11.4 Attachments to Chapter 4

Attachment 11.4.1: **Comparison of the Greifswald NPP (KGR) and the Kozloduy NPP (KNPP) and estimation of the impacts by the decommissioning Units 1 to 4 at Kozloduy NPP**

Attachment 11.4.2: **Experience from Greifswald NPP decommissioning in Germany (EWN Environmental Impact Register – Summary)**

Attachment 11.4.3: **Summarized results of the perfomed wastewater physical and chemical tests in Kozloduy NPP region**

Attachment 11.4.1: Comparison of the Greifswald NPP (KGR) and the Kozloduy NPP (KNPP) and estimation of the direct impacts by the decommissioning Units 1 to 4 at Kozloduy NPP

The basis for this chapter is the experience from the ongoing decommissioning activities at KGR which are at present at the state of > 80 % complete. This experience is summarized in the EWN Environmental Impact Register (see Appendix 11.4.2).

The considered values of the direct impacts are estimated values which should be specified in more detail in the frame of planned activities for the preparation of the decommissioning process, e.g. the project radiological investigation of the Units 1-4. This specification is important for the detailed planning of dismantling activities.

1. Comparison of the Greifswald NPP (KGR) and the Kozloduy NPP (KNPP)

1.1 Site conditions

Both nuclear power plants are located at important surface waters, KGR at the Baltic Sea and KNPP at the Danube River. Both use these water reservoirs for direct cooling and as recipient for purified waste water. These waters are protected by international conventions, the Baltic Sea by HELCOM (Helsinki Convention for the Protection of the Baltic Sea) and the Danube by ICPDR (International Convention for the Protection of the Danube River).

Another common characteristic of both sites is the proximity to Protected Areas of the EU NATURA 2000 network.

Last but not least, the environmental law of the EU which was incorporated to national law is valid for the KGR and the KNPP site.

Technical Design of the Units to be decommissioned

Units 1 to 4 of KGR are Russian type WWER-440 model 230 with compartment system. Unit 5 is a Russian type WWER-440 model 213 with wet condensation system. For the comparison and estimation of the direct impacts the data from Units 1-4 were used.

Units 1 to 4 of KNPP are the same Russian type WWER-440 model 230. Between units 1 and 2 and 3 and 4 are differences due to the higher design safety level. Some installations of the WWER-440 model 213 were also realized in Units 3 and 4. The most important additional Safety Systems in Units 3 and 4 are:

- Tanks
- High pressure emergency core cooling systems with concentration higher than 40 g/l H_3BO_3 in the tanks when for Units 1 and 2 it is with concentration higher than 12 g/l H_3BO_3
- Steam generator emergency feed water system
- Emergency cooling spray system with heat exchanger before the pump system
- Modernized Accident localization system (ALS) including Filtering ventilation system and Jet Vortex Condenser (JVC);
- System for the recombination of Hydrogen in the primary circuits
- Additional emergency control room
- Three channels system for reliable supply of the first and second category safety related consumers.

The differences between the NPP Units of KNPP (3 and 4) and the KGR Units are due to the higher safety level in emergency mode but not in normal operation mode.

The differences described above have influence on the estimation of the masses for dismantling of Units 3 and 4.

Of course, there are a lot of differences in details between KGR and KNPP, for instance the treatment of the turbine condensate with mixed bed ion exchangers in KGR, but they have no or only minor influence on the estimation of the environmental impacts.

In case of the demolition of the building structures after the decontamination of the concrete surfaces the masses are estimated for:

- Reactor buildings: 147 800 t,
- The turbine hall and the turbine hall intermediate buildings: 170 000 t and
- Auxiliary buildings: 40 500 t (this amount is an estimation with big uncertainties).

Summarized, there are 338 300 t of building materials which can be reused and approximately 20 000 t concrete from the decontamination of building structures by surface abrasion.

No demolition of building is foreseen according to the Updated Decommissioning Strategy for units 1 to 4 of Kozloduy NPP [7].

For the impact assessment, the resulting amount of waste after the dismantling and waste treatment processes is important and is described for KGR in the EEIR [50]. This waste from decommissioning can be divided in:

- Conventional waste for utilization;
- Conventional waste for removal (e.g. landfill or incineration);
- RAW for decay storage (e.g. large components for later cutting);
- RAW for reuse or utilization in nuclear facilities;
- RAW prepared for final storage.

The detailed amounts of these types have to be defined in the frame of the preparation of the decommissioning processes, by use of the material data base for detailed planning of the different dismantling activities.

The given estimates are a coarse estimate based on the data from KNPP (KPMU/DPL/013), the EWN experience (KGR) [50] and the calculations from the EIA-Report for the Bohunice NPP [18].

Technological material (without building structures): appr. 75 000 t

There from:

- Conventional waste (material category 1 and material category 2 and 3 after free release): 65 000 t
- RAW: 10 000 t (solid RAW from dismantling).

The amount of RAW does not include any operational RAW and depends on the waste management strategy and is only valid when the EWN strategy (after dismantling decontamination in the Warm Workshop as described in Annex 1 of the EEIR) is used. According to the Technical specification for SRDW [156] similar waste management strategies are planned. In case of using other methods for waste treatment, e.g. cementation without post dismantling decontamination, the mass is higher.

About 80% of the conventional waste is expected as waste for utilization.

Operation

The main differences between KGR and KNPP due to Units 1 to 4 are the operation times and the amounts of produced energy.

Table 1.1-1 Basic data about the reactor Units 1-4 KGR and KNPP

Unit	Operation time [years]	Produced el. Energy [TWh]
1 KNPP/ KGR	28 / 17	66.7 / 41.3
2 KNPP/ KGR	27/ 15	68.9 / 40.0
3 KNPP/ KGR	26 / 12	68.7 / 36.0
4 KNPP/ KGR	24 / 11	66.7 / 32.1

The longer duration of operation of the KNPP units leads to a higher level of activation of the RPVs and their internals. But according to the KGR experience from the dismantling of activated components (EEIR [50]) the influence of the activation level to the radiation exposure of the personnel is small, as the main dismantling activities are remote controlled procedures.

A more important aspect for the activation level is the storage of dismantled activated components due to the necessary shielding equipment.

The higher duration of operation did not lead to a higher level of contamination and dose rates in the Controlled Areas and the Turbine Hall of KNPP. The project "Radiological investigation of the KNPP Units 1+2" was accomplished under the leadership of KGR specialists with experience from the radiological investigation of the Units 1-4 in the KGR (see chapter 1.1.3). The main conclusions are:

- The radiological situation of Units 1-2 is comparable with the initial situation of the Greifswald NPP and was expected for KNPP because of the same type of nuclear power plant and a similar operation history.
- The detected surface contamination inside the systems is also similar to the initial situation at Greifswald NPP (Turbine Hall).
- The results of the performed dose rate measurements are comparable with the situation at the Greifswald NPP some years after the shutdown.
- In general, the level of detected surface contamination inside the systems is similar to the contamination level in EWN (1993/94)."

Emissions of radioactive nuclides into air and water during operation and post operation

As described Units 1-4 of KGR and KNPP have the same technical design for the ventilation systems, water-supply and waste water systems of the controlled areas.

A crucial characteristic of the post operation phase 1990 - 1995 in the KGR and present in the KNPP (E-mode) is that all activities are in the frame of the operation license and similar activities were or become realized for KNPP.

The following table gives examples for the comparison of emissions of radioactive nuclides into air.

It has to be mentioned that since 1991 the sampling systems and the measurement/evaluation systems were improved, so that the use of data before 1991 is not exactly a hundred percent, but in a sufficient precision for this comparison.

Table 1.1-2 Emissions of nuclides into air during operation and post operation KGR and KNPP

Units 1-4	Year	LLA [MBq]	I-nuclides [MBq]	Noble gases [TBq]	Mode	Remarks
KGR	1987	22 004	8 616	230	operation	
KNPP	2000	783	2 137	182	operation	
KNPP	2006	63	259	3	operation	Units 1+2 out of operation
KGR	1993	380	0	0	Post operation	3 years after final shutdown
KNPP	2008	17	0	0	Post operation	Units 1-4 out of operation

The common feature at KGR and KNPP is the missing of noble gases and I- nuclides and the important reduction of the aerosol emissions after the final shutdown.

The comparison of the operation of all 4 units between KGR (1987) and KNPP (2000) shows, that the noble gas emissions are on the same level, the I-nuclides are comparable but lower at KNPP and the aerosol emissions are much lower at KNPP. Cause for this main difference is the change of the "Petrjanow" aerosol filters to aerosol filters according to the best available techniques with higher (several orders of magnitude) filtration efficiency. This change was realized after the final shutdown and finished 1997 at KGR. The reduction of emissions at KNPP in comparison 2000 to 2006 is also a result of taken measures.

By the comparison of the post operation emissions the above mentioned facts have to be taken into account. The change of the "Petrjanow" filters was finished at KGR 2 years after the beginning of the decommissioning process.

Summarizing can be stated that the reduction of emissions into air is on a high level at KNPP due to the best available techniques and the safety culture.

The following table gives examples for emission of radioactive nuclides into water.

Table 1.1-3 Emissions of nuclides into water during operation and post operation KGR and KNPP

Units 1-4	Year	Activity without ^{3}H [MBq]	^{3}H [GBq]	Mode	Remarks
KGR	1987	26 239	15 457	operation	
KNPP	2000	1 547	15633	operation	^{3}H from the whole KNPP site
KNPP	2006	661	6 450	operation	Units 1+2 out of operation
KGR	1993	172	31	Post operation	3 years after final

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Units 1-4	Year	Activity without ^3H [MBq]	^3H [GBq]	Mode	Remarks
					shutdown
KNPP	2008	157	370	Post operation	Units 1-4 out of operation

Common for KGR and KNPP is the important reduction of the emissions in comparison operation to post operation. The higher emissions of nuclides (without ^3H) in KGR were caused by steam generator leakages. The ^3H emissions during operation were in comparison KGR and KNPP on a comparable level. The emissions of ^3H from the KNPP Units 1-4 in the post operation phase are higher than from the KGR Units 1-4.

Collective effective doses (CED) during operation and post operation

The following table (1.1-4) gives examples for the CED during operation and post operation.

Table 1.1-4 CED during operation and post operation KGR and KNPP.

Units 1-4	Year	CED [mSv]	Number of exposed persons	Number of monitored persons
KGR, operation	1987	9 900	1 348	Appr. 4000
KNPP, operation	2002	2 548	1 391	2 866
KNPP, operation	2006	663 (1)	472	1 508
KGR, post operation	1993	529	350	905
KNPP, post operation	2008	124	231	1188

(1) Units 1+2 out of operation

The results given in this table show considerable reduction of CED after units shutdown as well in KGR as in Kozloduy NPP, compared to the normal operation mode. Moreover, the number of the people subject to radiation exposure is significantly reduced in both NPPs.

