equipment and plant proposed by the Contractor. The excavator buckets used shall be of the correct size with respect to the width and depth of the trench. The Contractor shall use, if necessary, a trench support system adapted to the width and depth of the trench. The Contractor shall ensure that the equipment and methods used ensure a safe and secure working environment.

The wastes excavated from the trenches shall either be re-used for backfilling the trench, or, if not considered suitable, shall be placed as fill elsewhere on the landfill.

Trenches for pipes in natural soils

Before the start of trenching works, the Contractor shall assess the geotechnical data available (and carry out additional investigation if considered necessary), in order to understand the types of soils and their depths, and to use the equipment and methods adapted to the ground conditions.

The trenches shall be carried out using the equipment and plant proposed by the Contractor. The excavator buckets used shall be of the correct size with respect to the width and depth of the trench. The Contractor shall use, if

necessary, a trench support system adapted to the width and depth of the trench. The Contractor shall ensure that the equipment and methods used ensure a safe and secure working environment.

The soils excavated from the trenches shall either be re-used for backfilling the trench, or, if not considered suitable, shall be used as general fill or transported to a stockpile for future use.

The base of the excavation shall have a bearing capacity of EV2 > 30 MPa with K < 2 and an in-situ density > 95 % Optimum Proctor Normal.

The trenches for pipework may be backfilled with the soils excavated if they meet certain conditions:

- no particles >40mm
- no materials with a Dmax > 2/3 of the backfill layer thickness will be allowed
- a particle size distribution will be carried out for each type of soil used.

The trench backfill shall be compacted to a density of >95% Optimum Proctor Normal.

Installation of Pipework

The leachate drainage pipe shall be placed in the gravel surround in the bottom of the leachate drainage trench or concentrate infiltration drain as indicated in the Drawings. The HDPE pipes shall be joined by polyfusion and the end of the pipes closed with a polyfusion welded end cap.

The leachate header pipe shall be laid in a trench on a levelled sand bed 0.10 m thick and surrounded with a compacted sand backfill. The trench excavation shall be backfilled progressively using the excavated material or other suitable soils. The backfill material shall be compacted in layers no thicker than 200mm.

A pressure test (air or water) shall be performed on the HDPE pumping header pipe.

Testing on Completion and Trial Operation & Maintenance

General requirements

The Contractor shall submit his detailed programme for the Tests on Completion not later than 28 days before commencement of the Tests on Completion for Review by the Project Manager.

The Tests on Completion shall be carried out in the following sequence:

Pre-commissioning tests, which shall include the appropriate inspections and ("dry" or "cold") functional tests to demonstrate that each item of Plant can safely undertake the next stage, (b);

Commissioning tests, which shall include the specified operational tests to demonstrate that the Facilities can be operated safely and as specified, under all available operating conditions; and

Trial Operation, which shall demonstrate that the Facilities perform reliably and in accordance with the Contract.

Pre-Commissioning Tests

Functional Mechanical and Electrical Equipment Tests are to be completed for all equipment as agreed with the Project Manager and with reference to the specific testing required in the Mechanical Facilities Specifications and in the Electrical and Automation Facilities Specifications. The equipment includes but is not limited to:

- All electrical and automation systems
- Motors
- Safety overloads

Commissioning Tests

The Contractor shall record and undertake sampling and analyses as agreed with the Project Manager to obtain necessary information during commissioning. The data shall be compiled and presented to the Project Manager.

The commissioning shall be undertaken until the Facilities has attained stable operating conditions for a period of at least one month. The automation system shall be operating in accordance with the design and the Employer's Requirements.

Trial Operation

Within the Trial operation period the Contractor shall demonstrate that the Facilities perform reliably and in accordance with the Contract. The duration of the Trial Operation period shall be in accordance with the Contract.

During trial operation, when the Facilities are operating under stable conditions, the Contractor shall give notice to the Project Manager that the Facilities are ready for any other Tests on Completion, including performance tests to demonstrate whether the Facilities conform with criteria specified in the Employer's Requirements and with the Schedule of Guarantees.

The Contractor shall provide all the staff, materials, consumables, equipment etc. needed for the tests and pay for all other associated costs.

Process Performance Tests

All the Employers Requirements must be shown to be attained before Taking Over. Therefore, the approval of the Performance Tests does not relieve the Contractor of his obligations to comply with the Employer's Requirements or his Guarantees.

The Contractor shall submit his detailed programme for the Trial operation period not later than 28 days before the start of this period for Review by the Project Manager.

The objective of the Performance Tests is to confirm that the Plant will fully meet the Employer's Process Requirements and the Designed and Guaranteed treatment and performance criteria.

This includes the following operational guarantee values:

- treatment criteria according to Design Conditions

To perform the process performance tests the plant shall be operated in such a manner as to simulate operation under the design flows and loads as far as possible as agreed with the Project Manager. This may require operation of a reduced number of parallel process units and/or equipment.

During the Performance Test Period the Contractor shall record and undertake daily sampling and analyses as agreed with the Project Manager to at least obtain the following information:

Treatment rate	m^3/day
Temperature	°C
pH	
Conductivity	
Transparency	cm
BOD	mg/l
COD	mg/l
Dry solids	mg/l
Sulphates	mg/l
Chloride	mg/l
Ammonical nitrogen	mg/l
Nitrite	mg/l
Nitrate	mg/l

The table does not include the control and recording parameters covered by on-line instruments. These shall be recorded and daily figures shall be presented to the Project Manager.

The performance test shall be considered satisfactory if the process performance guarantee have been obtained during the Process Performance Test.

