CEYHAN PROPANE DEHYDROGENATION - POLYPROPYLENE PRODUCTION PROJECT

BAT-BREF EVALUATION

(ANNEX-P)

FEBRUARY 2023

ANKARA

Tables 1 and 2 present an analysis of compliance with BAT requirements set out in LVOC BAT conclusions. LVOC BAT[1] conclusions apply to the planned PDH unit, together with its auxiliary systems for propylene production in the catalytic propane dehydrogenation process. In accordance with the scope of application set ou in BAT LVOC conclusions, LVOC conclusions do not apply to polymer production.

Table 1. General requirements of LVOC BAT conclusions

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
Monitoring of emissions to the air						
Monitoring of spot emissions from process furnaces/heaters						
1	**Monitoring of CO emissions**		MWt ≥50 standard: general EN* standards frequency: continuous mode	**Not applicable.** According to column 5 of the table presented in BAT 1, monitoring of CO emissions is applicable in the cases specified in Table 2.1. BAT- AEL values for NOx and NH_3 emissions to the air from the pyrolytic furnace for the production of lower olefins. Table 2.1 applies to the production of lower olefins in the steam cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Applicable for CEYHAN** Utility -boilers A and B will operate in continuos mode and to fulfil this BAT requirement of CEMS, which monitorizes CO emisions, will be instaled in the boilers stack, it will be considering in the design and purchase stage of the EPC project; carring out also the statements of the ESIA, Chapter 9, Subsection 9.7.2.	
			MWt 10 to <50 standard: EN 15058 frequency: once every three months. The minimum monitoring frequency for periodic measurements may be limited to monitoring once every six months if the emission levels prove to be sufficiently stable.	**Not applicable.** The total heat output of process furnaces (2 furnaces) connected to one emitting device will be 52.14 MW (variant 1) or 54.56 MW (variant 2)	**Applicable for CEYHAN** Ceyhan Plant includes 4 Process Heaters in PDH unit, each one with one stack. 28.14 MW, 25.46 MW, 20.88 MW, 30.94 MW, therefore MWt 10 to <50 standard: EN 15058 is applicable.	
	Monitoring of dust		MWt ≥50 standard: general EN* standards and EN 13284-2 standard frequency: continuous mode	**Not applicable.** Monitoring of dust emissions shall not apply if only gaseous fuels are combusted. Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient).	**Applicable for CEYHAN** No significant Dust emission expected during operation of the Project due to use of gaseous fules such as natural gas and propane. Therefore, continuous monitring of dust emission is not required during operation.	
			MWt 10 to <50 standard: EN 13284-1 frequency: once every three months. The minimum monitoring frequency for periodic measurements may be limited to monitoring once every six months if the emission levels prove to be sufficiently stable.	**Not applicable.** The total heat output of process furnaces (2 furnaces) connected to one emitting device will be 52.14 MW (variant 1) or 54.56 MW (variant 2)	**Applicable for CEYHAN** Ceyhan Plant includes 4 Process Heaters in PDH unit, each one with one stack . 28.14 MW, 25.46 MW, 20.88 MW, 30.94 MW therefore MWt 10 to <50 standard: EN 13284-1 is applicable	
	Monitoring of NH3 emissions		MWt ≥50 standard: general EN* standards frequency: continuous mode	**Not applicable.** Selective catalytic reduction and selective non-catalytic reduction is not planned (no NH_3 source).	**Not Applicable.** CEYHAN Plant has no NH_3 sources	
			MWt 10 to <50 standard: no EN standard available frequency: once every three months. The minimum monitoring frequency for periodic measurements may be limited to monitoring once every six months if the	**Not applicable.** The total heat output of process furnaces (2 furnaces) connected to one emitting device will be 52.14 MW (variant 1) or 54.56 MW (variant 2)	**Not Aplicable.** CEYHAN has 4 Process heaters each one with one stack in PDH plant, but as stated in the ESIA documentation there isno- NH_3 emissions.	

[1] Commission Implementing Decision (EU) 2017/2117 of 21 November 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the production of large volume organic chemicals.

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
			emission levels prove to be sufficiently stable.			
	Monitoring of Nox emissions		MWt ≥50 standard: general EN* standards frequency: continuous mode	NOx emissions from process furnaces will be monitored continuously in accordance with BAT requirements.	**Applicable for CEYHAN** The ESIA report (Chapter 9) (Subsection 9.7.2) recommends the monitorization of NO2. To fulfil this BAT requirement, a CEMS, which monitorizes NO2 emisions, will be instaled in the boilers chimney, it will be considering in the design and purchase stage of the EPC.	
			MWt 10 to <50 standard: EN 14792 frequency: once every three months. The minimum monitoring frequency for periodic measurements may be limited to monitoring once every six months if the emission levels prove to be sufficiently stable.	**Not applicable.** The total heat output of process furnaces (2 furnaces) connected to one emitting device will be 52.14 MW (variant 1) or 54.56 MW (variant 2)	**Applicable for CEYHAN** Ceyhan Plant includes in PDH unit 4 Process Heaters each one with one stack . 28.14 MW, 25.46 MW, 20.88 MW, 30.94 MW therefore MWt 10 to <50 standard: EN 14792 is applicable	
	Monitoring of SO_2 emissions		MWt ≥50 standard: general EN* standards frequency: continuous mode	Monitoring of SO2 emissions from process furnaces will be carried out continuously in accordance with BAT requirements.	**Applicable for CEYHAN** The ESIA report (Chapter 9) (Subsection 9.7.2) recommends emission monitoring. To fulfil this BAT requirement, a CEMS, which monitorizes SO2 emisions, will be instaled in the boilers chimney, it will be considering in the design and purchase stage of the EPC.	
			MWt 10 to <50 standard: EN 14791 frequency: once every three months. The minimum monitoring frequency for periodic measurements may be limited to monitoring once every six months if the emission levels prove to be sufficiently stable. In the case of process furnaces/heaters combusting gaseous fuels or oil with a known sulfur content and if no flue gas desulfurization is carried out, continuous monitoring may be replaced by periodic monitoring with a minimum frequency of once every three months, or according to calculations, so as to ensure the provision of data of equivalent scientific quality.	**Not applicable.** The total heat output of process furnaces connected to one emitting device (2 furnaces) will be 52.14 MW (variant 1) or 54.56 MW (variant 2)	**Applicable for CEYHAN** Ceyhan Plant includes in PDH unit 4 Process Heaters each one with one stack . 28.14 MW, 25.46 MW, 20.88 MW, 30.94 MW therefore MWt 10 to <50 standard: EN 14791 is applicable	
Monitoring of spot emissions to the air other than emissions from process furnaces/heaters						
2	**Monitoring of benzene emissions**		standard: no EN standard available frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** According to the information obtained on the planned propylene production technology, spot benzene emission will not occur.	**Not Applicable.** In CEYHAN, benzene vapor/ gases emissions are not expected. Benzene traces may be present in the waste spent solvent flow.	

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
	Monitoring of total VOC emissions from all processes/source		standard: EN 12619 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** According to the information obtained on the planned propylene production technology, spot emission of substances classified as volatile organic compounds will not occur.	**Applicable for CEYHAN** The ESIA consider the tanks as a possible source of VOC, the emission values comply with both hourly and short-term national limit values; Therefore, these parameters will be monitored once the facility is in operation. To fulfil this BAT requirement, during the design and purchase stage of the EPC project, will be searching for a technology that allows to monitorize continuosly the VOC emisions.	
	Monitoring of dust emissions		Standard: EN 13284-1 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** According to the information obtained on the planned propylene production technology, other sources of spot dust emissions in addition to combustion of fuel gas in process furnaces will not occur.	**Applicable for CEYHAN** Ceyhan Plant includes in PDH unit 4 Process Heaters each one with one stack. 28,14 /25,46/20,88/30,94 MW therefore MWt 10 to <50 standard: EN 113284-1 are applicable.	
	Monitoring of emissions of gaseous chlorides expressed as HCl		standard: EN 1911 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** According to the information obtained on the planned propylene production technology, spot emission of gaseous chlorides will not occur.	**Applicable for CEYHAN** The 1-PK-401 generates HCl emissions. During Plant operation it has to be ensured the compliance with standard: EN 1911, where the minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	To be revised/ confirmed by Employer
	Monitoring of SO2 emissions from all processes/sources		standard: EN 14791 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	According to the information obtained on the planned propylene production technology, in addition to combustion of fuel gas in process furnaces, CCR catalyst regeneration section will be the spot source of SO2 emission. Monitoring of SO2 emissions from the CCR catalyst regeneration section will be carried out once a month, in accordance with BAT requirements.	**Applicable for CEYHAN** The ESIA consider the tanks as a possible source of SO2, Operation phase SO2 emissions may exceed hourly emission limits 1 time in one year, which is within the acceptable exceedance by the standards (i.e., 24 times). Daily and yearly emissions are expected to comply with emission standards, except that daily SO2 exceeds the IFC limit value. But the ESIA conclusion at the end is Operation Phase SO2 emissions are expected to comply with the emission standards, and these parameters are recommended to be monitored once the facility is operational To fulfil this BAT requirement, during the design and purchase stage of the EPC project, will be searching for a technology that allows to monitorize continuosly the SO2 emisions.	
	Monitoring of CO from thermal oxidizer		standard: EN 15058 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** It is not planned to use a thermal oxidizer.	**Applicable for CEYHAN** The ESIA Table 9-22Stack Information and Emission Values Used in Modelling Study consider values from RTO monitorization during FEED. Nevertheless, EPC Contractor will replace the RTO by an improved system N-Viro (UOP Technology) that optimizes the emissions.	