Decommissioning activities

The KNPP dismantling strategy as described in chapter 1 can be summarized by the following steps:

- "E" mode (post operation) is the present operation mode under valid license for the post operational phase, but is not in the scope of the decommissioning permission.
- Stage 1
  - Preparation of Safe Enclosure (start may be different for Units 1+2 and Units 3+4)
  - Operation of Safe Enclosure for 5 years (start may be different for Units 1+2 and Units 3+4)
  - Dismantling Turbine Hall
  - Implementation of decommissioning preparation projects (e.g. SRDW, Decay storage sites and sites for conventional waste from decommissioning).

- These preparatory projects are comparable with the KGR projects for the dismantling process (free release facility, Interim Storage North and improvement of the Warm Workshop for size reduction and decontamination) - more detailed information is given in the EEIR [50].

- Stage 2

Dismantling within the Safe Enclosure (start may be different for units 1+2 and units 3+4)

The "E" mode activities are not a part of the present EIA-Report for Decommissioning of the Units 1 to 4 at KNPP site, as they are validated by the operation permission and the permission for the Dry Spent Fuel Storage. Thus the following activities are formally not assessed but mentioned in this EIA-Report:

- All activities with the spent fuel assemblies included the final storage in the Dry Spent Fuel Storage;
- All pre-dismantling decontamination activities including the decontamination of the primary circuits and of other installed components. The post-dismantling decontamination activities are part of this EIA-Report.
- All insulation removal activities in the Turbine Hall and the Reactor Halls are mentioned in Section 1.5.
- The treatment of operational radioactive waste from operation. The operational radioactive waste from the dismantling is a part of this report.

The validity of the decommissioning license starts with Stage 1 of the decommissioning. It is possible, that some of the above mentioned activities will be finalized during Stage 1 of decommissioning.

In KGR similar activities were realized in the post operation phase, but the management of fuel assemblies up to the storage in CASTOR casks in the ISN was realized in the dismantling period. Also the removal of the insulation was realized during the dismantling period, in difference to the KNPP plan.

The difference of the EWN dismantling strategy in comparison to the KNPP strategy can be defined by:

- No Safe Enclosure;
- Start of all activities in parallel.

The implementation of the KNPP strategy in comparison to the EWN strategy has the following consequences for KNPP:

- Longer duration of the whole project,
- Higher expenditure (for the Safe Enclosure preparation) and
- Lower radiation exposure during the dismantling of the Safe Enclosure area at Stage 2.

These consequences are insignificantly related to the estimation of the direct environmental impacts. The radiation exposure is lower but additional exposure is expected during the period of Safe Enclosure operation.

2. Estimation of the direct impacts by the decommissioning Units 1 to 4 at KNPP

Resulting from Section 1 of this attachment can be summarized that the Units 1to 4 of KNPP are comparable with the Units 1 to 4 of the Greifswald NPP related to the direct impacts during the decommissioning.

Estimation of the releases of radioactive nuclides into air and water from decommissioning of the KNPP Units 1 to 4

Based on the comparison of the emissions during operation and post operation and 14 years EWN experience from KGR decommissioning are estimated gas-aerosol emissions from the stacks Unit 1+2, Unit 3+4 and AB-1 and AB-2:

Emissions into air:

- 20 MBq LLA average annual value during the entire decommissioning period

In this value the emissions from the planned projects: Size Reduction and Decontamination Workshop and Decay Storage Sites are included.

Emissions into water (water releasing points of the units 1 – 4):

- Nuclides (without ^{3}H): 120 MBq average annual value during the decommissioning period;
  Tritium: 50 GBq average annual value during the decommissioning period.

In this value the emissions from the above mentioned projects and all decontamination activities are included.

These emission values into air and water may be interpreted as upper limit and include the emissions from the planned Size Reduction and Decontamination Workshop and Decay Storage Sites.

Estimation of the Collective Effective Dose from dismantling of the KNPP Units 1 to 4

Based on the comparison of the CED during the EWN experience during the decommissioning, the CED can be estimated for the dismantling of the KNPP Units 1 – 4 including the activities in the SRDW and the Decay Storage:

CED: 200 mSv average annual value during the decommissioning period for 350 exposed persons.

This CED summarizes all activities during the dismantling period: the dismantling of the equipment; the treatment, transport and storage of waste from dismantling and operational waste from dismantling in the Units 1 – 4, including the Size Reduction and Decontamination Workshop and Decay Storage Sites; post operation activities and maintenance of all needed facilities; radiation protection and last, but not least the guarding.

The shares of summarized CED for the dismantling of the activated components, the dismantling of the whole equipment of one unit and the treatment and storage of RAW can be estimated according to the EWN experience:

- Share of summarized CED for the dismantling of activated components: 300 mSv,
- Share of summarized CED for the dismantling unit (without waste treatment) of one unit: 500 mSv,
- Share of summarized CED for the treatment and storage of RAW: 300 mSv.

These CED values may be interpreted as upper limit, because additionally the high level of the safety culture at KNPP has to be taken into account and furthermore the consequent realization of the ALARA principles.

Estimation of non-radioactive impacts during the decommissioning period

Emissions into air

Dismantling: Dust and gases from oxyacetylene-, electric arch- and plasma cutting are limited to the working place and in the frame of limit values according to the occupational safety requirements. According to EWN experience this is valid for all dismantling and cutting places (Reactor Buildings, Turbine Hall, Size Reduction and Decontamination Workshop and Decay Storage Sites for Transitional RAW).

Site for Conventional Waste from Decommissioning: The emissions depend on the acceptance conditions and the type of dump. In the case of a mono purpose dump for inert material the emissions (dust) are negligible.

Breaker plants: Dust 40g / t concrete according EWN experience. In case of the complete demolition of all building structures of Units 1-4 (not foreseen at present) the following could be expected: *mineral dust: 13.2 t*

Heat Generation Plant: Dust, NO_x, CO, SO_2, as air pollutants and CO2 as climate damaging substance. These emissions depend on the demand (due to the availability of units 5 and 6). For this project a separate EIA procedure is necessary. The CO_2 emissions are permitted in the frame of the Emission Trade.

Emergency Diesel Generator F: PM10, VOC, SO_2, NO_x, as air pollutants and CO_2

For these facilities IPPC permission is in preparation and thus formally it is not a part of this EIA Report. But it has to be mentioned, that according to EWN experience this impacts can be reduced with the progress of the dismantling process.

Plasma Melting Facility: SO_2, HCl, CO, dioxins and furans as air pollutants

For this project a separate EIA procedure is necessary und thus it is not a part of this EIA-Report.

According to the law requirements to use the Best Available Techniques for the reduction of air pollutants it could be expected that only low emissions will occur.

Internal and external transport activities: PM10, NO_x from diesel fuel

These emissions are predominantly generated by waste transport activities.

In the EWN the diesel fuel consumption for the internal transport is approximately 100 m^3 per year and thus it can be expected in the same order of magnitude during Stages 1 and 2 of decommissioning of KNPP Units 1 to 4.

Emissions into water

Post operation and production of dematerialized water:

Nutrients**:** N and P compounds, water pollutants: COD, AOX, heavy metals

Corresponding with the EWN experience an important reduction of this impact was stated in decommissioning period in comparison to the operation phase. According to the EWN experience the decrease of these impacts could be expected as after the shutdown no heat of condensation from the generation process is produced. The small remaining thermal releases are mainly caused by cooling of spent fuel and the operation of the evaporation plants for water purification.

Thermal releases

The thermal releases in comparison to operation are negligible, because after the shutdown no heat of condensation from the generation process is produced. The small remaining thermal releases are mainly caused by cooling of spent fuel and the operation of the evaporation plants for water purification.

Other conventional impacts (harmful physical impacts)

Noise

Activities with the highest level of noise are demolition of building structures (not foreseen at present) by operation of hydraulic chisels and operation of excavator and the ramming of spiles for the foundation of new buildings (e.g. for the projects SRDW and Heat Generation Plant).

Table 2-1 Noise levels result of the performed activities according EWN experience [50]

Activity	**Sound power level L_{WA} [dB (A)]**	**Peak sound power level L_{WA} [dB (A)]**
Ramming of spile walls	126	140
Operation of hydraulic chisels	105	125
Operation of excavator	100.5	125

These impacts are short term impacts.

Vibration

As per EWN experience there are no data about vibrations levels from the demolition and pilot foundation activities.

Vibrations by operation of the SRDW

According to the Technical Specification for the SRDW areas for cutting operations are planned. The selection of the necessary equipment is the task of the Contractor. In the case of the use of a scrap shear, essential vibrations are not expected when this facility is mounted on leaf spring packs (EWN experience with the scrap shear MARS).

Water demand, electrical- and thermal energy demand

Related to the impacts of water demand, electrical energy demand and thermal energy demand during the decommissioning activities on the basis of the EWN experience it can be stated that there will be no change in comparison to the post operation phase. The main share of the water demand is the one of the sanitary water for the personnel. The main consumers of electrical and thermal energy are the systems for the perpetuation of the safe post operation status. (E.g. the ventilation systems of the Reactor Buildings).

Attachment 11.4.2 Experience from Greifswald NPP decommissioning in Germany (EWN Environmental Impact Register – Summary)

EXPERIENCE FROM GREIFSWALD NPP DECOMMISSIONING IN GERMANY
(EWN ENVIRONMENTAL IMPACT REGISTER)

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List of abbreviations

AOX	Adsorbable Organic Halides
CASTOR	Cask for dry storage of spent fuel elements
COD	Chemical Oxygen Demand
EDTA	Ethylene Diamine Tetra Acetic acid
FFH	Flora Fauna Habitat areas (EU definition)
ISN	Interim Storage North (storage for radioactive waste with conditioning plants and storage for filled CASTOR casks)
KTA	Rules of the committee for nuclear technology
LUNG	Environmental Protection Agency of Mecklenburg – Western Pommerania
NTA	Nitrilo Tri Acetic acid
RPV	Reactor Pressure Vessel
TRGS	Technical Rules for handling hazardous materials
UBA	Federal Environmental Agency
WWER-440 213	Water Water Energy Reactor 440MW_{el} model 213, Russian type with wet condensation (advanced type)
WWER-440 230	Water Water Energy Reactor 440 MW_{el} $model_l$ 230, Russian type with hermetically sealed compartment system (first type)
ZAB	Wet storage for spent nuclear fuel
ZAW	Central Warm Workshop, facilty for dismantling and decontamination of plant parts

1. Introduction

EWN GmbH Rubenow company has gained much experience with Environmental Impact Assessment (EIA) procedures regarding the decommissioning of Units 1 to 5 of the Greifswald NPP.