Commissioning and Trial Operation Review

A documented Commissioning Review shall be held at the beginning of the Trial Operational Period in order to identify and feedback any improvements in measures or procedures identified during the Tests On Completion and reported by the Contractor in his Certified Report of the Results. The document shall be prepared by the Contractor for his planning of this phase of the works and agreed with the Project Manager.

This document will include but not be limited to information on:

Actual loads and leachate characteristics

Deviations from design figures

Recommendations to improvements in operability

Trial Operation Obligations

The Contractor shall perform specified services with Contractor's supervision staff and qualified personnel from the Employer in accordance with the following:

The Contract

The Operation and Maintenance Manual (O&M manual)

Optimum conditions in relation to the lifetime of the plant

Performance guarantees

Applicable laws

During the Trial Operational Period the Contractor shall:

Manage the Trial Operation and Maintenance of the whole of the Facilities constructed under this Contract on a 24-hour basis for a minimum period of time specified in the Contract as duration of the Trial Operation period.

Manage or perform inspections at regular intervals and complete preventive maintenance at intervals and in the manner prescribed by the O&M manuals.

Carry out tests to ascertain the correct functioning of machines, instruments, etc, at intervals in accordance with the manufacturer's instructions or when the need for this will arise.

Manage the correction and repair of sudden faults interrupting the operation of the plant or important parts of the plant. When such a fault occurs it requires immediate action by the personnel to minimize plant outage. Record faults and repairs on checklists.

Direct, supervise and monitor the Employer's plant personnel with regard to the leachate treatment processes, supervise all other operations at the plant site.

Training of appropriately educated personnel supplied and employed by the Employer.

Manage procurement, storage and any testing of all chemicals and materials.

Accept responsibility for all unloading, transport, storage, collection etc of chemicals and materials within the plant site.

Accept responsibility for all handling of leachate within the physical limits of the contracted works.

Manage routine inspections. Prepare checklists for all types of tests, inspections and repair work. File the checking lists on site under lock and key. Keep key available to the Employer.

Review the checklists after three and six months as regards the intervals between the inspections and introduce suitable modifications if approved by the Employer.

Keep updated as-built drawings, lists of inventories of spare parts etc.

Regularly analyze and keep records of the composition of the leachate.

Revise the Operation and Maintenance Manual, with any updates, revisions, additions or modifications of the Plant.

Keep a complete and accurate daily Operation and Maintenance log.

Trial Operation Progress Reports

The Contractor shall submit monthly Trial Operation Progress Reports with at least the following content:

Main operation and maintenance activities for the actual period and scheduled activities for the next period.

Actual state of operation mode and scheduled changes for the next period.

Actual leachate loads and leachate characteristics.

Treated effluent (permeate, concentrate) characteristics.

Organization of Trial Operation

The Contractor shall present a Trial Operation organization, including number of staff. The organization shall be divided in the following main groups:

Operation team

Maintenance team

Management and Administration team

Each category of staff shall be described in accordance with the following:

Education

Qualifications

Working instructions

Working hours and duties

The Contractor shall supply management and training staff, having the expertise as required.

The Employer will provide the management, operations and maintenance staff to be trained and managed by the Contractor.

Operation and Maintenance Manual

The Operation and Maintenance shall be a "living" document that is updated in coordination with the Project Manager based on the plant operation experience and evaluation and optimisation mode.

Trial Operation and Maintenance Log

The Contractor shall supervise a complete and accurate daily log of the operation and maintenance of the Plant. The log shall be kept on site. The log shall set forth the following information:

The results of all analyses sampling and tests carried out during on and off site;

Measurements of all gauges and recorders;

All Reports generated from the SCADA system;

Description of all maintenance and repairs;

All operational incidents, stoppages, breakdowns etc;

Quantities of all materials, products and substances stored at the Plant and the quantities removed from the Plant.

Trial Operation and Maintenance Equipment and Spare Parts

The Contractor is to define, create, and supervise the purchase and maintain of a stock of spare parts, equipment and tools necessary to ensure the trial operation of the plant and replacement of parts, on a timely basis and to ensure compliance with the Trial Operation and Maintenance, and Performance Requirements.

Spare parts shall be clearly marked with their description and purpose.

The tools shall be contained in a suitable box clearly marked or labelled with its description. Each tool shall be identified and a list of tools shall be affixed to the inside of the box lid. Special tools essential for maintenance, shall be provided in lockable steel boxes. The tools for each different type of equipment shall be contained in a suitable box clearly marked or labelled with its description. Each tool shall be identified and a list of tools shall be affixed to the inside of the box lid. Each set of tools shall be labelled with the equipment with which it is associated.

Laboratory Equipment

To ensure a proper process control the Contractor is to ensure that the laboratory is equipped with adequate equipment for sampling and analyzing, to include but not be limited to:

Treatment rate

Temperature

pH

Conductivity

Transparency

BOD

COD

Dry solids

Sulphates

Chloride

Ammonical nitrogen

Nitrate

Alternatively, the Contractor may sub-contract the analyses to an accredited laboratory.

Trial Operation Monitoring

The Contractor is to manage all tests, sampling and analyses as and when required by the Operation and Maintenance Manual and as may be necessary or appropriate to ensure full compliance with the Employer's Requirements. The analysis shall complement the information obtained from on-line process instrumentation.

Without in any way limiting the above obligations, the Contractor is to manage the performance of all tests, sampling and analyses required in order to obtain at least the following information.

Daily analysis of:

pH

Conductivity

BOD

COD

Dry solids

Chloride

Ammonical nitrogen

Nitrate

As a minimum, the process parameters given below are to be measured on- line.

pH

Conductivity

The following data shall be compiled and presented each month to the Employer:

Electrical energy consumed (kWh)

Chemicals consumed (m^3 each)

Measurements of the noise levels at a one-metre distance from all noise- producing equipment are to be carried out at least once.