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
	Monitoring of NOx from thermal oxidizer		standard: EN 14792 frequency - once a month. The minimum monitoring frequency for periodic measurements may be limited to monitoring once a year if the emission levels prove to be sufficiently stable.	**Not applicable.** It is not planned to use a thermal oxidizer.	**Applicable for CEYHAN** The ESIA Table 9-22 Stack Information and Emission Values Used in Modelling Study consider values from RTO monitorization during FEED. Nevertheless, EPC Contractor will replace the RTO by an improved system N-Viro(UOP Technology) that optimizes the emissions.	
	Monitoring of dust emissions from decoking		BAT 2 standard: no EN standard available frequency: once a year or once during decoking if at a lower frequency	**Not applicable.** According to column 5 of the table presented in BAT 2, monitoring of dust emissions from decoking shall be applied when BAT 20 is applicable. BAT 20 applies to the production of lower olefins in the steam cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable.** CEYHAN Plant is not a steam cracking**.** The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions	
	Monitoring of CO emissions from decoking		BAT 2 standard: no EN standard available frequency: once a year or once during decoking if at a lower frequency	**Not applicable.** According to column 5 of the table presented in BAT 2, monitoring of dust emissions from decoking shall be applied when BAT 20 is applicable. BAT 20 applies to the production of lower olefins in the steam cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process	**Not Applicable.** CEYHAN Plant is not a steam cracking**.** The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions	
Emissions to the air from process furnaces/heaters						
3	**In order to reduce emissions of CO and residual substances to the air from process furnaces/heaters, it is necessary to ensure optimized combustion within BAT.**	Optimized combustion is achieved through good design and operation of the equipment, which includes optimization of temperature and residence time in the combustion zone, efficient mixing of fuel with combustion air and combustion control. Combustion control consists in continuous monitoring and automatic control of the relevant combustion parameters (e.g. O2, CO, fuel-air ratio and residual substances).		As part of the propane dehydrogenation unit, for process furnace operation, it is envisaged, i.a., to control the process by measuring the amount of oxygen and CO in fuel gas and control of the air-fuel ratio.	**Applicable for CEYHAN** Part of the propane dehydrogenation unit, for process furnace operation, it is envisaged, i.a., to control the process by measuring the amount of oxygen and CO in fuel gas and control of the air-fuel ratio.	

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
4	**In order to reduce NOx emissions to the air from process furnaces/heaters, it is necessary to use one of the following techniques or a combination of those within BAT.**	a) Fuel selection b) Stage combustion c) Fuel gas recirculation (external) d) Fuel gas recirculation (internal) e) Low NOx burner or ultra-low NOx burner f) Use of neutral diluents g) Selective catalytic reduction (SCR) h) Selective non-catalytic reduction (SNfCR)		Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient). As part of the propane dehydrogenation unit for the operation of process furnaces, it is envisaged to use ultra- low NOx emission burners.	Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient). As part of the propane dehydrogenation unit for the operation of process furnaces, it is envisaged to use ultra- low NOx emission burners.	
5	**To prevent or reduce dust emissions to the air from process furnaces/heaters, within BAT it is necessary to use one of the following techniques or a combination of those:**	a) Fuel selection b) Atomization of liquid fuels c) Fabric, ceramic or metallic filter		Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient). According to BAT 5, the use of filters is not applicable if combustion involves only gaseous fuels. Therefore, this requirement does not apply to the planned development project.	**Not Applicable** Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient). According to BAT 5, the use of filters is not applicable if combustion involves only gaseous fuels. Therefore, this requirement does not apply to the CEYHAN Project.	
6	**To prevent or reduce SO2 emissions to the air from process furnaces/heaters, within BAT it is necessary to use one of the following techniques or both of them.**	a) Fuel selection b) Wet cleaning with alkaline solution		Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient).	Process furnaces will be fed with residual (fuel) gas with addition of natural gas (if the residual gas stream is not sufficient).	
7	**In order to reduce emissions to the air of ammonia used in selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) to reduce NOx emissions, it is necessary to optimize the design or operation of SCR or SNCR (e.g. optimized reagent-NOx ratio, uniform distribution of reagent, optimum size of reagent droplets) within BAT.**			**Not applicable.** Selective catalytic reduction and selective non-catalytic reduction is not planned (no NH3 source).	**Not Applicable.** CEYHAN Plant has no NH3 sources	
Emissions to the air from other processes/sources						
8	**In order to reduce the load of pollutants sent to final waste gas treatment and to increase resource efficiency, it is necessary to use an appropriate combination of the below techniques in relation to waste gas streams from the technological process within BAT.**	a) Recovery and use of surplus or generated hydrogen b) Recovery and use of organic solvents and unreacted organic raw materials c) Use of spent air d) Recovery of HCl by means of wet cleaning for subsequent use e) Recovery of H_2S by means of regenerative washing amine for subsequent use f) Techniques to reduce capture of solids or liquids		The main by-product — hydrogen will be used in other GAP technological processes (for ammonia production). As part of the propane dehydrogenation unit, the spent organic solvent will be used as energy source. In addition, the unreacted raw material (propane) will be returned to the reactor section. Propane dehydrogenation will be carried out in a leak-tight, closed system.	**Applicable for CEYHAN** UOP has optimized the entire process by emitting the minimum concentration of pollutants (Vent gas treating system) H2 is recovered and used in the Polypropylene plant. The polypropylene plant has all the equipment for solid dust recovery. Additionally, CEYHAN Project will include a NVIRO to remove VOCs from both the polypropylene plant and off gas from the spent caustic treatment package.	

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
9	**In order to reduce the load of pollutants sent to final waste gas treatment and to increase energy efficiency, within BAT it is necessary to send waste gas streams from the technological process with sufficient net calorific value to the fuel combustion unit. BAT 8a and 8b shall take precedence over the sending of waste gas streams from the technological process to the fuel**	8 a) Recovery and use of surplus or generated hydrogen 8 b) Recovery and use of organic solvents and unreacted organic raw materials		The main by-product — hydrogen will be used in other GAP technological processes (for ammonia production). As part of the propane dehydrogenation unit, the spent organic solvent will be used as energy source. In addition, the unreacted raw material (propane) will be returned to the reactor section.	**Applicable for CEYHAN** UOP has optimized the entire process by emitting the minimum concentration of pollutants (Vent gas treating system) H2 is recovered and used in the Polypropylene plant. The polypropylene plantt includes all the equipment for solid dust recovery. Additionally,CEYHAN Plant will include an NVIRO Unit to remove VOCs from both the polypropylene plant and off gas from the spent caustic treatment package.	
10	**In order to reduce spot emissions of organic compounds to the air, it is necessary to use one of the following techniques or a combination of those within BAT.**	a) Condensation b) Adsorption c) Wet cleaning d) Catalytic oxidizer e) thermal oxidizer		**Not applicable.** According to the information obtained on the planned propylene production technology, spot emission of organic compounds will not occur.	**Applicable for CEYHAN** CEYHAN Plant Project includes a NVIRO Unit to avoid VOC emissions.	
11	**In order to reduce spot emissions of dust to the air, it is necessary to use one of the following techniques or a combination of those within BAT.**	a) Cyclone b) Electrostatic Precipitator c) Fabric filter d) Two-stage dust filter e) Ceramic/metallic filter f) Wet dedusting		**Not applicable.** According to the information obtained on the planned propylene production technology, other spot sources of dust emissions will not occur.	**Applicable for CEYHAN** In the Polypropylene Unit and in the Bagging and Peletizing Unit, cyclones and filters are implemented to avoid the emission of fines and dust. In the PDH unit, there isa package unit for the recovery of catalyst fines (01-X-401)	
12	**In order to reduce emissions to air of sulphur dioxide and other acid gases (e.g. HCl), BAT is to use wet scrubbing.**	a) Wet scrubbing		**Not applicable.** According to the information obtained on the planned propylene production technology, other spot sources of acid gases (e.g. HCL) emissions will not occur.	**Not Applicable.** CEYHAN Plant has no acid gas sources.	
Emissions from thermal oxidizer						
13	**In order to reduce spot emissions of dust to the air, it is necessary to use one of the following techniques or a combination of those within BAT.**	a) Removal of large quantities of NOx precursors from waste gas streams from technological process b) Selection of auxiliary fuel c) Low NOx emission burner d) Regenerative thermal oxidizer (RTO) e) Combustion optimization f) Selective catalytic reduction (SCR) g) Selective non-catalytic reduction (SNCR)		**Not applicable.** It is not planned to use a thermal oxidizer.	**Applicable for CEYHAN** To reduce the emissions from the RTO, a new techonology called n-Viro will be used	
Emissions to water						

