

BLOCK UPS (UPSTREAM)

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TECHNICAL ASSIGNMENT FOR DEVELOPMENT OF FEASIBILITY STUDY FOR OPTIMIZATION OF WASTE MANAGEMENT PROCESS WITHIN THE NIS j.s.c. DURING THE OIL EXPLORATION AND PRODUCTION

1. OBJECTIVE OF THE STUDY

Aim of the Study is to find legal compliant and optimal solutions for the treatment or final disposal of oily waste generated during the process of oil exploration and production within NIS j.s.c., and development of a long-term waste management strategy for these waste types.

Optimal solutions should be suggested based on the comparison of different variants of solutions based on the legislation that applies in EU countries and examples of best European practice.

1. TYPES OF WASTE GENERATED WITHIN THE BLOCK UPS (UPSTREAM)

Current waste management organization in Block UPS is presented graphically in Appendix No. 1. Relevant data about all waste streams are given in this chapter.

The waste generated during drilling of oil wells

* + 1. Waste drilling mud

Process of generation:

Drilling mud waste (waste drilling material) is a mixture of:

* Drilling fluid - liquid, viscous fluid which performs the flushing of cuttings during well drilling and coping with the pressure of pierced layers. All types of drilling fluids used in NIS j.s.c. (lignosulphate, bentonite, gypsum, Duratherm system and KCL system) are water-based prepared, by chemical composition they are fluids, suspension on the basis of very active swellable clay (bentonite) with certain additions / additives (biopolymers and synthetic polymers);
* The material whose origin is from the drilled rocks (mainly fragments of solid rock sandstone, marlstone, dolomite, limestone, gravel and breccia).

The Report on waste examination (index numbers):

In most cases, waste drilling mud is non-hazardous waste (index number 01 05 07 - in accordance with Directive 2000/532/EC) and as such can be disposed on landfills. However, it happens that drilling fluid is contaminated with hydrocarbons in a concentration greater than 2% and then it is a hazardous waste 01 05 05\* that has to be treated before disposal (with hydrocarbon content usually does not exceed 10%)\*.

\* In the framework of the legislation of the Republic of Serbia, which regulates waste disposal, until now were implemented EU Directives which regulates waste management (1999/31/EC, 2000/532/EC and others), while Directive 2006/21/EC which regulates management of mining waste has not been implemented yet (bylaw is currently in preparation).

Quantities generated annually:

In 2013, it was generated (and disposed on a landfill) a total of 30,000 tons of waste drilling mud (15,000 tons liquid phase and 15,000 tons solid phase) while in 2014 were generated a total of 40,000 tons (25,000 liquid phase + 15,000 solid phase)\*.

\*Solid phase is a mixture of drilling fluid and cuttings and it is mostly disposed on landfills. The liquid part (used drilling fluid) is treated and discharged into the environment.

Current method of treatment / disposal

Solid drilling fluid is disposed on landfills of non-hazardous (drilling)\* waste (optionally first treated), while the liquid part after treatment is discharged into the environment.

NIS owns the landfill for disposing of non-hazardous waste drilling mud at Novo Miloševo (the precise description is given in the chapter 4.1).

In 2014 was done pilot project for treatment of 2.000 tons of oily drilling muds (average calorific value of about 8 MJ/kg) by co-incineration in cement factory.

All NIS drilling facilities were equipped with metal or concrete pools for waste drilling mud collecting and systems for dewatering of the waste drilling mud (described in the chapter 4.2).

* + 1. Workover fluids

Process of generation

Basically there is two types of workover fluids which occurs in NIS j.s.c: technical (salt) water (about 90% of all workover fluids generated in NIS) and salt solutions (the most commonly used inorganic salts as NaCl, ZnBr2 KCl, CaCl2, NaBr, CaBr2), the residue concentration of less than 5% or remaining 10% and reacted HCI with dissolved impurities.

The Report of waste examination

This kind of waste is treated and disposed as mining waste (in accordance with EU Directive 2000/532/EC).

Quantities generated annually

Between 4,000 and 7,000 tons per year.

Current method of treatment / disposal

Currently these fluids has been disposing at the landfill Novo Miloševo and given to the external operators with the adequate treatment technology.

\*After signing the contract with the selected contractor NIS will submit the content and quantities of workover fluids used in NIS (and chemical analysis of the waste fluids), based on the contractors demands.