Units 1 to 4 (WWER 230) on the Greifswald site were shut down in 1990, first unit 2 followed by Unit 3, Unit 4, and Unit 1. The Unit 5 (type WWER 213) started trial operation 1989 and was shut down at the end of 1989. The construction of units 6 to 8 was stopped in 1990.

The units 1 to 4 of the Greifswald NPP with regard to EIA have the same technical design as the Kozloduy NPP Units 1 to 4. Differences to the EWN Units 1 to 4 are existing (see chapter 4.0 of the EIA-Report) but not important.

Another issue which has to be considered regarding EIA is the different approach for treatment and conditioning of operational radioactive waste.

EWN transition stage (1991 – 1995)
The main activities in this post operation phase were:

- defuelling, that means transport of all spent fuel elements from the units to theWet storage for spent fuel (ZAB),
- treatment of operational waste,
- decontamination.

In 1992 the dismantling of buildings and plants outside the controlled and monitored area (outside turbine hall and reactor buildings) started.

EWN decommissioning stage (1996 up to present end 2011, completion planned for 2014)
The EWN dismantling strategy comprises the removal of all components / equipment (e.g. steam generators and pressurizers) as large as possible for decay storage and their later treatment in the newly constructed Interim Storage North (ISN).

Contaminated plant parts can also be treated in the Central Warm Workshop (ZAW) by cutting and decontamination and other treatments.

At the end of 2011 approx. 88% of the plant parts of the controlled area Units 1-5, and 100% of the monitored area were dismantled.

In the frame of the remote dismantling of the activated components (reactors and internals), new technologies were developed and realized. In preparation a mock up phase (model dismantling) was realized in Unit 5 with non-activated components of the reactors of Unit 7/8.
The RPVs of Units 1 to 5 were stored as complete components in the ISN using special designed Shielding and Transport Devices. The high- activated RPV internals of the Units 1 and 2 have been cut on the basis of the mentioned newly developed and tested technology.

The RPV internals of the reactors 3 - 5 were stored without cutting in shielded casks in the ISN.

The RPV Units 3 and 4 were stored with parts of their internals (core barrel). These activities were finished in September 2009.
The spent fuel elements stored in the Wet storage for spent nuclear fuel (ZAB) were reloaded into CASTOR casks in the following steps:

– Transport from the Wet storage for spent fuel (ZAB) to the reloading facility (Unit 3),
– Reloading into CASTOR cask,
– Closing, emptying and drying of the CASTOR casks, and
– Transport into the ISN (hall 8).

This process started in 1999 and was finished in May 2006.

The treatment of operational and post operational waste is ongoing. After reconstruction of the Special Building No. I, the conditioning of mixed operational waste, stored there in concrete pits, was carried out from 1998 until 2002.

Up to the end of 2011 100 % of all operational waste was conditioned.

2. Direct impacts from EWN decommissioning in comparison to impacts from the operation and post operation phases

General:

- important reduction of all impacts, after shut down of the operating units, except conventional emissions into the air,
- all impacts are well below under limit values or other legally required values,
- the low level impacts by decommissioning are in the same range as impacts from other activities (e.g. post operation),
- the most relevant impacts are temporary and disappear or are essentially reduced at the end of the decommissioning process (e.g. waste),
- all activities in the controlled area take place in a closed system with effective control, exhaust air cleaning systems according to the best available techniques and a closed water system with waste water treatment plants and control of all outside releases.

2.1 Radiation exposure of personnel

During the operation stage the Collective Effective Dose (CED) was about 10 Sv/year (average 1986 – 1989).
In the post operation stage (1991 – 1995) the CED decreased from 0.56 Sv/year (1991) to 0.23 Sv/year (1995).
In the ongoing dismantling stage the average annual CED (1996 – 2011) was between 0.06 Sv (2011) and 0.26 Sv/year (1998). For this stage the radiation exposure of the annual average CED can be splitted due to activities in the following approximate range:

1. dismantling incl. treatment of waste from dismantling between 30 to 50%
2. post operation and all other activities (outside 3. – 6.) between 20 to 30%
3. guarding about 10 to 20 %
4. radiation protection less than 10 %
5. fuel reloading (into CASTOR casks) about 5 to 10 % (1999 – 2006)
6. conditioning of operational waste about 5 to 10 %

The annual CED are comparable with other NPP decommissioning projects in Germany (Würgassen and Stade). The data show that the exposure during the several phases of decommissioning and dismantling is much lower than during the operation phase [10].
For the dismantling of all facilities and plant parts (without demolition of building structures and activated components) of one unit, the total CED is < 0.5 Sv.
For the remote dismantling of activated components (core components without Reactor Pressure Vessel) of one unit, the total CED is < 0.1 Sv. The main part of the exposure is caused by preparation activities.
The total CED for all activities (described on page 4) with all activated components of Units 1 to 5 up to the storage in the ISN was summarised as 270 mSv.
The total CED for the whole process of reloading of 4800 spent fuel elements with the total amount of 555.3 Mg into Castor Casks (described on page 5) was summarised as 148 mSv and the collective neutron dose as 190 mSv.
The annual CED from all activities in the Interim Storage North has been increased from 1.5mSv in 1998 (start of operation) to 19.1 mSv/year until 2009 and decreased to 13.3 mSv in 2011 (γ and n doses). The summarized CED for the whole transition and decommissioning stage can be expected as lower than the CED of one year during operation.

2.2 Release of radioactive nuclides into air

- In comparison between operation and post operation the emission of aerosols is reduced in 1 order of magnitude at the beginning of the post operation (from 28155 MBq/year to 2744 MBq/year) to 2 orders of magnitude at the end of the post operation (422 MBq) .
- In comparison of post operation and dismantling stage the emission of aerosols is decreasing to 1 order of magnitude (average 22 MBq/year in the dismantling stage).
- The main emitters are the stacks 1-3, the quotas of ZAB, ZAW and ISN are all together in the range of some percents.
- The emissions of aerosols in the decommissioning stage are on a very low level (0.01 – 0.05 % of the limited values). ***The effects of dismantling activities regarding the emission of aerosols are existing but not explicitely detectable***. The low level is caused by an effective system of measures for prevention and separation of aerosols (closed dismantling areas with additional exhaust air plants, use of filters with the best available rate of filtration for the exhaust air system).
- An influence of the remote dismantling was not detectable.
- At the stack of the conditioning area of the ISN aerosols are not detectable.
- The aerosol emissions from the ventilation systems of the ISN storage halls are calculated by model of emissions with the assumptions:
  - 100 % capacity utilization rate, and
  - the maximum of contamination of 4 Bq/cm^2 on all surfaces at stored boxes and components

  These calculated emissions are 2 orders of magnitude below the aerosol emissions of the whole KGR site and thus to be considered as negligible.

2.3 Release of radioactive nuclides into surface water (Baltic Sea)

- In comparison between operation and post operation and dismantling, the total emissions (without ^3H) were reduced in 2 orders of magnitude (28 800 MBq/year by operation to 164 MBq / year in 1996).
- The main source for these emissions is the treatment of operational and post operational waste. All emissions are caused exclusively by the waste water treatment process.

- ***An influence of the dismantling activities is not detectable*** as:
  - all dismantling activities are realized on empty and dry facilities;
  - in the case of dismantling activities with water use, band saw and remote dismantling, the waste water is contaminated with solid particles which have very small influence on the quality of evaporator condensate;
  - waste water from post dismantling decontamination has only a small influence on the quality of evaporator condensate as it is neutralized before evaporation.

2.4 Waste

The whole mass of the site is about **1 800 000 t.**
This mass is divided into 3 Categories. The Category 1 is defined as unrestricted material and the part of the whole mass is about 1 235 000 t. This material is conventional waste.
Material of the Category 2 is defined as suspected material, i.e. material with possible contamination. Material of the Category 3 is defined as contaminated material. The materials of Categories 2 and 3 are radioactive waste (The definition „radioactive residual material“ is used in Germany for all interim stages before final storage).Their part of the whole mass is about 565 000 t.
They can be exempted from the Atomic Law after free release measurement procedure (measurement and decision of the radiation protection authority when the values are below defined limit values) and possible previous decontamination.

Another type of Category 3 material is operational waste from operation and post operation.

2.4.1 Radioactive waste

The treatment or conditioning of operational- and dismantling waste according to the requirements for final disposal leads to an important decrease of the emergency potential.
On the other hand, the total amount of radioactive waste is reduced by treatment, and the release as conventional waste is possible.
These aspects are to be considered by the assessment of the low environmental impacts by treatment and conditioning of waste.

At the end of 2011, the incurred amount of all radioactive residual material was 263 361 t.
About 90 % of this amount was disposed off as conventional waste (unrestricted release and release with restrictions) after free release measurement and possible previous decontamination:
At the end of 2011 the net inventory of stored material in the ISN from the KGR site was 21 424 t with a total activity of 4.336E+16 Bq.

2.4.2 Conventional waste

Besides the waste from the NPP dismantling: the Category 1 material and Categories 2 and 3 material after free release, important amounts of the disposed waste are generated by other dismantling activities on the EWN site.
In the years with the highest mass of conventional waste (2001, 2003, 2004 and 2007) in the range of annually < 50 000 t, the main part (about 75 %) was concrete and other mineral building materials.
More than 10 % are scrap metals.
About 90 % of this conventional waste was recovered (e.g. by recycling).

For the assessment of the impacts from waste recovering it has also to be taken into account that the use of natural resources is reduced and thus environmental impacts (e.g. by ore processing) are prevented.
The quota of about 10 % not recoverable waste is disposed environmentally friendly by deposition in landfills (dumps) or burning in waste incineration plants.
All subcontractors for treatment, disposal and recovery of waste are regularly audited.
The transport emissions are an important impact of the conventional waste management (see 2.6) as secondary temporary impact.

2.5 Thermal output (cooling water)

The thermal output with the cooling water was important during operation but insignificant after shut down.