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
14	**In order to reduce the amount of wastewater, the load of pollutants discharged to the appropriate final treatment (typically biological treatment) and emissions to water, it is necessary to use the integrated strategy of wastewater management and treatment within BAT, including an appropriate combination of process-integrated techniques, techniques for recovering pollutants at source and pretreatment techniques based on the information included in the wastewater stream list as defined in BAT conclusions on common wastewater/waste gas treatment and management systems in the chemical sector.**			As part of the Polimery Police Project, an integrated strategy for wastewater management and treatment has been applied. The system of water supply and wastewater drainage shall ensure strict control over these streams, enabling optimization of their use. The unit will use pretreatment technology (WAO) and GAP water and sewerage systems. Wastewater will be discharged to GAP sewerage systems and treated in GAP treatment systems.	The unit will use pretreatment technology and sewerage systems. The Wastewater Treatment Package shall be designed to accept and treat the compliant feed streams in all normal and design operating cases as stated within the specification in order to achieve the required discharge conditions without causing theoperating plants to reduce production rates.In general , the Waste water treatment package will configure as below treatment system: - Oil Separation to remove oil - Equalization Basin - Coagulation & Dissolved Air Floatation removing suspended solid and oil contents - Bio-treatment Unit removing organic matters (Aeration + Clarifier) - Sludge Dewatering Unit - Filtering facility using sand and activated carbon - Final Effluent Pond - Required Chemical Dosing system. According to Turkish Regulation on Water Pollution Control and IFC EHSGuidelines, treated waste water quality shall not exceed the stringent between the National limits and IFC guideline values.	
Resource efficiency						
15	**In order to increase resource efficiency when catalysts are used, it is necessary to use a combination of the below techniques within BAT.**	a) Catalyst selection b) Catalyst protection c) Process optimization d) Catalyst efficiency monitoring		As part of the propane dehydrogenation unit, platinum-based catalyst (no toxic metals), Oleflex catalyst protection in the form of a raw material treatment station, process control through temperature and pressure measurement and adjustment in the reactor section and monitoring of catalyst activity (test of the quantity of coke on the catalyst) have been used. The process manual will specify optimum process conditions that ensure an optimum balance between conversion efficiency and catalyst life.	As part of the propane dehydrogenation unit, platinum-based catalyst (no toxic metals), Oleflex catalyst protection in the form of a raw material treatment station, process control through temperature and pressure measurement and adjustment in the reactor section and monitoring of catalyst activity (test of the quantity of coke on the catalyst) is specified by Licensor. The process manual will specify optimum process conditions that ensure an optimum balance between conversion efficiency and catalyst life.	
16	**In order to increase resource efficiency, within BAT it is necessary to recover and reuse organic solvents.**	Organic solvents used in processes (e.g. chemical reactions) or operations (e.g. extraction) are recovered by appropriate techniques (e.g. distillation or liquid phase separation), cleaned if necessary (e.g. distillation, adsorption, stripping or filtration) and reused as part of the given process or operation. The quantity recovered and reused depends on the given process.		The organic solvent used in the process is regenerated in the distillation process and the spent organic solvent is used as a source of energy.	Solvent isregenerated and returned to process (01-C-104, Solvetn Recovery Column and associated systems). PDH Unit, spent solvent will be transported by truck out of the Plant for treatment.	
Residues						

BAT	BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
17	**In order to prevent waste from being sent for disposal or, if this is not feasible, to reduce the amount of waste sent for disposal, it is necessary to use an appropriate combination of the below techniques within BAT.**	a) Adding inhibitors to distillation systems b) Minimization of production of high-boiling residues in distillation systems c) Recovery of materials (e.g. by distillation, cracking) d) Regeneration of catalysts and adsorbents e) Use of residues as fuel		Material recovery will be used. The C4 fraction separated in the distillation column will be directed to the stripping column, from where gases are discharged to the combustion system and the liquid fraction will be returned to the solvent recovery system. The fumes from the distillation column will be condensed and directed to the separation section. See also BAT 8. The catalyst will be regenerated in the continuous catalyst regeneration section (CRR). The catalyst will be regenerated after removal of solid particles at four stages: 1. coke combustion; 2. removal of excess moisture, 3. oxidation and dispersion of (platinum), 4. reduction of metallic promoters (platinum). The use of residues as fuel is indicated in BAT 9. Flue gas from the process furnaces will be used to produce high-pressure steam in a boiler of special design.	The C4+ material recovered from the bottom of the Depropanizer in the Fractionation Section is stripped off for any light ends in the Depropanizer Bottoms Stripper. The offgas is sent to the fuel gas preparation system while the bottoms is sent to the Solvent Recovery Column for the recovery of the solvent PDH reaction catalyst is regenerated continously in CCR Unit : CATALYST REGENERATION Oleflex catalyst regeneration requires six basic steps: 1) Stripping sulfur off the catalyst 2) Removing fines from the catalyst 3) Burning coke 4) Oxidizing and redispersing metal promoters 5) Removing excess chlorine 6) Reducing active metal promoters	
Conditions other than normal operating conditions						
18	**In order to prevent or reduce emissions from malfunctioning of equipment, it is necessary to use all the below techniques within BAT.**	a) Identification of critical equipment b) Asset reliability program for critical equipment c) Back-up systems for critical equipment		Within the framework of the Polimery Police Project, all critical pieces of equipment will be identified and their operation will be monitored, i.a., using IT systems (Enterprise Assets Management, Computerized Maintenance Management Systems, Machine Monitoring System, Electrical Control & Monitoring System, Asset Management System).	Critical pieces of equipment will be identified and their operation will be monitored, i.a., using IT systems (Enterprise Assets Management, Computerized Maintenance Management Systems, Machine Monitoring System, Electrical Control & Monitoring System, Asset Management System).	IT systems implementation for maintenance To be revised/ confirmed by Employer
19	**In order to prevent or reduce emissions to the air and water in conditions other than normal operating conditions, it is necessary to implement measures proportionate to the importance of possible releases in relation to: (i) start-up and shutdown; (ii) other circumstances (e.g. regular and extraordinary maintenance and cleaning of waste gas treatment units or system), including circumstances that could affect proper operation of the unit**			The planned development project involves the installation of only new equipment, which will be subject to regular scheduled inspections and maintenance according to an established schedule. In the event of abnormal operating conditions of the unit, it will be subject to additional inspection. A detailed operating manual for the detection and removal of leaks will be developed for the unit, in accordance with the principles applicable at GAP. The technical design includes the use of equipment compliant with BAT requirements.	CEYHAN project involves the installation of only new equipment, which will be subject to regular scheduled inspections and maintenance according to an established schedule. In the event of abnormal operating conditions of the unit, it will be subject to additional inspection. A detailed operating manual for the detection and removal of leaks will be developed for the unit. The technical design includes the use of equipment compliant with BAT requirements.	

* General EN standards for fixed measurements include EN 15267-1, -2 and -3, and EN 14181. The table provides EN standards for periodic measurements.