Waste generated during processing and manipulation of oil

* + 1. Oily sludge generated during regular cleaning and maintenance of process equipment

Process of generation:

Sludge generated during regular cleaning and maintenance of process equipment (tank cleaning, auto tanks, pipelines, etc..).

They have high content of hydrocarbons (40-50%), sand, other impurities (30-40%), and water which is added during the cleaning of the tank (10-20%), in order to enable the material collection (pump out).

Characterization of waste:

Oily sludge are hazardous waste, (index number 05 01 06\* - oily sludge from maintenance operations of plants and equipment, 05 01 03\* - sludge from reservoirs cleaning, 16 07 08 \* - wastes containing oil - in accordance with Directive 2000/532/EC) and must be treated (components that makes this waste hazardous are hydrocarbons with content range from 10 to 50%) before disposing.

Quantities generated annually:

On the level of Block Exploration and production annually is generated approximately 2,500 tons of oily sludge.

Current method of treatment / disposal:

Current practice is to treat this sludge by operators who have a license for the treatment of this type of waste by solidification (the waste is heated and separated first in order to recover the oil as much as possible), and disposal on landfills for non-hazardous waste.

Considering the fact that this solution is not in accordance with best available techniques, several pilot projects are done, and some of them are still under development, namely:

*a) Recovery of the oil in the process, after processing,*

Advantages: reduced waste, recovery of oil in the process;

Risks: these materials contain high levels of sand and if the quality of processed fluids is not sufficient, it can cause serious damage to process equipment (pumps)

*b) Co-incineration in cement factory*

Advantages: calorific value of the waste (10-40 MJ / kg) is used for heating furnaces in cement factory.

Disadvantages: The materials are often not homogeneous; in addition, water used to make the material pump greatly reduces the calorific value of waste.

* + 1. Oily soil as a result of spills of crude oil

Process of generation:

Oily soil created by spills of crude oil;

Oily soil (from <1% to 30% of hydrocarbons, an average of 4-10%).

Characterization of waste:

For this type of waste are usually assigned next index numbers: 17 05 03 \* - soil and stones containing dangerous substances, or 17 05 04 - clay and stone other than those mentioned in 17 05 03 \* (In accordance with Directive 2000/532/EC).

Quantities generated annually:

On the level of Block UPS it is generated about 2,000 tons of oily soil annually.

Current method of treatment / disposal:

Contaminated soil is handed over to operators that are licensed for the treatment (usually by solidification or bioremediation) and disposed on landfills for non-hazardous waste.

Considering the fact that this type of treatment disposing of contaminated soil at the landfills is not in accordance with the BAT, and that in most cases, it is a word about agricultural soil (which have to be remediated and returned to the environment if it is possible), it is necessary to develop a pilot project that would consider the possibility to treat this soil by bioremediation to hydrocarbon content lower than 0.5% (even 0.2-0.3) which is the limit (remediation) value for returning of soil in the environment.

Historical waste

Process of generation:

Within the NIS j.s.c. there is a quantity of about 100,000 tons of historical waste that is not properly disposed. Content of historical waste is:

* 60,000 tonnes of that quantity are oily drilling muds (characteristics described in chapter 2.1.1.).
* 15,000 tons of oily mud from process equipment maintaining (characteristics described in chapter 2.2.1.);
* 10,000 tons is contaminated soil described in chapter 2.2.2;
* 15,000 tons of oily water (mix of the waste drilling fluids described in chapter 2.1.1, workover fluids described in chapter 2.1.2 and atmospheric water).

Historical waste, is caused by NIS Upstream business activities, during the last 20 years and temporary disposed at the specially constructed mud pits and sedimentation lagoons.

Characterization of waste:

Described in previous chapters (above mentioned).

Current method of treatment / disposal:

Current practice is to engage operators who have a license for the treatment of these types of waste. Treatment methods are described in previous chapters, depending on the waste type.

Quantities generated annually:

Yearly NIS treats about 20,000 – 30,000 tons of this waste and it is planned to treat complete amount in the next few years.

1. Formation water which is separated during the preparation of crude oil

Process of generation:

Water obtained during the production of crude oil. It is isolated by separation during the preparation process of crude oil.