2.6 Conventional emissions into air

Conventional emissions were increased by operation of the thermal power station, but this station was a necessary prerequisite for shut down the NPP units. In the year 2008, 14 t N-oxides and 1.5 t CO were emitted. With the decreasing energy consumption during the progress of decommissioning, these emissions are reduced.
Steady emissions come from the emergency diesel engines. The annual emissions between 1988 and 2001 were about 3400kg N-oxides, 130kg SO_2, 115kg VOC (Volatile Organic Compounds) and 230kg PM10 (Particulate Matter < 10 µm). Since 2002 these emissions have beenn stepwise reduced due to the replacement by smaller emergency diesel engines.
The emissions from decommissioning activities:

- dismantling and cutting of facilities and facility parts,
- removal of insulation,
- removal of asbestos materials,
- waste conditioning,
- cutting of concrete structures,
- demolition of buildings, and
- demolition of plants for utilization of concrete and other mineral building materials

are reduced also by mitigation measures (e.g. filtration plants, band saw facilities), and present significant emissions are only limited to the working area.
The emissions from the transport of waste are more important. The range of these emissions is (worstly estimated) about 300g NO_x and 10g PM10 per ton of waste. The calculated (base fuel demand of 100 m^3) average annual emissions from all intra company transport activities are 1200 kg NO_x and 20 kg PM 10.

2.7 Emissions of nutrients and water pollutants into surface water (Baltic Sea)

In comparison to the operation stage the annual emissions of nutrients, particulary N-compounds, were reduced from 6 930 kg to 860 kg at the end of the post operation stage. Since the dismantling stage, the annual emissions were reduced to < 100 kg since 2005.
The tendency emission of water pollutants, e.g. Chemical Oxygen Demand or heavy metals, was similar.
Impacts from the decommissioning process are not detectable. With the progress of decommissioning further decrease of the amount of waste water and the load of nutrients and water pollutants is expected.

2.8 Groundwater consumption

An approximately constant quantity of groundwater consumption is caused by groundwater lowering for keeping a constant groundwater level of the EWN site. This quantity is independent from the stages operation, post operation and dismantling and on a level of about 940 T m^3 per year.

Another part of the groundwater consumption is the drinking water. This annual consumption depends on the number of personnel and was decreasing from 1996 to 2005 from 312Tm^3 to approximately constant 100Tm^3 since this year. .

The annual technological groundwater demand, primarily for the production of demineralized water is decreasing (214Tm^3 1996 to 46Tm^3 2005). ***Significant impacts from the decommissioning process are not detectable.***

2.9 Energy consumption

The annual **electrical** energy demand for the whole site decreased almost continuously after shut down, except the period of the ISN construction. The demand in 1991 was 80 606 MWh and in 2008 it was 55 905 MWh.

The most important consumers of electrical energy are the pumps of the cooling systems, the ventilation systems, lighting and the ISN.

The annual **thermal** energy demand for the whole site decreased from 403 000 MWh after shut down in 1990 until the year 2000 when reached the value 138 580 MWh and is approximately constant since this year.

There are no significant impacts from the decommissioning process.

With the progress of decommissioning, further decreasing of the energy consumption is to be expected.

Another part of energy demand is the energy demand of transport processes from decommissioning, primarily for the internal and external transport of waste from decommissioning. This amount of primary energy is worstly estimated in the range of about 150kWh per ton of waste.

2.10 Noise

According to our experience from demolition of buildings outside the controlled or monitoring (area out of the operation license) area the acoustic sources with the highest noise level are the activities ram of spile walls and operation of hydraulic chisels. Noise levels above the limited values of the German Technical Instruction for Noise in the nearest residential areas were not measured or calculated for planning.

For the demolition of concrete structures of the hermetic compartments in the controlled area, band saw facilities with a low noise level will be used.

Thus, ***the temporary noise impacts of the whole decommissioning process are below the legally required limit values.***

2.11 Land use

The construction of the ISN was a necessary prerequisite for the decommissioning process.
Land consumption outside the EWN site was not necessary.

3. Evaluation of the impacts to the protected goods

3.1 Characteristics of EWN site

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The EWN site is surrounded by the FFH areas "Greifswalder Bodden"and "Struck", by a bird protection area, by the community Lubmin, a seaside resort, and large woodlands.

3.2 Immission of radioactive nuclides

Small amounts of nuclides were detected in sediments of a sewer which flowed into the cooling water outlet channel and in sediments of the closed part of the cooling water outlet channel inside the EWN territory.
In the environment outside the EWN territory only artificial radionuclides from the Chernobyl disaster were found. ***Impacts from decommissioning are not detectable.***

3.3 Immission of air pollutants (FFH areas)

The immission state was slightly deteriorated by the operation of the thermal power station. This deterioration was below a detectable level.
Impacts from decommissioning are not detectable.

3.4 Surface water (Greifswalder Bodden)

The important impacts from the operation phase (thermal, transport of dirty river water, nutrients and water pollutants) were reduced after shut down to a very low level.
Impacts from decommissioning are not detectable.

3.5 Groundwater (hydrogeology)

Impacts from decommissioning are not detectable.

3.6 Socio – economic impacts

The shut down caused an important reduction of the personnel to about 1/3 of the initial staff. The decision to use own personnel for decommissioning resulted in a personnel need of about 1000 for the decommissioning period.
The social impacts are essentially mitigated by decommissioning.

4. Classification of impacts

With the shut down of all units and the beginning of the post operation stage, the following impacts were reduced in comparison with the operation stage:

- important reduction of the thermal output,
- important reduction of personal radiation exposure (almost 2 orders of magnitude),
- important reduction of the release of radioactive nuclides into air (almost 1 order of magnitude),
- important reduction of the release of radioactive nuclides into water,
- important reduction of the release of nutrients and water pollutants into water,
- important reduction of the groundwater consumption for the production of demineralised water,
- reduction of the electrical energy consumption,
- reduction of the thermal energy consumption.

Additional impacts

- emissions of conventional air pollutants generated by the thermal heating station,
- social impacts (reduction of personnel).

1. Impacts caused by post operation, independent of NPP dismantling activities:
    - groundwater consumption for the production of demineralised water,
    - release of nutrients and water pollutants into water,
    - release of radioactive nuclides into water,
    - thermal energy consumption,
    - electrical energy consumption,
    - quota of release of radioactive nuclides into air (post operation, fuel reloading, treatment of operational- and post operational waste),
    - quota of radiation exposure of personnel (post operation, guarding, radiation protection),
    - quota of radioactive waste (operational and post operational waste),
    - quota of impacts from ISN operation,
    - quota of conventional waste (post operation waste, dismantling of facilities and buildings outside the controlled and monitored area).

2. Impacts caused by decommissioning

    a) low level impacts
    - quota of radiation exposure,
    - quota of release of radioactive nuclides into air,
    - quota of emission of conventional air pollutants by dismantling activities,
    - quota of impacts from ISN operation,
    - small quota of electrical energy demand,
    - small quota of thermal energy demand.

    b) important impacts
    - radioactive waste, but on the other hand reduction of the emergency potential,
    - mitigation/reduction of social impacts

    c) important impacts but independent from other decommissioning options
    - conventional waste,
    - emissions into air by transport of waste.

3. Impacts independent from operation, post operation and decommissioning
    - emissions from the emergency diesel engines,
    - groundwater demand from groundwater lowering of the site.

The experience of EWN shows that the impacts on the protected goods from decommissioning/dismantling are on a significant low level, independent from chosen options.

5 Impact mitigation measures

5.1 Organisational measures

Additional to the legal required documents as the operational manual, the industrial safety instructions and radiation protection instructions, an environmental manual according to the EMAS and ISO 14000 requirements has been issued. As an important tool for supervision and control of all environmental impacts and environmental related activities, an Environmental Information System in the companies intranet was developed.

The EWN company is certified as "Company specialised for plants with water harmful substances". The responsible department for conventional waste management is certified as "Specialised Waste Management Department".

5.2 Technical measures

5.2.1 EWN dismantling strategy

This strategy comprises the removal of all components/equipment Category 3 (e.g. steam generators, pressurizers and RPVs) as large as possible for decay storage and their later treatment in the ISN.

New dismantling technologies are tested with components without contamination.

Another part of this strategy is the decontamination of plant parts before dismantling. This decontamination measures were realized as soon as possible.

5.2.2 Reduction of the radioactive waste amont

The main strategy is the decontamination of plant parts after cutting and other preparation measures with different technologies, depending on material, form and contamination.
A main condition for this strategy is the use of the effective mass flow tracking system and the free release complex with buffer storages.

5.2.3 Minimisation of conventional and radioactive emissions

In the exhaust air systems of the controlled area, the Petrjanow filters were changed in 1997/98 to filters with the best available technique (HEPA filters).

For all activities with the potential of aerosol formation, additional mobile systems for capturing and filtering are used. In the case of thermal cutting, non-inflammable ceramic filters have been used.

For the removal of asbestos materials in the controlled and monitored areas tight rooms with additional filtration systems and airlocks for personnel and material were used. Components with asbestos parts were dismantled as whole parts, the removal took place in an asbestos workshop under optimised conditions.

On all cutting places in the turbine hall, capturing and filtration systems are installed.
The cutting of armoured concrete structures is realised by diamond wire saw systems.
Advantages of these systems are:

- high cutting performance (1 – 2 m^2/h),
- low aerosol / dust release (water cooling),
- low noise level (73 dB(A)), and
- possible automatic operation.

The removal of insulation of piping and plant equipment in the turbine hall was done by implementing a mobile suction system with separation of the insulation material in big bags. Advantages of this system are:

- high performance of removal of insulation,
- low release of stone fibres,

- only one worker is needed for operation of the suction system, and
- no direct handling of the insulation material.

5.2.4 Waste water treatment

For the purification of waste water from pickling activities in the operation stage (pickling of steam generators secondary side); and pickling of turbine condensers cooling water side resulting in the water pollutants high concentrations of heavy metals, small contamination with radioactive nuclides and high concentrations of complexones (EDTA and NTA), a treatment procedure with the steps UV radiation exposure, precipitation and filtration was developed and implemented.

5.2.5 Reduction of groundwater demand

The high capacity demineralisation plant (planned for 8 NPP units) was oversized for post operation and decommissioning purposes. Caused by the lower consumption of demineralised water, the internal water consumption rate of this plant was about 44 %**.**
With the erection and operation of a smaller demineralisation plant according to the best available techniques the internal water consumption rate was reduced to 3.5 %.