Table 2. Requirements of LVOC BAT conclusions for the production of lower olefins, including propylene

BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions
BAT-AEL values for NOx emissions to the air from the pyrolytic furnace for the production of lower olefins: NOx (new furnace)	60-100 mg/Nm^3, at 3% vol. of O_2	*see BAT 1 in the above table*	**Not applicable.** The BAT-AEL value is applicable for the production of lower olefins in a thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
BAT-AEL values for NH3 emissions to the air from the pyrolytic furnace for the production of lower olefins: NH3	< 5–15 mg/Nm^3, at 3 % vol. of O_2	*see BAT 1 in the above table*	**Not applicable.** The BAT-AEL value is applicable for the production of lower olefins in a thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
No BAT-AEL is specified	As an indicator, CO emission level may generally amount to 10-50 mg/Nm3	*see BAT 2 in the above table*	**Not applicable.** The BAT-AEL value is applicable for the production of lower olefins in a thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
BAT 20: In order to reduce dust and CO emissions to the air during decoking of cracking furnace tubes, an appropriate combination of decoking frequency reduction techniques and one or a combination of the below emission reduction techniques should be used.	**Techniques to reduce decoking frequency**			
	a) Use of pipe materials that delay coke formation b) Use of sulfur compound admixtures in the case of feed raw materials c) Optimization of thermal decoking		**Not applicable.** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
	Emission reduction techniques			
	d) Wet dedusting e) Dry cyclone f) Combustion of waste gases from the decoking process in the process furnace/heater		**Not applicable.** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions

BAT / AEL	Techniques / AEL	Related monitoring	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions
BAT 21: In order to prevent discharge of organic wastewater for treatment or reduce their amount, maximum recovery of hydrocarbons from cooling water should be achieved at primary fractioning stage and cooling water should be reused in the dilution steam generation system.	This technique is to ensure effective isolation of the organic and water phases. The recovered hydrocarbons are returned to the cracking furnace or used as raw materials in other chemical processes. The recovery of organic compounds can be improved, for example, by using steam or gas stripping, or by a circulator. The treated cooling water is reused in the dilution steam generation system. The treated cooling water stream is discharged for further final wastewater treatment to prevent the accumulation of salts in the system		**Not applicable.** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
BAT 22: In order to reduce the organic load discharged for wastewater treatment from spent scrubbing lye from the removal of H2S from cracked gases, it is necessary to use striping within BAT.	For the description of stripping, see point 12.2. (12.2.: Volatile substances are removed from the water phase by means of a gas phase (e.g. steam, nitrogen or air) passed through the liquid, and then recovered (e.g. by condensation) for further use or disposal. The removal efficiency can be enhanced by increasing the temperature or lowering the pressure.) The stripping of solutions in scrubbing lye is carried out using a gas stream, which is then combusted (e.g. in a cracker furnace).		**Not applicable.** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectively dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions
BAT 23: In order to prevent or reduce the amount of sulfides discharged for wastewater treatment, originating from spent scrubbing lye generated during removal of acid gases from cracking, it is necessary to use one of the following techniques or a combination of those within BAT.	a) Use of low-sulfur raw materials as feed material in a cracker furnace b) Maximum use of amino washing to remove acid gases c) Oxidation		**Not applicable.** The BAT-AEL value is applicable for the production of lower olefins in a thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process.	**Not Applicable** BAT are applicable for the production of lower olefins in the thermal cracking process. The planned development project concerns propylene production in the catalytic propane dehydrogenation process. The Oleflex™ Process is a moving bed catalytic process designed to selectivel dehydrogenate a paraffin feed to the corresponding mono-olefin. Feed to the Oleflex unit must be free of impurities that could harm the platinum containing catalyst or cause reactor fouling. The catalyst employed is highly selective for the desired reaction; successive and competing reactions such as skeletal isomerization, diolefin production, and cracking are minimized by proper catalyst formulation and choice of operating conditions

Table 3 presents an analysis of compliance with BAT requirements for polypropylene production as set out in the Best Available Techniques Reference Document in the Production of Polymers (August 2007). The table takes into account the general BAT requirements and BAT requirements for the production of polyolefins[2]. These requirements apply to the planned PP unit, together with its auxiliary systems - the unit for polypropylene production by gas polymerization.

Tablo 3. General BAT requirements for polymer production

BAT guidelines	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
General BAT			
Implementation of environmental management, e.g. EN ISO 14001: 2015 or EMAS.	Grupa Azoty Zakłady Chemiczne "Police" S.A. implements the Management Policy, which ensures that the company's strategic objectives are achieved on the basis of the Integrated Management System, which complies with international standards. Priorities of the business activity: high quality, care for technical safety and the environment are effectively supervised and ensure effective company management. The Integrated Management System is developed on the basis of the principles of prioritizing the client, minimizing environmental losses and risk of hazards, and continuous improvement. Management systems are based on the continuous improvement concept. At Grupa Azoty Zakłady Chemiczne "Police" S.A. the following applies: Quality Management System, compliant with EN ISO 9001:2008; Environmental Management System, compliant with ISO 14001:2004; Energy Management System, compliant with ISO 50001:2011; • Occupational Health and Safety Management System compliant with PN-N 18001:2004 and BS OHSAS 18001:2007; • Food Safety Management System, compliant with ISO 22000:2005; PDH Polska S.A., as part of Grupa AZOTY, will implement the systems currently in force at Grupa Azoty.	CEYHAN Plant will develop an Environmental Management policy and Integrated or Environmental Management System as requested. For example "XXXXXX S.A. implements/will implement the Management Policy, which ensures that the company's strategic objectives are achieved on the basis of the Integrated/Environemtal Management System, which complies with international standards. "	Employer to confirm if an Environmental Management policy and Integrated or Environmental Management System is available. If not, Employer to implement an Environmental Management policy and Environmental Management System as requested.
Reduction of non-point emissions owing to advanced equipment design, including: • use of valves with bellows or double gasket or equally effective equipment. Valves with bellows are recommended in particular for use with highly toxic substances • magnetic-driven or cased pumps or pumps with double gaskets and liquid barrier • magnetic-driven or cased compressors or compressors incorporating double gaskets and liquid barrier • magnetic-driven agitators or cased agitators with double gaskets and liquid barrier • minimization of the number of flanges (joints) • effective sealing • closed sampling systems • discharge of contaminated wastewater in closed systems • collection of discharges.	In accordance with the requirements of the contract for the implementation of the Polimery Police project in the EPC formula, all BAT recommendations must be implemented. This also applies to equipment design solutions, including: double gaskets and liquid barriers (pumps and compressors), leaktight valves for all utilities present in the unit, minimization of the number of flanges designed on the basis of licensor's requirements, closed sampling systems, hydrocarbon discharge system with a flare, separated drainage systems and closed drainage systems for chemicals. In addition, in accordance with the implemented licensor's technology and technical solutions, the PP production unit will be leaktight and equipped with a waste gas recovery system for the recovery of monomer, propylene and ethylene from the waste gas streams discharged from the polymer degassing system. The waste gases from the monomer polishing section will be directed to the fuel gas system in the PDH unit. Circulating waste gases, supplementing nitrogen from the waste gas recovery system and hydrocarbons released from polymer will be discharged from the product degassing tank through the filter to the waste gas recovery system. Recovered waste gases (propylene/propane + ethylene) will be returned to the reaction system and to the PDH unit for reuse. Nitrogen will be heated, mixed with steam and fed to the product degassing tank. Steam hydrolyses waste T2 catalyst and other active catalyst. Waste vapor, nitrogen and isolated hydrocarbons will be removed as a bypass stream.	In accordance with the requirements of the CEYHAN PDH-PP-U&O Project BAT recommendations must be implemented. This also applies to applicable equipment design solutions, including: double gaskets and liquid barriers (pumps and compressors), leaktight valves for all utilities present in the unit, minimization of the number of flanges designed on the basis of licensor's requirements, closed sampling systems, hydrocarbon discharge system with a flare, separated drainage systems and closed drainage systems for chemicals. In addition, in accordance with the implemented licensor's technology and technical solutions, the PP production unit will be leaktight and equipped with a waste gas recovery system for the recovery of monomer and propylene from the waste gas streams discharged from the polymer degassing system. The waste gases from the monomer polishing section (offgas) will be directed to the fuel gas system along with off gas from PDH unit. The system of water supply and wastewater drainage will ensure strict control over these streams, enabling optimization of their use. The CEYHAN Project includes a wastewater treatment unit.	

[2] Commıssıon Implementıng Decısıon (EU) 2017/2117 of 21 November 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the production of large volume organic chemicals.