All testing, sampling and analyses are to be performed on Site in a professional manner, in accordance with the Operation and Maintenance Manual. Sampling and analysis are to be carried out in accordance with Ukrainian Standards.

Operational Acceptance and Taking Over

General requirements

After the end of Trial Operation period, the Operational Acceptance procedure shall be performed in accordance with the Contract.

Handing over Requirements

When the Facilities is handed over to the Employer by the Contractor it must have shown the capacity and performance as stated in the Employer's Requirements and fulfilled the specified guarantee requirements.

The contractor shall hand over to the Employer any facilities and equipment provided under the Contract such as furniture, office equipment, machinery, vehicles, tools, spare parts, consumable goods, drawings, records, etc collected and used for the project up to the end of the Trial Operational Period.

The facilities and equipment shall be handed over to the Employer in a fully serviceable and well-maintained condition.

The Contractor shall arrange safety inspections before hand over in order to safeguard personnel and equipment. The inspections shall be carried out by an independent inspector with a theoretical and practical training suited to this purpose and approved by the Employer.

The inspection shall comprise equipment, tests and investigations. The Contractor shall record the observations and work carried out on checklists.

Employer and Contractor Joint Inspections

At least 14 days before the end of the Trial Operational Period an inspection is to be made by the Project Manager and the Contractor. The objective of this inspection is to determine the state of repair of the Plant, and a plan is to be made for maintenance work, repairs etc

Laboratory analysis data for leachate

Samples of the leachate in the lagoons were taken and sampled in December 2019. The results are summarised in the table below.

parameter	Unit	Measured value
pH		8,8
Electrical conductivity	µS/cm	4262,2
Dissolved oxygen	mg/dm^3	9,2
Turbidity	mg/dm^3	-
Dry residue	mg/dm^3	56235,2
Ammonium nitrogen	mg/dm^3	120,1
Nitrites	mg/dm^3	2,4
Nitrates	mg/dm^3	120,7
ORP	mV	164,2
BOD5	mgO_2/dm^3	125,0
COD	mgO/dm^3	4300,0
Alkalinity total	$mmol/dm^3$	35,2
Calcium	mg/dm^3	179,4
Magnesium	mg/dm^3	87,5
Sodium	mg/dm^3	572,5
Potassium	mg/dm^3	151,9
Sulfates	mg/dm^3	483,4
Chlorides	mg/dm^3	640,0
Iron total	mg/dm^3	13,5
Mn	mg/dm^3	0,6
Cd	mg/dm^3	0,01
Cr	mg/dm^3	0,1
Co	mg/dm^3	0,175
Ni	mg/dm^3	0,38
Pb	mg/dm^3	0,05
Zn	mg/dm^3	1,7
As	mg/dm^3	0,002
Ba	mg/dm^3	0,01
Orthosphates	mg/dm^3	12

Full results for laboratory analysis of the leachate are included in **Appendix 4**

Volume III.ii

Appendices

Table of Contents

1. ‘Feasibility Study with division into lots of rehabilitation of the landfill for solid household waste in order to prevent environmental emergencies at Khmelnytsky, st. Prospect Mira 7’, Center Eco Consulting, 06/21
2. Technical details of existing transformer substation.
3. Analytical results for leachate from Khmelnytskyi Landfill
4. Discharge criteria for treated effluent.
5. Plan view and cross-section of sewer connection pipeline.

All specified additions has been uploaded in full (excluding estimates) to the file server in PDF format and is available at the following link: https://drive.google.com/drive/folders/1OQLWls7dcpOb8cc4x8tZxlKtgjQ-cl3p?usp=sharing

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(g) Bill of Quantities

Price Schedules

Preamble

1. General

The Participant's rates and prices in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include (but not limited to) the cost of performing construction works by the Contractor, in accordance with the scope of design as defined in the Contract, Contractor's equipment, staff and labour, materials, dismantling, erection, commissioning, maintenance, insurance, profit, taxes and duties together with all general risks, obligations and liabilities set out or implied in the Contract that are necessary to successfully complete the ***Supply and installation of a new leachate treatment system.***

Participants must price each item in the Bill of Quantities. Subsequently, the unit prices indicated in the Bill of Quantities will be used for the following:

- payments for the works performed,
- estimates of changes of the scope of works that can be made at the request of the Employer in the course of works execution, or
- where necessary, the introduction of changes agreed by the Parties in case of Adjustment of the detailed design in accordance with sub-clause 4.1 PCC and clause 13 of "Variations and Adjustments".

In the event that any of the items will not be priced by the Participant, it is considered that the execution of works and the supply of materials under this item are included in the cost of the Tender.

All goods required for the Works shall be priced based on the terms DDP (7 Prospekt Myru Street, Khmelnytskyi, Khmelnytska oblast, 29000, Ukraine) (Incoterms 2020) including all applicable duties taxes and levies, as well as cost of handling, unloading and other required services in accordance with the Contract.

The Bill of Quantities must be read with all the other contract and design documents and the Contractor shall be deemed to have thoroughly acquainted himself with the detailed descriptions of the works to be done and the way in which they are to be carried out.

2. Quantity of items

The quantities set forth against the items in the Bill of quantities are an estimate of the quantity of each kind of the work likely to be carried out under the contract and are given to provide a common basis for tenders. There is no guarantee to the Contractor that it will be required to carry out the quantities of work indicated under any one particular item in the bill of quantities or that the quantities will not differ in magnitude from those stated.

When pricing items, reference should be made to the conditions of contract, the specifications and relevant drawings for directions and descriptions of work and materials involved. The rates and prices for the works covered by the respective items are deemed to cover all labour, materials, temporary works, plant, overhead and profit.