Attachment 11.4.3: Summarized results of the perfomed wastewater physical and chemical tests in Kozloduy NPP region

1. SUMMARIZED RESULTS OF THE PERFORMED WASTE WATER PHYSICAL AND CHEMICAL TESTS IN KOZLODUY NPP REGION FOR 2006

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	7.74	7.73	7.31	7.74
Suspended solids	mg/dm^3	50	**70**	47.5	33	35
Total β – activity	Bq/dm^3	-	0.070	0.093	0.093	0.094

Table 1-1 Results of samples test in sampling point N 1 (ASS – Auxiliary sewerage system).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	8.57	7.92	7.92	8.52
Total β – activity	Bq/dm^3	-	0.024	0.019	< 0.013	< 0.016

Table 1-2 Results of samples test in sampling point N 2 (DE – Drain expander (DE)).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	-	-	-	-
Boron	mg/dm^3	1	-	-	-	-
Oil products content	mg/dm^3	10	-	-	-	-
Total β – activity	Bq/dm^3	-	-	-	-	-

Table 1-3 Results of samples test in sampling point N 3 (RB-1)

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	**9.94**	-	-	**10.8**
Suspended solids	mg/dm^3	50	**186**	-	-	**457**
Ferrous content /total/	mg/dm^3	1	**18.6**	-	-	**5.25**
COD /bichromatic/	mg/dm^3	-	66	-	-	120

Table 1-4 Results of samples test in sampling point N 4 (CHD – Chemistry department)

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	-	8.34	**9.5**	-
Suspended solids	mg/dm^3	50	-	**233**	**421**	-
Ferrous content /total/	mg/dm^3	1	-	**4.88**	**2.95**	-
COD /bichromatic/	mg/dm^3	-	-	32	119	-

Table 1-5 Results of samples test in sampling point N 5 (CHD – Chemistry department)

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	8.23	7.6	8.15	8.37
Suspended solids	mg/dm^3	50	-	-	34	-
Oil products content	mg/dm^3	10	0.07	1.12	0.272	0.170

Residual chlorine content	mg/dm^3	0.2	-	-	0.03	-

Table 1-6 Results of samples test in sampling point N 6 (KC+AKC Condenser Hotwell and Nitrogen/Oxygen Station (AKC).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	7.88	7.78	7.88	7.85
Suspended solids	mg/dm^3	50	**90**	38	11	40
Nitric nitrogen content	mg/dm^3	-	0.049	0.014	0.014	0.026
Nitrate nitrogen content	mg/dm^3	-	2.15	1.42	1.14	1.54
COD /bichromatic/	mg/dm^3	-	27	21	21	11.9
Nitrogen content (Keldal's)	mg/dm^3	-	< 1	< 1	< 1	< 1
Total nitrogen content	mg/dm^3	-	2.20	1.43	1.7	1.85
Total β – activity	Bq/dm^3	-	0.091	0.065	0.088	0.087
Oil products content	mg/dm^3	10	< 0.035	0.385	< 0.035	0.455
Residual chlorine	mg/dm^3	0.2	< 0.01	0.06	0.03	< 0.01
Temperature	^0C	<3 °C mid season	18.1	**26**	23.2	**24.6**
Ferrous content /total/	mg/dm^3	1	-	-	0.120	-
Zink	mg/dm^3	1	-	-	0.008	-
Boron	mg/dm^3	1	-	-	< 0.05	-
Cobalt	mg/dm^3	0.5	-	-	< 0.001	-

Table 1-7 Results of samples test in sampling point N 7 (Hot channel 1 – Danube River).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	7.77	7.84	7.94	7.84
Suspended solids	mg/dm^3	50	42	**52**	25	22
Nitric nitrogen content	mg/dm^3	-	0.077	0.099	0.067	0.082
Nitrate nitrogen content	mg/dm^3	-	2.23	1.5	1.42	1.97
Phosphates	mg/dm^3	-	0.167	0.148	0.086	0.28
Permang. oxidation	mg/dm^3	-	3.52	2.98	3.78	3.92
COD /bichromate/	mg/dm^3	-	23	19	17	25
BOD_5	mg/dm^3	-	6.3	5.1	3.78	4
Nitrogen by Keldal's	mg/dm^3	-	1.99	1.8	1.39	1.85
Total nitrogen content	mg/dm^3	-	4.3	3.4	2.9	3.9
Total β – activity	Bq/dm^3	-	0.1	0.078	0.085	0.087
Oil products content	mg/dm^3	10	0.105	1.07	2.21	2.11
Residual chlorine	mg/dm^3	0.2	0.02	0.18	0.08	< 0.1
Ferrous content /total/	mg/dm^3	1	-	-	0.09	-
Zink	mg/dm^3	1	-	-	0.011	-
Boron	mg/dm^3	1	-	-	0.077	-
Cobalt	mg/dm^3	0.5	-	-	< 0.001	-

Table 1-8 Results of samples test in sampling point N 8 (TCC).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	7.8	7.86	7.79	7.81
Suspended solids	mg/dm^3	50	**59**	54	34	20
Nitric nitrogen content	mg/dm^3	-	0.234	0.438	0.138	0.105
Nitrate nitrogen content	mg/dm^3	-	2.43	0.884	0.872	2.38
Phosphates	mg/dm^3	-	0.632	0.67	0.303	0.695
Permang. oxidation	mg/dm^3	-	7.19	6.78	4.85	3.12
COD /bichromate/	mg/dm^3	-	43	58	26	20
BOD_5	mg/dm^3	-	22	20.4	13,5	2,1
Nitrogen by Keldal's	mg/dm^3	-	7.04	9.57	6.19	2.41
Total nitrogen content	mg/dm^3	-	9.7	10.9	7.2	4.9
Total β – activity	Bq/dm^3	-	0.190	0.201	0.162	0.109
Oil products content	mg/dm^3	10	0.105	0.46	0.067	0.269
Residual chlorine	mg/dm^3	0.2	0.02	0.11	0.09	0.13

Table 1-9 Results of samples test in sampling point N 9 (DN 300)

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	8	7.92	7.95	8.06
Suspended solids	mg/dm^3	50	32	45.5	**77**	8
Nitric nitrogen content	mg/dm^3	-	0.06	0.017	0.017	0.036
Nitrate nitrogen content	mg/dm^3	-	1.74	1.13	1.54	1.65
Phosphates	mg/dm^3	-	0.067	0.136	0.110	0.132
Permang. oxidation	mg/dm^3	-	10.7	3.02	2.66	1.62
COD /bichromate/	mg/dm^3	-	15	16	26	13
BOD_5	mg/dm^3	-	2.74	2.16	5.84	2.38
Nitrogen by Keldal's	mg/dm^3	-	< 1	< 1	< 1	< 1
Total nitrogen content	mg/dm^3	-	< 1	1.15	2.3	1.8
Total β – activity	Bq/dm^3	-	0.105	0.078	0.084	0.086
Oil products content	mg/dm^3	10	0.07	0.28	3.66	0.33
Residual chlorine	mg/dm^3	0.2	0.17	0.12	0.06	< 0.1

Table 1-10 Results of samples test in sampling point N 10 (DN 1000).

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	7.76	7.56	7.75	7.74
Suspended solids	mg/dm^3	50	**61**	27	22	15
Nitric nitrogen content	mg/dm^3	-	0.063	0.029	0.015	0.025
Nitrate nitrogen content	mg/dm^3	-	1.7	0.047	1.09	1.79
Phosphates	mg/dm^3	-	0.131	0.131	0.086	0.138
Permang. oxidation	mg/dm^3	-	4.54	3.02	2.21	1.7
COD /bichromate/	mg/dm^3	-	15	26	24	16
BOD_5	mg/dm^3	-	5.9	12.8	2.16	3.24
Nitrogen by Keldal's	mg/dm^3	-	< 1	< 1	< 1	< 1
Total nitrogen content	mg/dm^3	-	< 1	< 1	1,7	2,1
Total β – activity	Bq/dm^3	-	0.110	0.085	0.086	0.131
Oil products content	mg/dm^3	10	0.175	0.630	0.520	0.658

Monitored indcator	Unit	Emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
Residual chlorine	mg/dm^3	0.2	< 0.01	0.09	0.08	< 0.1
Ferrous content /total/	mg/dm^3	1	-	-	0.160	-
Zink	mg/dm^3	1	-	-	0.015	-
Boron	mg/dm^3	1	-	-	0.075	-
Cobalt	mg/dm^3	0.5	-	-	< 0.001	-

Table 1-11 Results of samples test on MDC discharge flow

2. SUMMARIZED RESULTS FROM PHYSICAL AND CHEMICAL TESTS OF THE WASTEWATER IN THE AREA OF KNPP SITE FOR 2007

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	7.72	7.76	-	-
Suspended solids	mg/dm^3	-	41	24	-	-
Total β – activity	mBq/dm^3	-	108	8	-	-

Table 2-1 Results of sample test from sampling point 1 (Auxiliary sewage system).

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	7.66	9.07	-	-
Total β – activity	mBq/dm^3	-	< 9	< 13	-	-

Table 2-2 Results of sample test from sampling point N 2 (DE).

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	8.53	-	-	-
Suspended solids	mg/dm^3	-	1923	-	-	-
Ferrous content /total/	mg/dm^3	-	4.95	-	-	-
COD /bichromatic/	mg/dm^3	-	80.2	-	-	-

Table 2-3 Results of sample test from sampling point N 4 (Chemistry department).

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	8.37	-	-	-
Suspended solids	mg/dm^3	-	1782	-	-	-
Ferrous content /total/	mg/dm^3	-	4.6	-	-	-
COD /bichromatic/	mg/dm^3	-	79.1	-	-	-

Table 2-4 Results of sample test from sampling point N 5 (Chemistry department).

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	7.73	8.02	-	-
Suspended solids	mg/dm^3	-	51	29.5	-	-
Oil products	mg/dm^3	-	0.733	0.610	-	-
Residual chlorine	mg/dm^3	-	-	0.05	-	-

Table 2-5 Results of sample test from sampling point N6 (CH+AKC).