BAT guidelines	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
General BAT			
	The combined extraction streams will be fed to the filter, and the filtered stream will be fed to the flare. The system of water supply and wastewater drainage will ensure strict control over these streams, enabling optimization of their use. The unit will use GAP water and waste water systems. Wastewater will be discharged to GAP waste water systems and treated in GAP treatment systems.		
Assessment and measurement of unorganized losses in order to classify components in terms of type, operation and process conditions, so as to identify elements that demonstrate the greatest potential for unorganized loss.	The technological process will be continuously monitored in order to quickly identify and eliminate possible irregularities. A program based on precise calculations of the number of flanged connections, automatic valves, mechanical seals on rotating devices will be used to estimate unorganized emissions	The technological process will be continuously monitored in order to quickly identify and eliminate possible irregularities. A program based on precise calculations of the number of flanged connections, automatic valves, mechanical seals on rotating devices will be used to estimate unorganized emissions.	To be revised/ confirmed by Employer
Establishment and operation of a program for monitoring and maintenance of equipment and/or detection and removal of leaks based on the component and maintenance database combined with assessment and measurement of unorganized loss.	It is planned to build a modern unit, consisting exclusively of new equipment. The unit will be subject to safety and major industrial accident prevention procedures applicable at the plant, and will be regularly reviewed and evaluated in terms of technical condition. The technological process will be continuously monitored in order to quickly identify and eliminate possible irregularities.	It is planned to build a modern unit, consisting exclusively of new equipment. The unit will be subject to safety and major industrial accident prevention procedures applicable at the plant, and will be regularly reviewed and evaluated in terms of technical condition. The technological process will be continuously monitored in order to quickly identify and eliminate possible irregularities. : Monitoring during plant operation to be accoridng to BAT requirments	To be revised/ confirmed by Employer
Reduction of dust emission by combining the following techniques: • dense phase transfer is more effective in preventing dust emissions than transferring the diluted phase • velocity reduction in diluted phase transfer systems to the lowest possible values • reduction of dust generation in transfer lines through surface treatment and appropriate pipe alignment • use of cyclones and/or filters in air outlets from dedusting equipment; use of fabric filter systems is more efficient, especially in the case of fine dust • use of water scrubbers.	Polypropylene from the reaction system is transported in a hermetic system; the carrier gas comprises hydrocarbons that are the reaction environment. In the hydrocarbon (monomer) recovery system, a system of filters shall be used to protect the ingress of dust into the monomer recovery system. Polypropylene powder is transported by gravity to the extrusion system through a cell feeder. Additives used during extrusion of polypropylene are discharged at stations equipped with a dust filtration system. Dust formed during granulation of polypropylene is captured in the transport water tank from where, through the system of mesh filters, it is separated from water. A dust recovery system using a cyclone/dust separator will be used on the system for granulate pneumatic transport to the logistics platform.	Polypropylene from the reaction system is transported in a hermetic system; the carrier gas comprises hydrocarbons that are the reaction environment. In the hydrocarbon (monomer) recovery system, a system of filters shall be used to protect the ingress of dust into the monomer recovery system. Polypropylene powder is transported by gravity to the extrusion system through a cell feeder. Additives used during extrusion of polypropylene are discharged at stations equipped with a dust filtration system. Dust formed during granulation of polypropylene is captured in the transport water tank from where, through the system of mesh filters, it is separated from water. A dust recovery system using a cyclone/dust separator will be used on the system for granulate pneumatic transport to the logistics platform.	
Minimization of unit start and shutdown sequences in order to avoid peak emissions and reduce overall consumption (e.g. energy and monomer per ton of product).	The operation of the unit will be monitored continuously in order to reduce the risk of emergency situations and stopping the unit. In the case of process disturbances, the polymerization reaction will be deactivated or slowed down using the polymerization interruption system. A propylene storage system is provided on the monomer supply system to ensure continuity of production of the PP unit in the case of a short-term shutdown of the PDH unit. For critical equipment, redundancy has been used where possible, while in other cases high reliability indicators of the equipment have been determined.	CEYHAN Plant is to have a continuous operation, minimizing units start and shutdown sequences. The operation of the unit will be monitored continuously in order to reduce the risk of emergency situations and stopping the unit. In the case of process disturbances, the polymerization reaction will be deactivated or slowed down using the polymerization interruption system. A propylene storage system (4 Propylene spheres) is included to ensure continuity of production of the PP unit in the case of a short-term shutdown of the PDH unit. For critical equipment, redundancy has been used where possible, while in other cases high reliability indicators of the equipment have been determined.	To be revised/ confirmed by Employer
Protection of the reactor's contents in case of emergency shutdown (e.g. through the use of shutdown systems).	The stopped material which may comprise unreacted monomers, solvents, polymers, etc. shall, where possible, be recycled or used as a fuel, e.g. for polymers of unspecified quality. The unit will be provided with an interlock system to protect the reactor against the effects of uncontrolled polymerization.	Reactor protection system is defined according to Licensor design, including all the interlock system and teh correct operation procedures to avoid any upset Fire fighting system and gas/fire detectors are implemented in the plant for safery watching	
Return of contaminated material to the process or using it as fuel	The polymer obtained by emergency reactor stopping is still a commercial product and may be recycled outside the plant.	Streams recovered within the PDH separation sysetm is used for fuel gas in the reactor heaters	

BAT guidelines	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
General BAT			
		Polymer not fulfilling the specifications is re-processed	
Prevention of water pollution by appropriate design and selection of pipe materials to facilitate inspection and repair, wastewater collection systems in new units and upgraded systems have, e.g.: • pipes and pumps placed above the ground • pipes placed in the channels available for inspection and repair.	Process pumps and compressors will be installed on the foundations above the ground. Process pipelines will be installed on pipe racks. Drainage pipelines will be installed in closed channels backfilled with expanded clay, with a cover sealed with elastic material. The unit will partially use the existing GAP sewerage system. The PP unit will be provided with an internal waste water aggregation system equipped with oil separators and solid particle traps. After pretreatment, the waste water from the PP unit will be directed to the GAP waste water system.	CEYHAN Plant will comply to the requirements for Prevention of water pollution defined in the Reference Document on Best Available Techniques in the Production of Polymers, August 2007 by appropriate design, as: -Process effluent and drainage or sewerage systems within the plant are made from corrosionresistant materials and designed to prevent leaks to reduce the risk of loss from underground pipelines -To facilitate inspection and repair, effluent water collection systems at new plants and retrofitted systems are either: • pipes and pumps placed above ground • pipes placed in ducts accessible for inspection and repair. -Measures for water pollution prevention include separate effluent collection systems for: • contaminated process effluent water • potentially contaminated water from leaks and other sources, including cooling water and surface run-off from process plant areas, etc. • uncontaminated water.	
Use of separate waste water collection systems for: • contaminated process waste water • potentially contaminated water from leaks and other sources, including cooling water and surface drainage water from process unit areas, etc. • uncontaminated water.	The PP unit will be provided with separate waste water collection systems. These will be: clean rainwater drainage network, oily water drainage network, chemical waste water network All waste water generated in the PP unit is process waste water and is pretreated by means of oil separation and removal of solids, and will then be directed to the GAP waste water system. The waste water treatment plant (WWT) consists of : • oily waste water oil separation system, • storage of clean and deoiled wastewater, • waste water treatment system.	CEYHAN Plant will be provided with separate waste water collection systems. These will be: clean rainwater drainage network, oily water drainage network (included potentially contaminated rainwater) , chemical wastewater drainage network All waste water generated in process waste water is pretreated by means of oil separation and removal of solids, and will then be directed to the waste water system. The waste water treatment plant (WWT) consists of: • oily waste water oil separation system, • storage of clean and deoiled wastewater, • waste water treatment system.	
Treatment of purging air streams from the vents of degassing silos and reactors by one or more of the following techniques: • recycling • thermal oxidation • catalytic oxidation • adsorption • combustion in flares (only in the case of continuous flows).	Air is not used as a cleaning medium on the reactor system. The source of VOC emissions on the blending silos system may be peroxide degraded polymers. When using the UNIPOL process, it may be resigned from the use of peroxide, which effectively eliminates the need to treat the polymer cleaning air in the blenders.	NVIRO system will be implemented in the CEYHAN Unit for the treatment of the purge air which could carry VOCs SPHERIPOL Process by LyondellBassell requires the use of peroxide.	
Application of combustion systems in flares to treat discontinuous emissions from the reactor system. Combustion in flares of discontinuous emissions from reactors is the best available technique unit only if these emissions cannot be returned to the process or used as fuel.	The combined extraction streams will be fed to the filter, and the filtered stream will be fed to the flare. In the event of an emergency stop of the unit including hydrocarbon discharge, the unit will be equipped with low and high pressure discharge headers connected to the flare.	Flare system is implemented in the project to handle emergency reliefs or overpressur situations during upsets	
Use, where possible, of power and steam from the cogeneration system. Cogeneration is usually installed when the unit consumes the generated steam or where an outlet for the generated steam is available. The electricity generated may be consumed by the system or sent outside.	**Not applicable.** The PP unit is an energy (steam, power) consumer; no unit process carried out in the unit results in energy production.	Steam is produced in the PDH unit (heat integration) using the flue gas from Charge Heater and interheaters. Steam is used both PDH as PP plant. No power is generated from steam	
Reaction heat recovery by generation of low pressure steam in the process or systems	**Not applicable.** The propylene polymerization process is a low-temperature	Steam is produced in the PDH unit (heat integration) using the flue gas from Charge Heater and interheaters. Steam is used both PDH as PP plant. No power is generated from steam	