The quantities given in the Bill of quantities are provisional and reflect the estimates made at the time of approval to provide a basis for this tender documents and tenders. Participants must consider every aspect of the tender documents carefully.

Any comments concerning the quantities must be made in the form of a Schedule, following the system of itemization, quoting the codes and brief descriptions, as in the present documents, including the rates and prices. These comments shall be provided by the Participant to the Employer before submission of the tender proposal.

Save where the technical specifications or the Bill of quantities specifically and expressly state otherwise, only permanent works are to be measured. Works will be measured net to the dimensions shown on the drawings or ordered in writing by the Engineer, save where described or prescribed elsewhere in the contract.

In adjusting extras or variations on the contract, works will be measured on the same basis as that on which the quantities were prepared. All works not specifically mentioned in the bill of quantities will be taken as included in the prices of various items.

Where, in the opinion of the Engineer, extra works cannot be properly measured or valued, the Contractor may, if so directed by the Engineer, carry out the work at the daywork rates shown in the schedule of daywork. All completed daywork sheets must be signed by the Engineer on or before the end of the week in which the works are executed.

Provisional sums included and so designated in the Bill of Quantities may be expended in whole or in part at the direction and discretion of the Engineer in accordance with the Conditions of Contract

3. Rates and Prices

The Contractor shall be deemed to have inserted against each item in the Bills such rates and prices as he may deem necessary to cover the requirements of the Contract. Where neither price nor rate is entered against an item or if the term "included" or any such similar term is used it shall be deemed to have been included in the other priced items in the BOQ and measured accordingly. The units and rates in figures entered into the Bill of Quantities should be typewritten or if written by hand, must be in print form.

All rates and prices entered against any item in the BOQ shall be deemed to include all the detailed requirements of the Scope of Works and Specifications and the requirements of the Section VI.

Rates and prices shall be inserted in the unit rate column of the Bill of Quantities. Each part of the Bill of Quantities shall be totalled and the totals carried to the Summary and Grand Summary.

The prices and rates shall be fixed and shall not be subject to any revision.

When requested by the Employer for the purposes of evaluation, making payments, valuing of variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any item included in the Bill of Quantities.

4. Method of Measurement

All measurements in the Bill of Quantities are taken strictly net. The principle of net measurements shall apply to all Works executed. All quantities measured for payment shall be measured by the Engineer on the basis of actual net quantities of Work fixed in position. Item not used shall neither be measured nor included by the Contractor in his statements.

The quantities given in the Bill are the estimated quantities. In no sense shall such quantities be considered as limiting or extending the amount of the work to be done by the Contractor and of the materials to be

supplied by him. The Contractor shall be responsible for checking quantities and for making any necessary surveys and investigations prior to placing any order for materials.

The Participant is obliged to check the number of the pages of the Bill of Quantities and should any be found missing or duplicated or the figures or writing indistinct, the Participant must notify the Employer at once and have the matter rectified before the Tender is submitted. No liability whatsoever will be accepted in respect of any claim for errors in the Participant's offer resulting from failure to comply with the afore-going.

Notwithstanding that practical care was exercised in preparing the BOQ, but all quantities given herein shall be deemed to be estimated quantities of the work to be done but they are not to be taken as actual and correct quantities of the work to be executed and they are not to absolve the Contractor of his obligations under the Contract. They are not to be taken as guarantee that the actual quantities will not be changed (increase or decrease), and any claim whatsoever submitted for cost or extra expenses incurred from such increase or decrease will not be accepted by Employer/Engineer except where else stipulated in the Contract.

5. Units of measurements

The units of measurement used in the annexed technical documentation are those of the International System of Units (SI). No other units may be used for measurements, pricing, detail drawings etc. (Any units not mentioned in the technical documentation must also be expressed in terms of the SI.)

Abbreviations used in the bill of quantities are to be interpreted as follows (but not limited to):

m	***means metre***
m²	***means square metre***
m³	***means cubic metre***
t	***means tonne (1000 kg)***
pcs	***means pieces***
lm	***means line metre***
set	***means set***
km	***means kilometer***

6. Materials

All materials used are to be of the best new available and subject to the Employer / Engineer approval, and of durable nature, guaranteed, not liable to any base exchange and manufactured according to applicable Standards.

Items that contain materials or products of special make with names of manufacturers are to be taken as samples of what will be required. Subject to the Employer / Engineer approval, the Contractor may, at his discretion, offer similar products of other make if the equivalent quality of the specified materials is guaranteed. In this case, the Contractor shall submit a description and drawings showing all technical conditions, characteristics, make, type and address of Manufacturer etc., of the materials offered as alternatives.

Brand names, catalogue numbers or similar classifications indicated in the Tender Documents and in the Drawings included to the Tender Documents shall be read with the word "or equivalent". The Participant

may propose equivalent goods which have similar characteristics and which performance and compliance with standards is equivalent to those specified. If the Participant propose the equivalent device, the brand name, make and technical details shall be provided in the technical proposal.

7. Prices and Currency

The prices given, by the Contract, hereunder in the Bill of Quantities shall be as stated in Sub-Clauses 14.15 PCC and Appendix to Tender. Furthermore, inflation and escalation or changes whatsoever shall not be subject of claim later on.

The Unit Price shall cover all costs of every kind whatsoever including, without being limited to, all charges for additional site installations, relocation, supervision, labour, transportation and supply of materials; the provision, maintenance, use and efficient repair of all plant, equipment and appliance of every kind, the construction and maintenance of all temporary works, the performance of all services and the fulfilment of all obligations and responsibilities herein defined.