Monitored indcator	Unit	Individual emission limit – HC1	Individual emission limit – HC1 and HC2	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6 ÷ 9	6 ÷ 9	7.77	8.55	8.23	7.82
Suspended solids	mg/dm^3	100	100	66	25	23	43
Nitric nitrogen content	mg/dm^3	-	-	0.025	0.023	0.021	0.03
Nitrate nitrogen content	mg/dm^3	-	-	1.93	0.9	0.109	1.36
COD /bichromatic/	mg/dm^3	100	100	9.9	8.1	12.2	29

Monitored indcator	Unit	Individual emission limit – HC1	Individual emission limit – HC1 and HC2	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
Nitrogen content (Keldal's)	mg/dm^3	-	-	< 1	1.98	2.57	0.86
Total nitrogen content	mg/dm^3	15	15	2.6	2.9	2.7	2.25
Total β – activity	mBq/dm^3	750	750	8	74	101	125
Oil products content	mg/dm^3	0.5	0.5	< 0.035	0.35	0.187	0.165
Residual chlorine	mg/dm^3	0.1	0.1	0.1	**0.12**	-	-
Temperature	^0C	<3 °C	<3 °C	18.4	28.4	-	-
Ferrous content /total/	mg/dm^3	5	5	-	0.11	0.306	-
Zink	mg/dm^3	10	10	-	< 0.005	< 0.005	-
Boron	mg/dm^3	1	-	-	0.145	< 0.05	-
Cobalt	mg/dm^3	0.5	-	-	< 0.001	< 0.001	-
Chlorine-ions	mg/dm^3	-	-	-	-	19.1	-

Table 2-6 Results of sample test from sampling point N7 (HC 1 – Danube River)

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6.0 – 8.5	8.1	8.1	8.43	7.83
Suspended solids	mg/dm^3	**50**	42	49	29	**56**
Nitric nitrogen content	mg/dm^3	-	0.056	0.127	0.123	0.082
Nitrate nitrogen content	mg/dm^3	-	3.24	0.58	1.86	1.97
COD /bichromatic/	mg/dm^3	-	2.8	3.4	-	-
Nitrogen content (Keldal's)	mg/dm^3	**70**	48.3	13.6	11.2	53
Total nitrogen content	mg/dm^3	**15**	**27.1**	7.1	4.84	**28.5**
Total β – activity	mg/dm^3	-	2.5	2.79	1.9	1.65
Oil products content	mg/dm^3	15	5.79	3.5	3.08	3.7
Residual chlorine	mg/dm^3	5	0.208	0.1	0.186	0.3
Temperature	mg/dm^3	-	0.11	0.12	-	-
Ferrous content /total/	mg/dm^3	**1.5**	-	0.11	0.1	0.291
Zink	mg/dm^3	5	-	< 0.005	< 0.005	0.014
Boron	mg/dm^3	Not allowed	-	**0.16**	**< 0.05**	**0.03**
Cobalt	mg/dm^3	0.1	-	< 0.001	< 0.001	< 0.001
Total Ph cont (as PO4)	mg/dm^3	2	0.157	0.122	0.343	0.515
Chlorine-ions	mg/dm^3	**300**	-	-	21.3	22.7
Detergents	mg/dm^3	**1**	-	-	< 0.05	< 0.5
Manganese	mg/dm^3	**0.3**	-	-	< 0.005	0.013
Nikel	mg/dm^3	**0.2**	-	-	< 0.001	0.007
Sulphate ions	mg/dm^3	**-**	-	-	33.1	-
Cadmium	mg/dm^3	-	-	-	< 0.001	-
Lead	mg/dm^3	-	-	-	< 0.005	-
Arsenic	mg/dm^3	-	-	-	0.0009	-
Copper	mg/dm^3	-	-	-	0.008	-
Total extractable substances	mg/dm^3	-	-	-	0.223	-
Total β – activity	mBq/dm^3	750	86	69	65	91

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
Tritium	mBq/dm^3	-	-	-	< 3	-
Specific activity of ^{137}Cs	mBq/dm^3	-	-	-	34	-
Specific activity of ^{34}Cs	mBq/dm^3	-	-	-	45	-
Specific activity of ^{60}Co	mBq/dm^3	-	-	-	47	-
Specific activity of ^{58}Co	mBq/dm^3	-	-	-	81	-
Specific activity of ^{54}Mn	mBq/dm^3	-	-	-	71	-

Table 2-7 Results of sample test from sampling point N8 (TCC)

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6.0 – 8.5	7.98	8.28	8.31	7.72
Suspended solids	mg/dm^3	**50**	32	33	27	49.5
Nitric nitrogen content	mg/dm^3	-	-	0.19	0.153	-
Nitrate nitrogen content	mg/dm^3	-	0.205	0.324	0.18	0.183
COD /bichromatic/	mg/dm^3	-	3.85	2.22	2.65	0.928
Nitrogen content (Keldal's)	mg/dm^3	-	4.51	3.58	-	-
Total nitrogen content	mg/dm^3	**70**	35.6	15.4	51	60
Total β – activity	mg/dm^3	**15**	19.2	6.9	11.5	**23.6**
Oil products content	mg/dm^3	-	1.94	5.06	3.95	3.99
Residual chlorine	mg/dm^3	15	6	7.6	6.78	5.1
Temperature	mg/dm^3	5	0.105	0.34	0.311	0.305
Ferrous content /total/	mg/dm^3	-	< 0.1	0.15	-	-
Zink	mg/dm^3	5	-	-	< 0.005	0.019
Boron	mg/dm^3	Not allowed	-	-	**< 0.05**	**0.029**
Cobalt	mg/dm^3	0.1	-	-	< 0.001	< 0.001
Total Ph cont (as PO4)	mg/dm^3	2	0.407	0.237	1.07	1.81
Chlorine-ions	mg/dm^3	**300**	-	-	37.6	40.4
Detergents	mg/dm^3	**1**	-	-	< 0.05	< 0.05
Manganese	mg/dm^3	**0.3**	-	-	< 0.005	0.013
Nikel	mg/dm^3	**0.2**	-	-	< 0.001	< 0.001
Sulphate ions	mg/dm^3	-	-	-	59.8	-
Cadmium	mg/dm^3	-	-	-	< 0.001	
Lead	mg/dm^3	-	-	-	< 0.005	-
Arsenic	mg/dm^3	-	-	-	0.0018	-
Copper	mg/dm^3	-	-	-	0.008	-
Total extractable substances	mg/dm^3	-	-	-	0.466	-
Total β – activity	mBq/dm^3	750	145	124	113	98
Specific activity of ^{137}Cs	mBq/dm^3	-	-	-	73	-
Specific activity of ^{34}Cs	mBq/dm^3	-	-	-	76	-
Specific activity of ^{60}Co	mBq/dm^3	-	-	-	36	-
Specific activity of ^{58}Co	mBq/dm^3	-	-	-	73	-
Specific activity of ^{54}Mn	mBq/dm^3	-	-	-	53	-

Table 2-8 Results of sample test from sampling point N 9 (DN300)

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	6.0 – 8.5	8.26	8.13	8.46	7.72

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
Suspended solids	mg/dm^3	**50**	32	29	32	28.5
Nitric nitrogen content	mg/dm^3	-	-	0.15	0.382	-
Nitrate nitrogen content	mg/dm^3	-	0.025	0.035	0.024	0.039
COD /bichromatic/	mg/dm^3	-	1,37	1.93	0.704	1.85
Nitrogen content (Keldal's)	mg/dm^3	-	2.68	6.8	-	-
Total nitrogen content	mg/dm^3	**70**	8.6	26.2	12	50
Total β – activity	mg/dm^3	**15**	3.25	4.15	4.88	-
Oil products content	mg/dm^3	-	2.56	1.74	2.2	1.67
Residual chlorine	mg/dm^3	15	3.96	3.7	2.92	3.55
Temperature	mg/dm^3	5	0.168	0.088	0.159	0.165
Ferrous content /total/	mg/dm^3	-	0.1	0.14	-	-
Zink	mg/dm^3	5	-	-	< 0.005	0.013
Boron	mg/dm^3	Not allowed	-	-	**< 0.05**	**0.02**
Cobalt	mg/dm^3	0.1	-	-	< 0.001	< 0.001
Total Ph cont (as PO4)	mg/dm^3	2	0.111	0.099	0.285	0.544
Chlorine-ions	mg/dm^3	**300**	-	-	20.6	18.4
Detergents	mg/dm^3	**1**	-	-	< 0.05	< 0.05
Manganese	mg/dm^3	**0.3**	-	-	0.035	< 0.005
Nikel	mg/dm^3	**0.2**	-	-	< 0.001	0.002
Sulphate ions	mg/dm^3	**-**	-	-	31.9	-
Cadmium	mg/dm^3	-	-	-	< 0.001	-
Lead	mg/dm^3	-	-	-	< 0.005	-
Arsenic	mg/dm^3	-	-	-	0.0032	-
Copper	mg/dm^3	-	-	-	0.007	-
Total extractable substances	mg/dm^3	-	-	-	0.318	-
Total β – activity	mBq/dm^3	750	81	72	92	91
Specific activity of ^{137}Cs	mBq/dm^3	**-**	-	-	27	-
Specific activity of ^{34}Cs	mBq/dm^3	**-**	-	-	43	-
Specific activity of ^{60}Co	mBq/dm^3	**-**	-	-	36	-
Specific activity of ^{58}Co	mBq/dm^3	**-**	-	-	95	-
Specific activity of ^{54}Mn	mBq/dm^3	**-**	-	-	58	-

Table 2-9 Results of sample test from sampling point N 10 (DN 1000)

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
pH	-	-	7.86	7.98	-	-
Suspended solids	mg/dm^3	-	60	56	-	-
Nitric nitrogen content	mg/dm^3	-	0.024	0.087	-	-
Nitrate nitrogen content	mg/dm^3	-	1.8	0.105	-	-
Phosphates	mg/dm^3	-	0.074	0.072	-	-
Permang. oxidation	mg/dm^3	-	4.17	4.5	-	-
COD /bichromatic/	mg/dm^3	-	15.4	18	-	-
BOD_5	mg/dm^3	-	4.98	5.85	-	-
Nitrogen content (Keldal's)	mg/dm^3	-	1.09	5.86	-	-
Total nitrogen content	mg/dm^3	-	2.91	6.05	-	-
Total β – activity	mBq/dm^3	-	136	133	-	-
Oil products content	mg/dm^3	-	0.3	0.2	-	-

Monitored indcator	Unit	Individual emission limit	I-st trimestre	II-nd trimestre	III-rd trimestre	IV-th trimestre
Residual chlorine хлор	mg/dm^3	-	0.13	0.13	-	-
Ferrous content /total/	mg/dm^3	-	-	0.17	-	-
Zink	mg/dm^3	-	-	0.013	-	-
Boron	mg/dm^3	-	-	0.231	-	-
Cobalt	mg/dm^3	-	-	< 0.001	-	-