BAT guidelines	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
General BAT			
when internal or external consumers of low pressure steam exist.	process (approx. 75℃), therefore it is not possible to generate steam through heat recovery from reactors.		
Reuse of potential waste from the polymer production unit.	All polypropylene products created in the PP unit will constitute a commercial product that can be used as a raw material outside the plant.	All polypropylene products created in the PP unit will constitute a commercial product that can be re-used as a raw material outside the plant. PP strands and polypucks from extruder section can be milled and sent through 3rd parties compounders to be re-used as raw material for compounding grades. Offspec PP pellets can be either internally recycled in the blending process or sold to external compounders as raw material.	
Application of pig cleaning systems in multi-product units with liquid raw materials and products.	**Not applicable.** The unit that will be built as part of the planned development project is not a multi-product unit.	**Not applicable.** The CEYHAN PP unit is not a multi-product unit in the current configuration	
Use of waste water buffer upstream of the waste water treatment plant to achieve a constant quality of waste water. This applies to all waste water generating processes such as PVC and ESBR.	Waste water resulting from polypropylene production will be directed to the equalization tank and then to the waste water pretreatment plant. In the pretreatment plant, the process of unbound hydrocarbons isolation will take place. The pretreated waste water will then be discharged to the GAP waste water system.	Waste water treatment plant is implemented in the project to handle and treat contaminated water from the units: Intermediate pits and tanks are included in the project for wastewater treatment.	
Efficient waste water treatment. Waste water may be treated in a central unit or in a unit intended for special activities. Depending on the quality of waste water, additional specialized pretreatment is required.	**Not applicable.** Specialized pretreatment will consist in catching polypropylene particles from the waste water discharged from the PP unit. Hydrocarbons from oily waste water will also be isolated. The remaining waste water treatment will be carried out outside the PP unit, on the PDHP waste water treatment plant, and then in the GAP unit.	Waste water treatment plant is implemented in the project to handle and treat contaminated water from the units: Intermediate pits and tanks are included in the project for wastewater treatment.	
BAT for polyolefin production			
Recovery of monomers from piston compressors in LDPE processes to: • return them to the process and/or • send them to the thermal oxidizer	**Not applicable.** The technique applies to LDPE processes. The planned development project concerns propylene production (PP)	**Not applicable.** It refers to LDPE processes. The planned development project concerns propylene production (PP)	
Collection of waste gases from extruders. The waste gases from the extrusion section (rear extruder gasket) in LDPE production have a high VOC content. By suction of vapors from the extrusion section, monomer emissions are reduced. The removal efficiency is > 90%.	**Not applicable.** The technique applies to LDPE production. The planned development project concerns propylene production (PP)	**Not applicable**. It refers to LDPE processes. The planned development project concerns propylene production (PP)	
Reduction of emissions from finishing and storage section Reduction of emissions from finishing and LDPE storage processes by: • *maintaining a low pressure separating vessel (LPS) at minimum pressure, and/or* • *selection of solvent, and* • *extrusion with degassing of volatile compounds or* • *treatment of purging air from degassing silos.*	**Not applicable.** The technique applies to LDPE production. The planned development project concerns propylene production (PP)	**Not applicable.** It refers to LDPE processes. The planned development project concerns propylene production (PP)	
Reduction of emissions from finishing and storage sections Reduction of finishing and storage emissions in low pressure suspension processes by: • *use of closed loop nitrogen purging systems, and* • *optimization of stripping process. By optimization of stripping, monomer content in polyolefins produced using low pressure technologies (PP, HDPE) is reduced to less than 25% and* • *recycling of monomers from stripping*	Recovery of unreacted propylene and ethylene from process gas streams discharged from the polymer degassing system will be carried out in an unreacted monomer recovery system. The recovered stream will be separated into three streams. The stream consisting mainly of propylene will be returned to the reaction system. Optimization of the stripping process does not apply to the planned technology. According to Chapter 12 of the Reference Document on Best Available Techniques in the Production of Polymers of August 2007, optimization of the stripping process concerns suspension processes. The process of gas polymerization will be used in the planned development project. The	Process design by Licensor(SPHERIPOL) minimize the emisions of HC from the polymer using low gas pressure separation system and an steamer to carry the monomers and recover them in the process. Final Gas streams are processed in the N-VIRO System (by UOP)	

BAT guidelines	Reference Project Proposed solutions	Ceyhan PDH-PP Proposed Solutions	REMARKS FOR EMPLOYER CONSIDERATION
General BAT			
process. Instead of combustion in a flare, monomers are returned to the production process. Approx. 10 kg of monomers per ton of product may be recycled and • *solvent condensation and solvent selection.*	other indicated techniques do not apply to the planned development project. According to Chapter 12 of the Reference Document on Best Available Techniques in the Production of Polymers of August 2007, the techniques concern polyethylene (PE) production.		
Reduction of emissions from finishing and storage sections Reduction of finishing and storage emissions in gaseous phase processes (LLDPE, HDPE, and PP) by: • *use in closed loop nitrogen flushing systems, and* • *selection of solvents and comonomer (LLDPE only).*	**Not applicable.** According to Chapter 12 of the Reference Document on Best Available Techniques in the Production of Polymers of August 2007, the techniques concern polyethylene (PE) production. The planned development project concerns propylene production (PP)	Monomers are recovered in the process based in the Process Licensor technology (SPHERIPOL)for the PP plant	
Reduction of emissions from finishing and storage sections Reduction of finishing and storage emissions in LLDPE solution processes by: • *solvent condensation and/or* • *selection of solvent, and* • *extrusion with degassing of volatile compounds or* • *treatment of cleaned air from degassing silos.*	**Not applicable.** The technique applies to LLDPE production. The planned development project concerns propylene production (PP)	Monomers are recovered in the process before entering in the extruder. In the extruder is released a minimum quantity of gas avoiding emissions in final storages and sending this gas stream to the vent gas system (prevoius low pressure degassing and steaming)	
Operating the reactor at the highest possible polymer concentration. By increasing polymer concentration in the reactor, the overall energy efficiency of the production process is optimized.	In the case of PP production technology in gaseous phase, the proportion of polymer phase in the reactor is determined by maintaining the fluidized bed in the reactor. This is regulated by the velocity of the gas passing through the reactor and the polymer level in the reactor. For the UNIPOL process, the conversion rate is set at 80/85%, which allows optimum use of the energy needed for PP production.	Reaction process according to Licensor technology (lyondellbasell, two reactors in series with a prepoly reactor (liquid and slurry phases) optimizing the energency efficiency	
Use of closed loop cooling systems	**Not applicable.** According to Chapter 12 of the Reference Document on Best Available Techniques in the Production of Polymers of August 2007, the technique concerns polyethylene (PE) production. The planned development project concerns propylene production (PP).	The heat of reaction of the loops is removed by circulating water in the reactors jackets. This is a semi-closed system with integration with the Cooling system of the Complex	

Requirements for the polypropylene production

1. Processes and techniques used in the production of polyolefins

BREF describes the production of polypropylene using the following processes:
- o processes in the gaseous phase (PP Unipol fluidized bed process and PP Novolen and PP Innovene dry bed process),
- o suspension processes.

The updated development project covers the UNIPOL polypropylene production process in the fluidized bed in gaseous phase.

2. BAT-associated emission and consumption levels

Emission and consumption levels for PP production have not been reported. According to BREF, they can be considered equivalent to comparable PE (polyethylene production) processes, i.e. in the case of an updated LLDPE (low density linear polyethylene) production development project, as shown in the Table 4 below:

Table 4. BAT-associated emission and consumption levels (BAT AEL) for LLDPE production

LLDPE	Unit per ton of product	BAT AEL	Ceyhan PDH-PP Project
Monomer Consumption	kg	1015	
Direct energy consumption	GJ	New Units: 2.08 Existing Units: 2.08-2.45	Not applicable .CEYHAN Plant will produce PP not LLDPE
Primary energy consumption	GJ	New Units: 2.92 Existing Units: 2.92 – 4.14	Not applicable .CEYHAN Plant will produce PP not LLDPE
Water consumption	m^3	1.1	
Air emissions			
Dust emission	g	11	
VOC emission	g	New Units: 200 - 500 Existing Units: 500 - 700	Not applicable .CEYHAN Plant will produce PP not LLDPE
Emissions to water			
COD emissions	g	39	Not applicable .CEYHAN Plant will produce PP not LLDPE
Waste			
Neutral waste	kg	1.1	Not applicable .CEYHAN Plant will produce PP not LLDPE
Hazardous waste	kg	0.8	Not applicable .CEYHAN Plant will produce PP not LLDPE

1. Direct energy comprises the consumption of delivered energy
2. Primary energy comprises energy calculated on return to fossil fuels. The following efficiencies were used for the calculation of primary energy: electricity: 40% and steam: 90%
3. Dust covers total dust, as reported by participants
4. VOC includes all hydrocarbons and other organic compounds including non-point emissions. VOC emissions depend on the type of comonomer (200 ppm for 1-butene and 500 ppm for 1-octene)
5. Neutral waste (intended for landfills) in kilograms per ton of product (kg/t)
6. Hazardous waste (intended for processing or incineration) in kilograms per ton of product (kg/ton).