The Participant shall be deemed to have fully considered all the conditions, obligations, and requirements of the Tender Documents before entering the respective unit price against the various items of the Bill of Quantities.

8. Completing the Bill of Quantities

Arithmetic errors will be corrected by the Employer as follows:

(a) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected.

(b) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.

(c) If there is a discrepancy between the Tender price in the Summary of Bill of Quantities and the Tender amount in item (c) of the Letter of Tender, the tender price in the Summary of Bill of Quantities will prevail and the Tender amount in item (c) of the Letter of Tender will be corrected.

(d) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b), and (c) above.

DAYWORK SCHEDULE

For minor or incidental works, the Engineer may, if in his opinion it is necessary or desirable, instruct that a variation shall be executed on a daywork basis. These dayworks may include unforeseen works necessary for the execution of the project, not captured in the detailed design and not described as specific items in the Bill of Quantities.

The works shall then be valued in accordance with the Daywork Schedule included in the Contract, plus a percentage to be entered by the Participant representing contractor's profit, overhead/provisional, sums and other charges.

The following procedure shall then apply:

(a) Before ordering goods for the works, the Contractor shall request for quotations from at least 3 (three) Suppliers and submit the same to the Engineer.

(b) Invoices, vouchers and accounts or receipts shall be kept by the Contractor for submission prior to payment.

(c) The Contractor shall deliver each day to the Engineer accurate statements in duplicate to include the following details of the resources used in executing the previous day's work:

- The names, positions and time of Contractor's personnel;
- The identification, type and time of Contractor's Equipment and Temporary Works; and,
- The quantities and types of Plant and Materials used.

(d) One copy of each statement will, as agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit approved daywork statement to be reflected into the project's Taking-Over Certificate for inclusion under the next Interim Payment Certificate.

Funds intended for dayworks may be charged against the Provisional Sum.

The Participant shall enter basic rates for each items of the daywork schedule below. These rates shall apply to any quantity of daywork schedule ordered by the Engineer. Nominal quantities have been indicated against each item of daywork, and the extended total for daywork shall be carried forward as a provisional sum to the Grand Summary Bill of Quantities. Unless otherwise adjusted, payments for works of Daywork Schedule shall be subject to price adjustment in accordance with the provisions in the Conditions of Contract.

LABOUR

In calculating payments due to the Contractor for the execution of dayworks, the hours for labour will be reckoned from the time of arrival of the labour at the job site to execute the particular item of daywork to the time of departure from the job site but excluding meal breaks and rest periods. Only the time of classes of labour directly doing the work ordered by the Engineer and competent to perform such work will be measured. The time of gangers (charge hands) actually doing work with the gangs will also be measured but not the time of foreman or other supervisory personnel. The Contractor shall be entitled to payment in respect of the total time that labour is employed on day work, calculated at the basic rates entered by him in the Work Schedule. The rates for labour shall be deemed to cover all costs to the Contractor including but not limited to the amount of wages paid to such labour, transportation time, overtime, subsistence allowances, and any sums paid to or on behalf of such labour for social benefits in accordance with laws and regulations as well as the Contractor's profit, overheads, superintendence, liabilities and insurance; allowance for labour, time keeping and clerical and office work; the use of consumable stores, water, lighting and power; the use and repair of staging, scaffolding, workshops and stores; portable power tools, manual equipment and tools; supervision by the Contractor's staff, foreman and other supervisory personnel; and all charges incidental to the foregoing. The rates shall be stated in EUR and payments will be made in the currency of payment stipulated in the Contract.

MATERIALS

The Contractor shall be entitled to payment in respect of materials used for day work (except for materials for which the cost is included in the day work labour costs as detailed heretofore) at the rates entered by

him in the Materials Day work Rates schedule. The said rates shall be deemed to include overhead charges and profit and shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, and losses and shall provide for delivery to store for stockpiling at site. The rates shall be stated in EUR and payments will be made in the currency of payment stipulated in the Contract.

EQUIPMENT

The Contractor shall be entitled to payments in respect of Contractor's Equipment already on Site and employed on work at the basic rental rates entered by him in the Equipment Work Rates schedule. The said rates shall be deemed to include due and complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumable, and all overhead profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants will be paid for separately as described under Day work Labour above. In calculating the payment to the Contractor for Contractor's Equipment employed on daywork, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Engineer, the travelling time from the part of the Site where the Contractor's Equipment was located when ordered by the Engineer to be employed on day work and the time for return journey thereto shall be included for payment. The rates shall be stated in EUR and payments will be made in the currency of payment stipulated in the Contract.

WORK ITEMS

The Bill of Quantities (BoQ) contains the following part Bills, which have been grouped according to the nature or timing of the work:

BoQ	*Supply and installation of a new leachate treatment system*
Price Schedule No.1 – PLANT AND EQUIPMENT	
Price Schedule No.2 – DESIGN, INSTALLATION AND OTHER SERVICES	
Price Schedule No.3 – TRIAL OPERATIONS AND MAINTENANCE SERVICES	
Price Schedule No.4 – GRAND SUMMARY	
Price Schedule No.5 - RECOMENDED SPARE PARTS	
Daywork Schedule: 1. Labor costs	
Daywork Schedule: 2. Materials	
Daywork Schedule: 3. Contractor’s Equipment	

The BoQ is provided as the separate document in the excel format.

PROVISSIONAL AND DAYWORK SCHEDULE SUMS

Amount per “Provisional sum” calculated as the percentage from the Total Price excluding VAT and shall cover additional expenses that may arise during execution of this contract. This sum shall be used only after preliminary written approval by the Employer. In case if use of this sum is not approved by the Employer, this sum shall not be paid to the Contractor after completing of this Contract.