Characterization of waste:

Formation water is not classified as waste (in Serbian legislation this subject is not regulated jet). The required quality of water for injecting in oil wells is determined by the internal documents of NIS).

Quantities generated annually:

Block UPS annually inject approximately 5,4 mil. m3 of formation water (in 2014).

Current method of treatment / disposal:

It is injected into the oil wells. Every injecting well has a system for preparing, monitoring and injecting of water, and if the water quality not satisfies the required parameters it returns for additional treatment.

1. EXISTING RESOURCES FOR WASTE DISPOSAL IN NIS

Landfill for waste drilling mud disposal “Novo Miloševo”

* + 1. The basic data

Location: Municipality Novi Becej area, 8 km away from Novo Milosevo, at the regional road Basaid - Novo Milosevo;

Landfill capacity: 5 pools for drilling mud disposing have built (dimensions 110x40 and 4.25 m depth) with a volume of 15.400 m3 each, giving 77.000 m3 of total volume.

Each pool is coated with the water resistant HDPE protective foil (resistant at the mechanical shocks and most of the organic and nonorganic chemicals – contains the quality certificate from the accredited laboratory).

Under the protection foil, each pool has a drainage system with the control manholes for leak control and for the receiving of the leaked fluids (in case of foil breakage) in order to prevent soil contamination with oiled materials from the pools.

Total surface of the landfill is about 8,5 hectares. The main project predicts the construction of 12 more pools (same like the existing pools) at this location.

Beside the pools for drilling materials disposing, the landfill owns the following facilities: building for employees with reception house, parking for vehicles, septic tank, weight bridge with a checkbox, well with pump, overhead power station, parking for trucks, object for workers-container, wastewater pool, pool for concrete waste, object for truck washing, oil separator for the oiled water from truck washing object, technological roads, access road, fence etc.

* + 1. Existing documentation

Environmental impact assessment Study for Landfill Novo MIloševo – NM (May 2007);

Main project (Original project) of Landfill Novo Miloševo (May 2007) consists of: main technological project, main project of access roads, main construction and hydro technical project, main remediation and re-cultivation project of the landfill, after fulfilling the pools;

Permit for use of Landfill NM was issued on 23/03/2010 by the Provincial Secretariat for Urban Planning (March 2010);

Working plan of the Landfill NM (28.11.2011);

Main remediation and recultivation project of the Landfill NM after closing (March 2011);

Permit for the temporary storing of the hazardous waste (for max one year, from 27.07.2012) issued for the pools 01 and 03, by the Provincial Secretariat for Urban Planning and environmental protection – never used (the pools 1 and 3 were partially filled with the drilling muds when the licence was obtained).

The Accident protection plan for the Landfill NM (28.11.2011).

Dry location/dewatering systems

During 2014 all NIS drilling facilities were equipped with metal or concrete pools for waste drilling mud collection (instead disposal in the mud pits) in order to prevent hazardous effects of this mud on the environment (by mixing with the surrounding soil). Also during this period most of the drilling facilities were equipped with Dewatering systems\* for recirculation of the drilling fluids. With this system it is possible to recover up to 60 % of drilling fluids and to decrease the total amount of drilling waste for about 10-30 % (considering that drilling fluids makes about 60% of total waste drilling muds).

\*Flocculation (dewatering) system consists of two containers (one with the system for flocculate production and second with two centrifuge units for solid phase separation and restoring of the liquid phase and barite into the system).

Water treatment unit at the Landfill Novo Milosevo

NIS has started the process of designing of water treatment unit at the Landfill Novo Miloševo. The purpose of this unit is to provide treatment and disposal into the environment the liquid phase of drilling waste (and some type of workover fluids) and atmospheric water collected in the pools.

Naftagas transport and cleaning services

NIS owns subsidiary companies for waste transport and collecting services:

* + 1. Naftagas transport

Owns the mechanization (truck tanks, tipper truck, self-loading truck and other specialized mechanization) and licences for transport of hazardous and non-hazardous waste;\*

* + 1. Naftagas technical services (the team for mechanical and chemical cleaning);

Owns the mechanization (truck tanks), trained staff and licenses for collecting and transport of oiled sludge from reservoirs and process equipment cleaning;\*

\* After signing the contract with the selected contractor NIS will submit the precise information like: list and characteristics of mechanization, existing certificates and licenses for mechanization and employees, number of employees and other relevant information based on the contractors requests.