The emission and consumption levels for the production of polyolefins presented in BAT do not refer to PP production. The proposed solutions presents unit consumption and emissions obtained from the Licensor of the PP process.

Emission and consumption levels for PP production determined on the basis of information from the Licensor.

Propylene Monomer consumption: 57125 kg/h
Direct energy consumption: total load 23484 KW
Steam consumption: LP steam 16345kg/h
Cooling Water consumption: 5340 kg/h (max)

Dust emission: TBD
VOC emission: TBD
Hazardous waste TBD
Neutral waste: amount of waste difficult to estimate, it depends on the amount of unit stops/grain size, overhaul of individual pieces of equipment, replacement of filter systems on filters, number of transitions between types and portfolio of produced types.

As regards to energy efficiency of PP and PE processes, BREF indicates that energy consumption is strongly related to the nature of the polymers produced. For example, PP impact copolymers, as well as bimodal PE, often require two or more reactors, resulting in higher wear in the reactor section. Also, the high molecular weight of polymers requires much more energy in the extrusion section. Differences in polymer properties for a given process may result in up to 20% difference in energy consumption between the individual units. In addition, specialized production affects the emission and consumption of a given process.

Requirements for large combustion plants

BAT requirements for combustion sources with a rated thermal power input exceeding 50 MWt are set out in BAT LCP conclusions and are binding. The conclusions require compliance with general (common for all LCPs) and specific BAT, depending on the combusted fuel. General BAT require, i.a., the introduction of an efficient environmental management system and the monitoring of process parameters and emissions. Pollutants emission levels must not exceed BAT-related levels (so-called BAT AELs). In addition, BAT require new units to achieve high energy efficiency (53-58.5%), efficient fuel usage and low emissions.

Table 5 presents an analysis of compliance with BAT LCP conclusions. These requirements apply to the boiler for the production of process steam , installed in the propylene production unit. The boiler will be fired with natural gas, and it will additionally be able to co-fire a process stream of offgas from PDH and PP Units

Table 5. Requirements for BAT LCP Conclusions

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
	It is necessary to ensure the implementation of and compliance with the environmental management system within BAT.	(i) commitment of the management, including senior management; (ii) definition, by the management, of an environmental policy that includes continuous improvement of the environmental performance of the unit; (iii) planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment projects; (iv) implementation of procedures with particular emphasis on: a) structure and responsibility; b) recruitment, training, awareness and competence; c) communication; d) employee involvement; e) documentation; f) efficient process control; g) scheduled regular technical maintenance programs; h) readiness for emergencies and responding thereto; i) ensuring compliance with environmental regulations; (v) verification of efficiency and taking corrective actions, with particular emphasis on: a) monitoring and measurement (see also the JRC reference report on monitoring emissions to the air and water by IED-ROM units); b) corrective and preventive actions; c) record keeping; d) independent (if possible) internal and external audit to determine whether the environmental management system complies with the planned arrangements and whether it is properly implemented andmaintained; (vi) review, by senior management, of the environmental management system and its continuing suitability, adequacy and effectiveness; (vii) following the development of cleaner technologies; (viii) consideration for the environmental impacts from the eventual decommissioning of the unit taken into account at the stage of designing a new facility, and throughout its operating life, including: a) avoiding buried structures; b) incorporating properties that facilitate dismantling; c) choosing surface finishes that are easily decontaminated; d) using an equipment configuration that minimizes trapped chemicals and facilitates drainage or cleaning; e) designing flexible, self-contained equipment that enables phased closure; f) using biodegradable and recyclable materials where possible; (ix) application of sectoral benchmarking on a regular basis; (x) quality assurance/quality control programs to ensure that the characteristics of all fuels are fully determined and controlled (see BAT 9); (xi) management plan in order to reduce emissions to the air or water under abnormal operating conditions, including start-up and shutdown periods (see BAT 10 and BAT 11); (xii) a waste management plan to ensure that waste generation is avoided, prepared for reuse, recycled or otherwise recovered, including the use of techniques given in BAT 16; (xiii) a systematic method to identify and deal with potential uncontrolled or unplanned emissions to the environment, in particular: a) emissions to soil and groundwater from the handling and storage of fuels, additives, by-products and waste; b) emissions associated with self-heating or self-ignition of fuel during its storage and handling-related activities; (xiv) (not applicable) (xv) noise management plan where a noise nuisance at sensitive receptors is expected or sustained, including: a) report for conducting noise monitoring at the plant boundary; b) noise reduction program; c) report on the response to noise incidents containing appropriate actions and schedules; d) review of historic noise incidents, corrective actions and dissemination of noise incident knowledge to the affected parties; (xvi) for the combustion, gasification or co-incineration of malodorous substances, an odor management plan including: a) report on odor monitoring; b) where necessary, odor elimination program to identify and eliminate or reduce odor emissions; c) report to record odor incidents and the appropriate actions and schedules; d) review of historic odor incidents, corrective actions and the dissemination of odor incident knowledge to the affected parties.		The company Zakłady Chemiczne "Police" S.A. implements the Management Policy, which ensures that the company's strategic objectives are achieved on the basis of the Integrated Management System, which complies with international standards. Priorities of the business activity: high quality, care for technical safety and the environment are effectively supervised and ensure effective company management. The Integrated Management System is developed on the basis of the principles of prioritizing the client, minimizing environmental losses and risk of hazards, and continuous improvement. Management systems are based on the continuous improvement concept, through: • establishing a policy, • planning actions to implement the policy, • creation of conditions for the implementation of planned activities, • checking the effects of actions, • improvement on the basis of periodic assessments of the results achieved. The Management Policy adopted in the company defines the objectives and principles related to the whole activity, providing the framework for setting and reviewing the indicated strategic objectives concerning quality, environment, occupational health and safety. Environmental policy is implemented in particular by: • ensuring the highest priority for environmental protection measures; • improvement of technological processes and modernization of pollution reduction equipment; • continuous monitoring of instrumentation and maintenance of environmental protection equipment at high technical efficiency; • promoting and communicating information on environmental protection issues to employees; • selection of suitable suppliers of raw materials and business partners that meet the highest environmental protection requirements. At Grupa Azoty Zakłady Chemiczne "Police" S.A. the following applies: • Quality Management System, compliant with ISO 9001:2008; • Environmental Management System, compliant with ISO 14001:2004; • Energy Management System, compliant with ISO 50001:2011; • Occupational Health and Safety Management System compliant with PN-N 18001:2004 and BS	CEYHAN Plant will have an Environmental Management policy and Integrated or Environmental Management System ,as an example: "XXXXXX S.A. implements/will implement the Management Policy, which ensures that the company's strategic objectives are achieved on the basis of the Integrated/Environemtal Management System, which complies with international standards.... "	Employer to confirm if an Environmental Management policy and Integrated or Environmental Management System is available. If not, Employer to implement an Environmental Management policy and Environmental Management System as requested.