"Daywork Schedule sum" shall be used as stipulated in this Preamble. This sum shall be used only after preliminary written approval by the Employer. In case if use of this sum is not approved by the Employer, this sum shall not be paid to the Contractor after completing of this Contract.

PRICE SCHEDULES FORMS / ФОРМИ ВІДОМОСТІ ЦІН

Price Schedule 1 – Plants and Equipment / Відомість цін 1 - Установки та обладнання

Item / Позиція	Description / Опис	Country Code / Код країни	Qty. (set) / Кількість (комплект)	Unit Price DDP, Euro excluding VAT / DDP, Ціна за одиницю без ПДВ	Total Price Euro excluding VAT / Загальна ціна в Євро без ПДВ
1	**Leachate Treatment Equipment / Обладнання для очищення фільтрату**				
	Containerized Leachate Treatment Plant 200 m^3/day, including all pumps, tanks, reservoirs, vessels, electrical equipment & cabinets, instrumentation, valves and controls, automation & SCADA, and any other necessary equipment / Установка для очищення фільтратів у контейнерах 200 м3/добу, включаючи всі насоси, резервуари, резервуари, посудини, електрообладнання та шафи, прилади, клапани та засоби управління, автоматику та SCADA та будь -яке інше необхідне обладнання	AUT	1	779000	779000
A	**Sub-TOTAL / Разом**				779000
B	**VAT / ПДВ – 20%**				155800
C	**TOTAL including VAT (A+B) (to the Schedule №4) / Загалом враховуючи ПДВ (A+B) (до таблиці 4)**				934800
Name of Tenderer					
Signature of Tenderer					

Price Schedule 2 – Design, Installation and Other Services / Відомість цін 2 - Проектування, монтаж та інші послуги

Item / Позиція	Description / Опис	Unit of measurement / Одиниця виміру	Quantity / Кількість	Unit price, Euro excluding VAT / Ціна за одиницю без ПДВ	Total price per item, Euro excluding VAT / Загальна ціна позиції в
1	Engineering and Design / Виконання проектно-конструкторських робіт	lump sum / фіксована вартість	1	75000	75000
2	Dismantling Works / Демонтажні роботи	lump sum / фіксована вартість	1	45000	45000
3	Civil Works / Загальнобудівельні роботи	lump sum / фіксована вартість	1	140000	140000
4	Infrastructure construction (roads, reservoirs, etc.) / Будівництво інфраструктури (дороги, резервуари, інше)	lump sum / фіксована вартість	1	270000	270000
5	Installation of Utilities / Встановлення інженерних мереж	lump sum / фіксована вартість	1	130500	130500
6	Installation of Plants and Equipment / Встановлення установок та обладнання	lump sum / фіксована вартість	1	146200	146200
7	Commissioning / Введення в експлуатацію	lump sum / фіксована вартість	1	57000	57000
8	Training / Навчання	lump sum / фіксована вартість	1	12700	12700
9	Environmental monitoring and reports / Екологічний моніторинг та звіти	lump sum / фіксована вартість	1	24570	24570
A	**Sub-TOTAL / Разом (1 to 9)**				900970
B	**VAT / ПДВ – 20%**				180194
C	**TOTAL including VAT (A+B) (to the Schedule №4) / Загалом враховуючи ПДВ (A+B) (до таблиці 4)**				1081164
Name of Tenderer					
Signature of Tenderer					

Price Schedule 3 – Trial Operation and Maintenance Services / Відомість цін 3 - Пробна експлуатація та послуги з технічного обслуговування

Item / Позиція	Description / Опис	Unit / Одиниця	Qty. / Кількість	Unit Price DDP, Euro excluding VAT / Ціна за одиницю без ПДВ	Total Price Euro excluding VAT / Загальна ціна позиції в Євро без ПДВ
1	Trial Operation and Maintenance (monthly basis) including purchase, delivery, storage, use / Випробувальна експлуатація і технічне обслуговування (щомісячно), включно з закупівлею, поставкою, зберіганням, використанням	monthly / щомісячно	24	700	16800
	1.1 Reagents / Реагенти	monthly / щомісячно	24	1380	33120
	1.2 Consumables / Витратні матеріали	monthly / щомісячно	24	5700	136800
	1.3 Power / Електроенергія	monthly / щомісячно	24	4320	103680
	1.4 Other resources / Інші ресурси	monthly / щомісячно	24	300	7200
	1.5 Labour / Робоча сила	monthly / щомісячно	24	1000	24000
	1.6 Samples and Tests / Зразки та випробування	monthly / щомісячно	24	360	8640
	1.7 Spare Parts / Запасні частини	monthly / щомісячно	24	960	23040
	1.8 Other Expenses / Інші витрати	monthly / щомісячно	24	1200	28800
A	**Sub-TOTAL / Разом**				382080
B	**VAT / ПДВ – 20%**				76416
C	**TOTAL including VAT (A+B) (to the Schedule №4) / Загалом враховуючи ПДВ (A+B) (до таблиці 4)**				458496
Name of Tenderer					
Signature of Tenderer					