Table 2-10 Results from sample test on sample from MDC 1

3. SUMMARIZED RESULTS FROM PHYSICAL AND CHEMICAL TESTS OF THE WASTEWATER IN THE AREA OF KNPP SITE FOR 2008

Monitored indcator	**Unit**	**Individual emission limit**	**Trimestre**							
			I-st		**II-nd**		**III-rd**		**IV-th**	
pH	-	6.0 – 8.5	8.14		7.99		8.10		8.45	
Total β – activity	mBk/dm^3	750	I	89	IV	95	VII	135	X	111
			II	85	V	115	VIII	102	XI	139
			III	98	VI	63	IX	103	XII	70
Suspended solids	mg/dm^3	50	I	-	IV	-	VII	**434**	X	4.0
			II	7.0	V	-	VIII	21,0	XI	**72.0**
			III	-	VI	25.0	IX	14.0	XII	18.0
BOD_5	mg/dm^3	15	I	-	IV	-	VII	**29.3**	X	7.48
			II	5.94	V	-	VIII	6.18	XI	**53.7**
			III	-	VI	4.77	IX	8.45	XII	2.10
COD (bichromatic)*	mg/dm^3	70	I	-	IV	-	VII	66.4	X	13.6
			II	13.8	V	-	VIII	27.0	XI	**179**
			III	-	VI	16.0	IX	24.0	XII	10.0
Total Phosphorous content (as PO_4)	mg/dm^3	2	0.973		0.137		0.219		0.730	
Ferrous content /total/	mg/dm^3	1.5	0.080		0.109		0.097		0.221	
Chlorine-ions	mg/dm^3	300	23.1		25.5		26.2		29.1	
Oil products	mg/dm^3	5	1.20		0.30		0.25		0.20	
Total nitrogen content	mg/dm^3	15	2.50		2.58		5.50		6.90	
Zink content	mg/dm^3	5	0.016		<0.005		0.038		0.017	
Boron content	mg/dm^3	Not allowed	< 0.05		<0.05		**0.11**		<0.05	
Cobalt content	mg/dm^3	0.1	<0.001		<0.001		<0.001		<0.001	
Detergents	mg/dm^3	1	<0.05		<0.014		0.015		0.014	
Manganese content (total)	mg/dm^3	0.3	0.0164		<0.0050		0.0074		0.0118	
Nikel content	mg/dm^3	0.2	0.0020		0.0030		0.0022		0.0032	
Specific activity of ^{137}Cs	Bk/dm^3	-	-		-		-		< 0.037	
Specific activity of ^{34}Cs	Bk/dm^3	-	-		-		-		< 0.040	
Specific activity of ^{60}Co	Bk/dm^3	-	-		-		-		< 0.052	
Specific activity of ^{58}Co	Bk/dm^3	-	-		-		-		< 0.067	
Specific activity of ^{54}Mn	Bk/dm^3	-	-		-		-		< 0.050	
Arsenic	mg/dm^3	-	-		-		0.0016		-	
Cadmium	mg/dm^3	-	-		-		<0.001		-	
Copper	mg/dm^3	-	-		-		0.0076		-	
Lead	mg/dm^3	-	-		-		<0.005		-	
Extractable substances	mg/dm^3	-	-		-		1.04		-	
Sulphate ions	mg/dm^3	-	-		-		-		32.6	

Table 3-1 Results of sample test from TCC discharge flow (sanitary, industrial and rainfall waters from EP-1 and EP-2).

Monitored indcator	Unit	Individual emission limit	Trimestre							
			I-st							
pH	-	6.0 – 8.5	8.31		7.87		8.16		8.02	
Total β – activity	mBk/dm^3	750	350		176		176		293	
Suspended solids	mg/dm^3	50	I	-	IV	-	VII	**55.0**	X	25
			II	34.0	V	-	VIII	37.0	XI	24
			III	-	VI	19	IX	26	XII	22.0
BOD_5*	mg/dm^3	15	I	-	IV	-	VII	**21.5**	X	**20.4**
			II	**42.3**	V	-	VIII	10.3	XI	7.56
			III	-	VI	3.9	IX	**19**	XII	3.85
COD(bichromatic)*	mg/dm^3	70	I	-	IV	-	VII	43.2	X	39.9
			II	51.4	V	-	VIII	49.0	XI	20.0
			III	-	VI	13	IX	31.0	XII	13.0
Total Phosphorous content (as PO_4)	mg/dm^3	2	**4.21**		0.475		**2.09**		**3.21**	
Ferrous content /total/	mg/dm^3	1.5	-		-		0.078		-	
Chlorine-ions	mg/dm^3	300	32.0		41.1		56.7		55.3	
Oil products	mg/dm^3	5	2.60		0.11		0.20		0.10	
Total nitrogen content	mg/dm^3	15	5.50		3.31		6.20		**17.9**	
Zink content	mg/dm^3	5	0.033		0.008		0.036		0.027	
Boron content	mg/dm^3	Not allowed	< 0.05		**0.15**		**0.1**		<0.05	
Cobalt content	mg/dm^3	0.1	<0.001		<0.001		<0.001		<0.001	
Detergents	mg/dm^3	1	0.204		0.078		0.715		0.056	
Manganese content (total)	mg/dm^3	0.3	0.0185		0.0145		0.0436		0.0076	
Nikel content	mg/dm^3	0.2	0.0038		0.0047		0.0025		<0.0010	
Specific activity of ^{137}Cs	Bk/dm^3	-	-		-		-		< 0.055	
Specific activity of ^{34}Cs	Bk/dm^3	-	-		-		-		< 0.050	
Specific activity of ^{60}Co	Bk/dm^3	-	-		-		-		< 0.049	
Specific activity of ^{58}Co	Bk/dm^3	-	-		-		-		< 0.067	
Specific activity of ^{54}Mn	Bk/dm^3	-	-		-		-		< 0.056	
Arsenic**	mg/dm^3	-	-		-		0.0017		-	
Cadmium**	mg/dm^3	-	-		-		<0.001		-	
Copper **	mg/dm^3	-	-		-		0.0096		-	
Lead **	mg/dm^3	-	-		-		<0.005		-	
Extractable substances **	mg/dm^3	-	-		-		0.55		-	
Sulphate ions **	mg/dm^3	-	-		-		-		65.3	

Table 3-2 Results of sample test from DN 300 channel discharge flow (sanitary waste waters from EP – 2).

<table>
<tr><th rowspan="2">Monitored indcator</th><th rowspan="2">Unit</th><th rowspan="2">Individual emission limit</th><th colspan="8">Trimestre</th></tr>
<tr><th colspan="2">I-st</th><th colspan="2"></th><th colspan="2"></th><th colspan="2"></th></tr>
<tr><td>pH</td><td>-</td><td>6.0 – 8.5</td><td colspan="2">8.30</td><td colspan="2">8.24</td><td colspan="2">8.20</td><td colspan="2">8.27</td></tr>
<tr><td>Total β – activity</td><td>mBk/dm^3</td><td>750</td><td colspan="2">93</td><td colspan="2">69</td><td colspan="2">94</td><td colspan="2">96</td></tr>
<tr><td rowspan="3">Suspended solids</td><td rowspan="3">mg/dm^3</td><td rowspan="3">50</td><td>I</td><td>-</td><td>IV</td><td>-</td><td>VII</td><td>41.0</td><td>X</td><td>5</td></tr>
<tr><td>II</td><td>9.00</td><td>V</td><td>-</td><td>VIII</td><td>15.0</td><td>XI</td><td>19</td></tr>
<tr><td>III</td><td>-</td><td>VI</td><td>24.0</td><td>IX</td><td>17</td><td>XII</td><td>12.0</td></tr>
<tr><td rowspan="3">BOD_5</td><td rowspan="3">mg/dm^3</td><td rowspan="3">15</td><td>I</td><td>-</td><td>IV</td><td>-</td><td>VII</td><td>13.0</td><td>X</td><td>2.86</td></tr>
<tr><td>II</td><td>-</td><td>V</td><td>-</td><td>VIII</td><td>3.38</td><td>XI</td><td>2.99</td></tr>
<tr><td>III</td><td>-</td><td>VI</td><td>5.88</td><td>IX</td><td>5.70</td><td>XII</td><td>3.00</td></tr>
<tr><td rowspan="3">COD(bichromatic)</td><td rowspan="3">mg/dm^3</td><td rowspan="3">70</td><td>I</td><td>-</td><td>IV</td><td>-</td><td>VII</td><td>24.8</td><td>X</td><td>6.30</td></tr>
<tr><td>II</td><td>16.7</td><td>V</td><td>-</td><td>VIII</td><td>12.0</td><td>XI</td><td>17.0</td></tr>
<tr><td>III</td><td>-</td><td>VI</td><td>17.0</td><td>IX</td><td>19.0</td><td>XII</td><td>11.0</td></tr>
<tr><td>Total Phosphorous content (as PO_4)</td><td>mg/dm^3</td><td>2</td><td colspan="2">0.880</td><td colspan="2">0.119</td><td colspan="2">0.151</td><td colspan="2">0.635</td></tr>
<tr><td>Ferrous content /total/</td><td>mg/dm^3</td><td>1.5</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">0.030</td><td colspan="2">-</td></tr>
<tr><td>Chlorine-ions</td><td>mg/dm^3</td><td>300</td><td colspan="2">23.6</td><td colspan="2">15.6</td><td colspan="2">18.4</td><td colspan="2">24.1</td></tr>
<tr><td>Oil products</td><td>mg/dm^3</td><td>5</td><td colspan="2">0.200</td><td colspan="2"><0.10</td><td colspan="2">0.43</td><td colspan="2"><0.1</td></tr>
<tr><td>Total nitrogen content</td><td>mg/dm^3</td><td>15</td><td colspan="2">3.50</td><td colspan="2">2.05</td><td colspan="2">4.30</td><td colspan="2">3.90</td></tr>
<tr><td>Zink content</td><td>mg/dm^3</td><td>5</td><td colspan="2">0.039</td><td colspan="2">0.016</td><td colspan="2">0.014</td><td colspan="2">0.008</td></tr>
<tr><td>Boron content</td><td>mg/dm^3</td><td>Not allowed</td><td colspan="2">0.020</td><td colspan="2"><0.05</td><td colspan="2">0.09</td><td colspan="2"><0.05</td></tr>
<tr><td>Cobalt content</td><td>mg/dm^3</td><td>0.1</td><td colspan="2"><0.001</td><td colspan="2"><0.001</td><td colspan="2"><0.001</td><td colspan="2"><0.001</td></tr>
<tr><td>Detergents</td><td>mg/dm^3</td><td>1</td><td colspan="2"><0.05</td><td colspan="2"><0.014</td><td colspan="2">0.028</td><td colspan="2">0.05</td></tr>
<tr><td>Manganese content (total)</td><td>mg/dm^3</td><td>0.3</td><td colspan="2">0.0120</td><td colspan="2">0.0164</td><td colspan="2"><0.005</td><td colspan="2"><0.005</td></tr>
<tr><td>Nikel content</td><td>mg/dm^3</td><td>0.2</td><td colspan="2">0.0027</td><td colspan="2">0.0020</td><td colspan="2"><0.001</td><td colspan="2"><0.001</td></tr>
<tr><td>Specific activity of ^{137}Cs</td><td>Bk/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">< 0.045</td></tr>
<tr><td>Specific activity of ^{34}Cs</td><td>Bk/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">< 0.045</td></tr>
<tr><td>Specific activity of ^{60}Co</td><td>Bk/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">< 0.049</td></tr>
<tr><td>Specific activity of ^{58}Co</td><td>Bk/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">< 0.026</td></tr>
<tr><td>Specific activity of ^{54}Mn</td><td>Bk/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">< 0.047</td></tr>
<tr><td>Arsenic**</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">0.0019</td><td colspan="2">-</td></tr>
<tr><td>Cadmium**</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2"><0.001</td><td colspan="2">-</td></tr>
<tr><td>Copper **</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">0.0097</td><td colspan="2">-</td></tr>
<tr><td>Lead **</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2"><0.005</td><td colspan="2">-</td></tr>
<tr><td>Extractable substances **</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">0.9</td><td colspan="2">-</td></tr>
<tr><td>Sulphate ions **</td><td>mg/dm^3</td><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">29.2</td></tr>
</table>