1. STUDY SHOULD INCLUDE:
   1. The optimal methods for treatment / disposal of the oily waste
      1. Comparison of the following disposing methods:
2. Bioremediation (for drilling muds and oily soil);

The study should take into account:

* Treatment options for oily soil, with demand to reach less than 2% hydrocarbons (for landfilling);
* Treatment options of oily soil with demand to reach from 0.5 to 0.2% of hydrocarbons (in order to return in the environment);
* Options for treatment of waste drilling material to 2% hydrocarbons (for landfilling).

1. Disposal at the landfills (for drilling muds/fluids and oily soil);

Study should take in to account:

* The requirements of Directive (1999/31/EZ) on the Landfill of waste;
* The requirements of landfill for waste from extractive industry - Directive (2006/21/EC), for each type of the landfill defined by Directive;

1. Injection in wells (for waste drilling fluids, workover fluids, and formation water);
2. Recirculation and reusing (for waste drilling fluids and waste workover fluids);
3. Centrifuge treatment of waste in order to enable oil recovery (for oily sludge);
4. Treatment and discharging into the environment (for waste drilling fluids, waste workover fluids and formation water);
5. Coincineration (for oily sludge, drilling muds and oily soil);
6. Using drilling muds as a construction material;
7. Other methods by choice.

Each analysis should include:

* Overview of the technology - the method description, required infrastructure, equipment, manpower, mechanization, transport equipment etc;
* The legal basis (EU legislation based on 2000/60/EC, 2008/98/EZ, 2006/21/EC, 91/689/EEC, 1999/31/EC and others). The study should consider the minimum and maximum limit values for final disposing of waste for each technology considering the legislation in EU countries;
* The examples from European practice for each technology (especially for landfills for mining waste in accordance with 2006/21/EC – the examples of the licence for the mining waste landfill, Category A waste facilities and other, at least two examples of the licence for the mining waste landfills);
* The assessment of the technical feasibility and implement ability, based on the waste characteristics, time required for the treatment process, technical requests for the equipment, environment, existing infrastructure, transport requirements etc;
* Required pre-treatment methods (if it is necessary);
* Handling risks (including potential treatment failures an problems) and potential negative impact at the human health and the environment (short term and long term), during and after the exploitation period;
* Financial analysis and assessment of costs of building the required infrastructure and equipment procurement (“CAPEX”) and costs of treatment per ton (“OPEX” costs). The assessment should include the complete process of waste disposing (including manipulation, transport, pre-treatment and treatment/disposing) and to consider the use of the existing resources of NIS.
  1. Preliminary design for optimal operations at the Landfill Novo Miloševo

Analysis of compliance of the existing project documentation and the current situation at the Landfill, with the EU legislation related to the construction of landfills for the disposal of waste drilling fluids (based on 2006/21/EC and 1999/31/EC).

1. Preliminary design for the closure of the existing pools at the Landfill should include:

Analysis of options (revision of existing project documentation) for landfill closure in terms of stability structures, resistance of protective foil, the necessary degree of compression of materials, the maximum permitted levels of moisture in the disposed materials, the necessary construction mechanisation, etc;

Analysis of the allowed degree of contamination of stored materials (examples of practices of European countries based on 2006/21/EC and 1999/31/EC comparison the minimum and maximum limit values in the EU countries);

Analysis of the risk of negative impact of the landfill on the environment after closure and practice of European countries in the management of closed landfills (required analysis, monitoring, the method of remediation in case of accident, etc.).

The prediction of measures based on the previous comparisons (which are not predicted by the main project), which should be realized in order to provide safe closing of the landfill, including the necessary mechanization and cost assessment.

1. Preliminary design for the construction of new pools on existing Landfill location based on the examples of best European practice

Considering that all 12 pools for drilling mud disposal are designed like the existing 6 pools, after revisions of the existing documentation and current condition of the existing pools the contractor should offer the preliminary design (the prediction for improvement of the project) for the construction of the remaining 12 pools based on the present condition, EU legislation and the examples from the best European practice.

Beside the description of expected improvements, the preliminary design should include the construction changes, required mechanization and cost assessment.