Price Schedule 4 – Grand Summary / Відомість цін №4 – Зведена таблиця

Item / Позиція	Description / Опис	Total Price Euro including VAT-20% / Загальна ціна в Євро з ПДВ
1	GRAND TOTAL VALUE IN ACCORDANCE WITH SCHEDULE NO.1 Plant and Equipment (including mandatory spare parts) / ЗАГАЛЬНА ВАРТІСТЬ У ВІДПОВІДНОСТІ ДО ВІДОМОСТІ ЦІН №1 Установки та обладнання	934800
2	GRAND TOTAL VALUE IN ACCORDANCE WITH SCHEDULE NO.2 Design, Installation and Other Services. / ЗАГАЛЬНА ВАРТІСТЬ У ВІДПОВІДНОСТІ ДО ВІДОМОСТІ ЦІН №2 - Проектування, монтаж та інші послуги	1081164
3	GRAND TOTAL VALUE IN ACCORDANCE WITH SCHEDULE NO.3 Trial Operation and Maintenance Services. / ЗАГАЛЬНА ВАРТІСТЬ У ВІДПОВІДНОСТІ ДО ВІДОМОСТІ ЦІН №3 - Пробна експлуатація та послуги з технічного обслуговування	458496
A	**TOTAL / РАЗОМ (1 to 3)**	2474460
B	**Contingencies -5 (five) percent (%) from Total (A)* / Непередбачувані витрати - 5 (п'ять) відсотків (%) від суми РАЗОМ (A)***	123723
C	**GRAND TOTAL (A + C) (to the Tender Form) ЗАГАЛЬНА ЦІНА (A+C) (для Форм Тендера)**	2598183
Name of Tenderer		
Signature of Tenderer		

Price Schedule №5 – RECOMMENDED SPARE PARTS / Відомість цін №5 - РЕКОМЕНДОВАНІ ЗАПАСНІ ЧАСТИНИ

Item / Позиція	Description / Опис	Unit / Одиниця	Qty. / Кількість	Unit Price DDP, Euro excluding VAT / Ціна за одиницю без ПДВ	Total Price Euro excluding VAT / Загальна ціна позиції в Євро без ПДВ
					0
	See Spare parts list RO RCDT XXL 2.0 63-17			7609,68	7609,68
	See Ware parts List RO XXL 2.0 63-17			22555,87	22555,87
A	**Sub-TOTAL / Разом**				30165,55
B	**VAT / ПДВ – 20%**				6033,11
C	**TOTAL including VAT (A+B) / Загалом враховуючи ПДВ (A+B)**				36198,66
Name of Tenderer					
Signature of Tenderer					

Daywork Schedule: 1. Labor costs /
Таблиця ставок щоденних робіт: 1. Трудові витрати

Item no./ Пункт №	Description/Опис	*Unit/ одиниця*	*Nominal quantity/ Номінальна кількість*	*Rate, EUR/ Розцінка ЄВРО*	*Extended amount/ Загальна сума*
1	Construction foreman / Бригадир	hour	1000	26	26000
2	Construction worker / Робітник-будівельник	hour	1200	15	18000
3	Installer/ Монтажник	hour	1200	17	20400

Daywork Schedule: 2. Materials /
Таблиця ставок щоденних робіт: 2. Матеріали

Item no./ Пункт №	Description/Опис	*Unit/ одиниця*	*Nominal quantity/ Номінальна кількість*	*Rate, EUR/ Розцінка ЄВРО*	*Extended amount/ Загальна сума*
1	Pumping station for pumping filtrate / Насосна станція для перекачування фільтрату	pcs/шт	1	42000	42000
2	Leachate treatment plant / Установка для очищення фільтратів	pcs/шт	1	370000	370000
3	Waterproofing clay / Гідроізоляційна глина	pcs/шт	1	23000	23000
4	Geotextiles / Геотекстиль	pcs/шт	1	14300	14300
5	Drainage perforated double-walled reinforced pipe / Дренажна перфорована двостінна армована труба	pcs/шт	1	17000	17000
Total for the Schedule of Daywork Rates: 2. Materials /					466300

Daywork Schedule: 3. Contractor's Equipment/
Таблиця ставок щоденних робіт: 3. Обладнання Підрядника

Item no./ Пункт №	Description/Опис	*Unit/ одиниця*	*Nominal quantity/ Номінальна кількість*	*Rate, EUR/ Розцінка ЄВРО*	*Extended amount/ Загальна сума*
1	Tractors on a pneumatic wheel course / Трактори на пневматичному колісному ходу	hour	100	35	3500
2	Excavators single-bucket diesel on caterpillar course (bucket capacity at least 1 m³) / Екскаватори одноковшові дизельні на гусеничному ходу (місткість ковша не менше 1 м³)	hour	100	30	3000
3	Mobile power plants, power 4 kW / Пересувні електростанції, потужність 4 кВт	hour	100	20	2000
4	The device for butt welding of polyethylene pipes / Пристрій для стикового зварювання поліетиленових труб	hour	100	20	2000
Total for the Schedule of Daywork Rates: 3. Contractor's Equipment /					10500

Contract Documentation

"Supply and installation of a new leachate treatment system"

Contract No. KhSWP-1

(h) Other Documents

Table of Contents

(h). i. Clarifications of Contractor's tender proposal requested by the Employer and responses received from the Contractor.

(h). ii. Amendments to the Tender Documents and Clarifications

(h). iii. Contractor's Proposal

(h). i. Clarifications of Contractor's tender proposal requested by the Employer and responses received from the Contractor.

Summary of the sent Clarification requests and received Responses:

Tenderer	Date of Clarification Request	Date of Response	Short description of the issue
Consortium of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH	26.05.2023	13.06.2023	Request for additional information on the qualification and financial statements of the Tenderer.
	02.06.2023	13.06.2023	Request for clarification of information about the adjustment of the Contract price.
	20.06.2023	26.06.2023	Request for additional experience information.

(h). ii. Amendments to the Tender Documents and Clarifications

Changes to the tender documentation, (a) list all issue dates (b) date(s) of Bank's no-objection	Amendment 1. Organization of a pre-tender meeting Amendment 2. Inclusion in the tender documentation of a provision on contract price adjustments 15.02.2022 17.04.2023
Clarifications to Tender Document (a) list all issue dates	1. Response to the Clarification request No.1 - 23.02.2022 2. Response to the Clarification request No.2 - 22.07.2023 3. Response to the Clarification request No.3 - 04.04.2023

(h). iii. Contractor's Proposal.