Table 3-3 Results of sample test from DN 1000 channel discharge flow (industrial waste and rainfall waters from EP-2)

Monitored indcator	**Unit**	**Individual emission limit**	**Trimestre**							
			I-st							
pH	-	6.0 – 8.5	-		-		8.15		8.19	
Total β – activity	mBk/dm^3	750	-		-		134		312	
Suspended solids	mg/dm^3	50	I	-	IV	-	VII	-	X	37
			II	-	V	-	VIII	-	XI	31
			III	-	VI	-	IX	14	XII	20.0
BOD_5*	mg/dm^3	15	I	-	IV	-	VII	-	X	**15.5**
			II	-	V	-	VIII	-	XI	7.85
			III	-	VI	-	IX	14.5	XII	3.40
COD(bichromatic)*	mg/dm^3	70	I	-	IV	-	VII	-	X	19.6
			II	-	V	-	VIII	-	XI	25.3
			III	-	VI	-	IX	49.0	XII	17.0
Total Phosphorous content (as PO_4)	mg/dm^3	2	-		-		0.235		**3.54**	
Ferrous content /total/	mg/dm^3	1.5	-		-		0.046		-	
Chlorine-ions	mg/dm^3	300	-		-		34.7		28.3	
Oil products	mg/dm^3	5	-		-		0.34		0.40	
Total nitrogen content	mg/dm^3	15	-		-		8.22		**16.3**	
Zink content	mg/dm^3	5	-		-		0.026		-	
Boron content	mg/dm^3	Not allowed	-		-		**0.09**		-	
Cobalt content	mg/dm^3	0.1	-		-		<0.001		-	
Detergents	mg/dm^3	1	-		-		0.044		0.087	
Manganese content (total)	mg/dm^3	0.3	-		-		0.0065		-	
Nikel content	mg/dm^3	0.2	-		-		0.0018		-	
Specific activity of ^{137}Cs	Bk/dm^3	-	-		-		-		< 0.056	
Specific activity of ^{34}Cs	Bk/dm^3	-	-		-		-		< 0.072	
Specific activity of ^{60}Co	Bk/dm^3	-	-		-		-		< 0.049	
Specific activity of ^{58}Co	Bk/dm^3	-	-		-		-		< 0.075	
Specific activity of ^{54}Mn	Bk/dm^3	-	-		-		-		< 0.049	
Arsenic**	mg/dm^3	-	-		-		0.0008		-	
Cadmium**	mg/dm^3	-	-		-		<0.001		-	
Copper **	mg/dm^3	-	-		-		0.0081		-	
Lead **	mg/dm^3	-	-		-		<0.005		-	
Extractable substances **	mg/dm^3	-	-		-		0.5		-	
Sulphate ions **	mg/dm^3	-	-		-		-		54.9	

Table 3-4 Results of sample test from Outdoor Switchyard discharge flow (sanitary sewage and rainfall water from Outdoor switchyard)

Indicator	Unit	Individual emission limit	Month											
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH	-	6.0 – 9.0	-	8.13	7.94	7.62	8.04	8.75	-	-	8.18	-	7.62	-
Total β – activity	mBk/dm^3	750	-	83	-	-	-	62	-	-	55	-	62	-
Suspended solids	mg/dm^3	100	24	7	26	8	16	14	16	16	18	7	14	6
BOD 5	mg/dm^3	-	6.99	3.68	1.78	2.91	3.75	3.45	2.32	4.84	7.8	5.56	3.17	2.6
COD (bichromatic)	mg/dm^3	100	18.9	18.4	16.5	10.2	11	20	14.0	24	21	9.87	14	10
Ferrous /total/content	mg/dm^3	5	-	-	-	-	-	0.078	-	-	0.145	-	0.217	-
Residual chlorine	mg/dm^3	0.1	-	0.1	-	-	-	0.07	-	-	0.016	-	0.1	-
Oil products	mg/dm^3	0.5	-	**0.6**	-	-	-	<0.10	-	-	0.22	-	<0.1	-
Totalnitrogen content**	mg/dm^3	15	-	3.1	-	-	-	1.13	-	-	3.7	-	4	-
Zink content	mg/dm^3	10	-	-	-	-	-	<0.005	-	-	0.042	-	0.012	-
Boron content	mg/dm^3	1	-	-	-	-	-	<0.05	-	-	0.1	-	<0.05	-
Cobalt content	mg/dm^3	0.5	-	-	-	-	-	<0.001	-	-	<0.001	-	<0.001	-

Table 3-5 Results of sample test from Hot channel 1flow

Indicator	Unit	Individual emission limit	Month											
			I				I				I			
pH	-	6,0 – 9,0	-	-	-	-	-	8.02	-	-	-	-	-	-
Total β – activity	mBk/dm^3	750	-	-	-	-	-	69	-	-	-	-	-	-
Suspended solids	mg/dm^3	100	-	-	-	-	-	16	-	-	-	-	-	4
BOD 5	mg/dm^3	-	-	-	-	-	-	4.1	-	-	-	-	-	2.75
COD (bichromatic)	mg/dm^3	100	-	-	-	-	-	23	-	-	-	-	-	11
Ferrous /total/content	mg/dm^3	5	-	-	-	-	-	0.257	-	-	-	-	-	-
Residual chlorine	mg/dm^3	0,1	-	-	-	-	-	0.1	-	-	-	-	-	-
Oil products	mg/dm^3	0,5	-	-	-	-	-	< 0.1	-	-	-	-	-	-
Total nitrogen content**	mg/dm^3	15	-	-	-	-	-	1.84	-	-	-	-	-	-
Zink content	mg/dm^3	10	-	-	-	-	-	< 0.005	-	-	-	-	-	-
Boron content	mg/dm^3	1	-	-	-	-	-	< 0.05	-	-	-	-	-	-
Cobalt content	mg/dm^3	0,5	-	-	-	-	-	< 0.001	-	-	-	-	-	-

Table 3-6 Results of sample test from Hot channel 2 flow

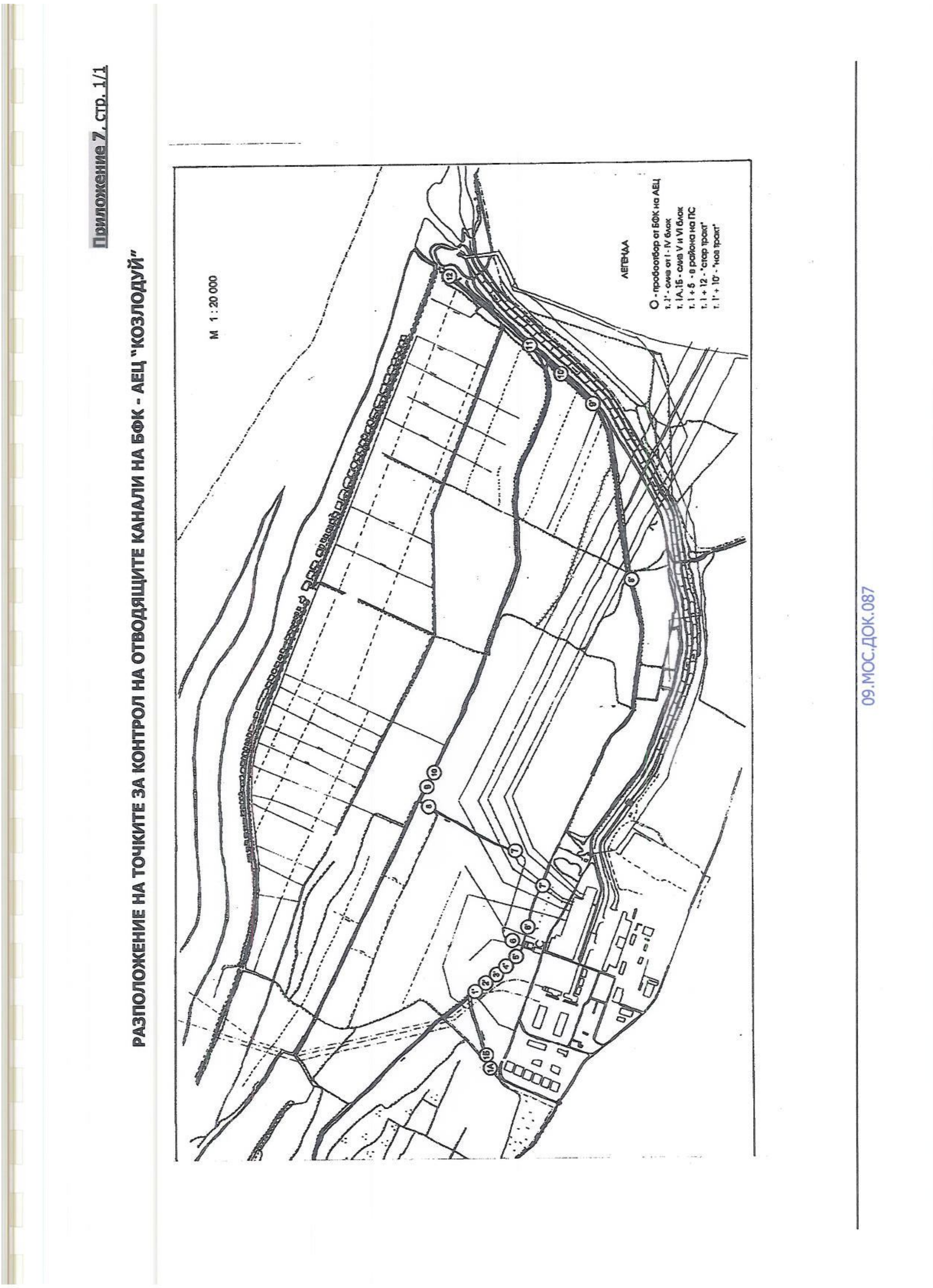

Fig. 1 Layout of the monitoring stations of the drainage channels of the sanitary sewage system