Organisation of the transport resources

The requests defined by the European regulative which collecting and transport equipment should meet (for collecting and transport of each type of waste defined in chapter 2);

The analysis of the compliance of the existing transport and collecting mechanization (described in the chapter 4.4) with the requirements defined by the EU regulative (ADR, ATEX etc);

Waste management organizational structure

Based on the completed analyses, the contractor should offer the general concept and approach to management of the current oily waste streams with optimal solution for establishing a waste management organisation in NIS and should determine:

* 1. The description of the waste management process/plan based on the selected optimal waste treatment technologies (look the Appendixes 1). The description should include technology description, required infrastructure, required mechanization for handling and transport of waste, other specific requirements and costs assessment (CAPEX and OPEX), based on the previous analysis;
  2. Waste management Organisation;
* Evaluation of current situation,
* Proposal for inhouse organisation,
* Outsourcing approach,
  1. Procedures and tools for integrated waste management;
  2. Monitoring and reporting system (Waste management information system);
  3. Implementation of selected solution and action plan for the implementation:
* Implementation approach;
* Detailed implementation actions;
* Implementation costs.

1. DUTIES AND RESPONSIBILITIES

After signing a Contract, Project company is obliged to:

* Together with representatives of NIS, visit locations of NIS and inspect the existing technical and project documentation and reports on the chemical analysis of waste;
* Together with representatives of NIS make a list of documents that should be submitted and possible physical and chemical analysis of waste to be carried out;
* Monthly progress meetings; visit or video conferences; discussing with all stakeholders;
* When 80% of the study is finished; discussion of the study progress and the solution proposal with all stakeholders;
* Upon receipt of the required documentation within 90 days complete the development of Study\*.

\*The Study must contain all elements described in the Technical assignment. The assessment of the relevance of the data in Study will be made by representatives of the Purchaser.

* 1. During the preparation of the Study, NIS is required to provide to the Project company previously agreed relevant documentation (based on the above described list) - "inputs" such as:
* The precise process data, existing studies, chemical analyses of the waste, results of the realized pilot projects, detail analyses of the waste, the precise information about treatment technologies available at the Serbian market, the prices of transport, construction and waste treatment services at Serbian market and other existing relevant documentation about the waste which is the subject of this Study, based on the contractors demands;
* The access to the project and technical documentation for the Landfill NM, dry location systems, existing collecting and transport mechanization, flocculation systems and water treatment unit at Novo Milosevo, based on the contractors demands;
* The Purchaser will secure the additional physical-chemical analyses of waste which are required by the contractor from the above-described list;
* Copies of the legislation of the Republic of Serbia at the request of the Project company;

The table of content and relevant parts/sections of each document (based on the list described in 6.1 chapter) will be translated in English (in agreement with the contractor).

1. ELIGIBILITY CRITERIA FOR PROJECT COMPANY

In order to qualify for the development of this study the potential contractor should meet the following requirements:

Reference list for the last 10 years:

* + At least five studies\*, related to the environmental protection processes (waste management, water treatment, remediation of contaminated sites) in the upstream oil industry in EU countries;
  + At least two realized designing projects\*\* in the EU countries, for the landfills of mining waste (minimum capacity of 10.000 tons, designed for the upstream oil industry) construction of bioremediation plants (minimum capacity of 1.000 tons for the oil industry).

\* Studies consider: feasibility studies, case studies, risk assessment studies, and remediation project studies;

\*\* Designing projects consider the services of designing and preparation of project documentation. Only realized project can be listed.

In order to confirm technical qualifications for the development of this Study the contractor should deliver:

The signed and verified reference list which will consist: the list of projects, the Client name, Client contact and the year of the project realization.

**APENDIX NO.1: the Current waste management ORGANIZATION IN BLOCK UPS**

**Oily sludges**

2.400 t/year

**Oily soil**

2000 t/year

**Drilling mud waste**

30.000 t/year

**Workover fluids**

4-7.000 t/year

NIS Landfill Novo Milosevo

total capacity for drilling mud - 77.000 m3

**Problem:**

- Mixing different types of waste

- increasing volume of existing pits

**Problem:**

- Disposal of workover fluids and oily waste is not permitted,

- Pollution of Landfill,

- Lack of water treatment,

- Lack of control of materials

Treatment by external operators (bioremediation and solidification like a pretreatment) and final disposal at landfills