The Contractor's tender, uploaded to the ECEPP portal on 28 April 2023 under the tender for ***"Supply and installation of a new leachate treatment system"*** is an integral part of this Contract.
A summary of the Contractor's proposal is set out below:

Table of content:

1. The Letter of Tender;

1.1 Appendix to Tender;

1.2 Appendix 1 to Tender. Covenant of Integrity from both Partners;

2. Decision of the Sole Shareholder of UAB "Arionex LT";

3. Power of Attorney to the Director of UAB "Arionex LT" LLC and JOINT ACTIVITY CONSORTIUM AGREEMENT dated 04.04.2023;

4. Spare parts list for 24 month of operation;

5. Quality Management Organisation Chart;

6. Schedule of Supplementary Information from both Partners;

7. Tenderer Identification;

8. Letter of Confirmation of Ukrainian registration;

9. ISO 9001, 14001 and 45001 certificates;

10. Copies of registration documents of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH;

11. Copies of financial statements of UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH;

12. Safety Data Sheet according to Regulation (EC) No 1907/2006, Article 31;

13. Scedule of work organization for delivery and setup of RO Unit;

14. Environmental and Social, Health and Safety Plan from both Partners;

15. Price Schedules / Bill of Quantities;

16. Basic Programme;

16.1 Base programme for the installation of an open tank (soil, geotextile, HDPE geomembrane);

16.2 Base program road construction;

17. Site Organisation and Method Statement;

18. Procurement and Logistics Plan;

19. Form PS-1. List of proposed subcontractors;

20. The list of suppliers/vendors for major items materials and plants;

21. Form ELI –1: Eligibility Participant Information Sheet;

22. Form ELI -2: JVCA Information Sheet;

23. Form HIS-1: Historical Contract Non-Performance;

24. Form FIN-1: Financial Situation;

25. Form FIN –2 Average Annual Turnover;

26. Form FIN-3: Financial resources;

27. Form FIN-4: Current Contract Commitments and Pending Awards;

28. Form EXP-1 General Experience with supporting documents;

29. Form EXP-2W: Specific Experience with supporting documents;

30. Form ESHS-1W: ESHS Certification and Documents;

31. Form ESHS-2W: ESHS Experience;

32. Form CON-1: Contractor's Equipment;

33. Form CON-2: Contractor's personnel;

34. Forms CON-3: Resume of Proposed Personnel;

35. Form IRC: Information Request Consent from UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH;

36. Form BIRC: Bank Information Request Consent from UAB "Arionex LT" and "Rotreat Abwasserreinigung" GmbH;

37. Technical specifications of a Containerized Leachate Treatment Plant with supporting documents.

Bank Austria
UniCredit Group

Abs.: P.O.Box 35000, A-1011 Vienna (8813)

Khmelnytskyi Communal Enterprise
"SPETSKOMUNTRANS"
1 Kniazia Sviatoslava Khorobroho Street
Khmelnytskyi 29008
Ukraine

Trade Finance Sales Austria
Rothschildplatz 1
A-1020 Vienna
Phone: 05 05 05-50835
Fax: 05 05 05-51028
E-Mail: dok@unicreditgroup.at
BLZ: 12000

Our Ref.	Your Ref.	Date:
8813G2306448		01.09.2023

To: Khmelnytskyi Communal Enterprise "SPETSKOMUNTRANS", organised and existing under the laws of Ukraine, identification code of the legal entity: 03356565, having its principal place of business at: 1 Kniazia Sviatoslava Khorobroho Street, Khmelnytskyi, 29008, Ukraine

Date:	01.09.2023
Type of Guarantee:	Performance Guarantee
Guarantee No.:	8813G2306448
The Guarantor:	UniCredit Bank Austria AG, Rothschildplatz 1, 1020 Wien, Austria
The Contractor:	Consortium of UAB "Arionex LT", 6 Ašigalio, Kaunas, 49142, Lithuania, and Rotreat Abwasserreinigung GmbH, Otto Baumgartner-Straße 7, 8055 Neuseiersberg, Austria
The Beneficiary:	Khmelnytskyi Communal Enterprise "SPETSKOMUNTRANS", 1 Kniazia Sviatoslava Khorobroho Street, Khmelnytskyi, 29008, Ukraine
The Underlying Relationship:	The Contractor's obligation in respect of Contract No. KhSWP-1 for supply and installation of a new leachate treatment system Contract value: EUR 2.598.183,00
Guarantee Amount and currency:	259.818,30 Euro (two hundred and fifty nine thousand eight hundred and eighteen Euros 30 Euro cents)
Any document required in support of the demand for payment, apart from the supporting statement that is explicitly required in the text below:	The Beneficiary's demand in writing declaring the Contractor to be in default under the Contract

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Language of any required documents:	English
Form of Presentation:	In paper form by courier-service to the Guarantor's address or in electronic form by authenticated SWIFT to the Guarantor's BIC: BKAUATWW
Time as from which a demand can be presented if different from the date of issue:	-
Variation of Amount Clause:	The Guarantee Amount will be increased by presentation to the Guarantor of the Contractor's statement that the underlying contract was amended to increase the scope or value of the works and specifying the amount and currency or the new value.
Guarantee Expiry:	This Guarantee shall expire no later than the 11th day of September, 2026

Any demand for payment under this guarantee must be received by the Guarantor on or before the expiry date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758 except that article 15(a) is hereby excluded.

Kind regards,

UniCredit Bank Austria AG

UniCredit Bank Austria AG

Hackauf Amon