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
				OHSAS 18001:2007; • Food Safety Management System, compliant with ISO 22000:2005; PDH Polska SA has not implemented environmental management systems yet. The implementation of such a system is planned, in line with the policy of Grupa Azoty. The Quality Management System has currently been implemented. Senior management review the environmental management system with a view to continuing suitability of the system, its regularity and effectiveness. The staff at all levels of the company's management are involved in environmental policy and actively participate in the implementation of environmental objectives. The company follows the development of cleaner technologies and takes into account the environmental impact of the development project during both the design phase of the new equipment unit and throughout its lifetime. All the characteristics of the BAT environmental management system are observed.		
2	Determination of the net electrical efficiency or unit fuel consumption or fuel combustion units by carrying out a performance test at full load	BAT are intended to determine the net electrical efficiency or unit net fuel consumption (...) of fuel combustion units by carrying out a performance test at full load, according to EN standards, after the unit handover for operation and after each modification that could significantly affect the net electrical efficiency or unit net fuel consumption or net mechanical efficiency of the unit. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.		Net efficiency of each product as well as efficiency of production fuel consumption will be determined on the basis of thermal and electrical measurements. This will be implemented in accordance with the generally applicable standards. For this purpose, the use of automatic control systems for production processes minimizing energy losses is envisaged.	CEYHAN Plant is not a LCP and therefore no net electrical efficiency or unit fuel consumption or fuel combustion units will be determined by carrying out a performance test at full load	
3	Monitoring of key process parameters applicable to air and water emissions.	Flue gas — monitoring method: periodic or continuous measurements of the following parameters: flowrate, oxygen content, temperature and pressure, steam content (if the sample is not dried before analysis).		Continuous on-line measurement was designed.	Continuous on-line measurement considered	
		Wastewater from flue gas treatment — monitoring method: continuous measurement of the following parameters: flowrate, pH and temperature.		**Not applicable.** No additional flue gas treatment system is planned.	**Not applicable.** No additional flue gas treatment system is planned.	
4	As part of BAT it is necessary to monitor emissions to the air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, it is necessary to use (as part of BAT) ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	*Substance/Parameter* — *Total rated thermal power input* — *Standard* — *Minimum Monitoring Frequency* — *NH3 related monitoring*				
		NH3 — All values — General EN standards — Continuous — BAT7		**Not applicable.** Monitoring of NH3 emissions applies if SCR or SNCR is used. The proposed development project does not provide for the use of SCR or SNCR.	**Not applicable.** Monitoring of NH3 emissions applies if SCR or SNCR is used. The proposed development project does not provide for the use of SCR or SNCR.	
		NOx — All values — General EN standards — Continuous — BAT 20, 24, 28, 32, 37, 41-43, 47, 48, 56, 64, 65, 73		Emissions to the air will be measured continuously in accordance with BAT requirements.	Emissions to the air will be measured continuously in accordance with BAT requirements.	
		N2O — All values — EN 21258 — Once a year — BAT 20, 24		**Not applicable.** Monitoring of N2O emissions shall apply when hard coal or lignite is used as fuel in circulating fluidized bed boilers or solid biomass or peat burned in circulating fluidized bed boilers. The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	**Not applicable.** Monitoring of N2O emissions shall apply when hard coal or lignite is used as fuel in circulating fluidized bed boilers or solid biomass or peat burned in circulating fluidized bed boilers. The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane,	

BAT No.	Technique	Description					BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
									ethane, butane) supplemented with natural gas.	
		CO	All values	General EN standards	Continuous	BAT 20, 24, 28, 33, 38, 44, 49, 56, 64, 65, 73		Emissions to the air will be measured continuously in accordance with BAT requirements.	Emissions to the air will be measured continuously in accordance with BAT requirements.	
		SO2	All values	General EN standards and EN 14791	Continuous	BAT 21, 25, 29, 34, 39, 50, 57, 66, 67, 74		Emissions to the air will be measured continuously in accordance with BAT requirements.	Emissions to the air will be measured continuously in accordance with BAT requirements in the 01-PK-401 VENT GAS TREATMENT in PDH Unit	
		SO3	All values	No standard available	Once a year			**Not applicable.** Monitoring of SO3 emissions applies if SCR or SNCR is used. The proposed development project does not provide for the use of SCR or SNCR.	**Not applicable.** Monitoring of SO3 emissions applies if SCR or SNCR is used. The proposed development project does not provide for the use of SCR or SNCR.	
		Gasoues Chlorides expressed as HCL	All values	EN 1911	Once every three months	BAT 21, 57		**Not applicable.** The applied fuels from chemical processes are not a source of emissions of the pollutants concerned.	Emissions to the air will be measured continuously in accordance with BAT requirements in the 01-PK-401 VENT GAS TREATMENT in PDH Unit during operation, measurements - once every three months	Monitoring by Employer
		HF	All values	No standard available	Once every three months	BAT 21, 57			**Not applicable.** No fluor is used nor present in the process, no HF emissions are expected.	
		Dust	All values	General EN standards and EN 13284-1 and EN 13284-2	Continuous	BAT 22, 26, 30, 35, 39, 51, 58, 75		Emissions to the air will be measured continuously in accordance with BAT requirements.	**Not applicable** BAT requirements not applicable to PP units	
		Metals and metalloids except for mercury (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Se, Tl, V, Zn)	All values	EN 14385	Once a year			**Not applicable.** Monitoring of metal emissions is applicable in the case of combustion of hard coal or lignite, solid biomass or peat, heavy fuel oil and diesel oil, co-incineration of waste and IGCC facilities. The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	**Not applicable.** Monitoring of metal emissions is applicable in the case of combustion of hard coal or lignite, solid biomass or peat, heavy fuel oil and diesel oil, co-incineration of waste and IGCC facilities. The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	
		Hg	Depending on the boiler power output or the fuel used	Depending on the boiler power output or the fuel used	Depending on the boiler power output or the fuel used			**Not applicable.** Monitoring of Hg emissions is applicable in the case of combustion of hard coal or lignite, including co-incineration of waste, solid biomass or peat, and co-incineration of waste with solid biomass or peat, heavy fuel oil and diesel oil and IGCC facilities. The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen,	**Not applicable.** Monitoring of Hg emissions is applicable in the case of combustion of hard coal or lignite, including co-incineration of waste, solid biomass or peat, and co-incineration of waste with solid biomass or peat, heavy fuel oil and diesel oil and IGCC facilities. The fuel used in	

BAT No.	Technique	Description					BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
								methane, ethane, butane) supplemented with natural gas.	the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	
		Total VOC	All values	EN 12619	Once every six months	BAT 33, 59		**Not applicable.** The applied fuels from chemical processes are not a source of emissions of the pollutants concerned.	**Not applicable.** The applied fuels from chemical processes are not a source of emissions of the pollutants concerned.	
		Formaldehyde	All values	No standard available	Once a year	BAT 45		**Not applicable.** Monitoring of formaldehyde emission is applicable to the combustion of natural gas in spark-ignition engines.	**Not applicable.** Monitoring of formaldehyde emission is applicable to the combustion of natural gas in spark-ignition engines.	
		CH4	All values	EN ISO 25139	Once a year	BAT 45		**Not applicable.** CH4 emission monitoring is applicable to natural gas fired engines.	**Not applicable.** CH4 emission monitoring is applicable to natural gas fired engines. No Gas turbines are considered in the CEYHAN Plant	
		PCDD/F	All values	EN 1948-1, EN 1948-2, EN 1948-3,	Once every six months	BAT 59, 71		**Not applicable.** The applied fuels from chemical processes are not a source of emissions of the pollutants concerned.	**Not applicable.** The applied fuels from chemical processes are not a source of emissions of the pollutants concerned.	
5	Within BAT, it is necessary to monitor emissions to water from flue gas treatment with at least the frequency given below and in accordance with EN standards.							**Not applicable.** No additional flue gas treatment system is planned.	**Not applicable.** No additional flue gas treatment system is planned.	
6	In order to improve the general environmental performance of combustion plants and to reduce emissions of CO and unburnt substances to the air, it is necessary to ensure, within BAT, optimized combustion and to use an appropriate combination of the techniques given beside.	a. Fuel blending and mixing - ensuring stable combustion conditions or reducing the emission of pollutants by mixing different qualities of the same fuel type. b. Maintenance of the combustion system — regular scheduled maintenance as recommended by the suppliers. c. Advanced control system. d. Good design of combustion equipment — good design of the furnace, combustion chambers, burners and associated equipment.						A control system will be applied as part of the optimization of the combustion process. In addition, the planned development project involves the installation of only new equipment, which will be subject to regular scheduled inspections and maintenance according to n established schedule. In the event of abnormal operating conditions of the unit, it will be subject to additional inspection.	A control system will be applied as part of the optimization of the combustion process. In addition, the CEYHAN project involves the installation of only new equipment, which will be subject to regular scheduled inspections and maintenance according to Opetation and Maintenance Management scheduled plans . In the event of abnormal operating conditions of the unit, it will be subject to additional inspection.	
7	Optimization of SCR or SNCR design or operation to reduce ammonia emission.						< 3-10 mg/Nm3 NH3 as annual average or average of the sampling period	**Not applicable.** SCR or SNCR will not be used.	**Not applicable.** SCR or SNCR will not be used.	
8	In order to prevent or reduce emissions to the air during normal operating conditions, within BAT it is necessary to ensure,							The planned development project involves the design and delivery of only new equipment, which will be subject to regular scheduled inspections and maintenance according to an established schedule.	The planned development project involves the design and delivery of only new equipment, which will be subject to regular scheduled inspections and	

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
	by appropriate design, operation and maintenance, so that the emission reduction systems are used at optimum capacity and availability.				maintenance according to an established schedule.	
9	In order to improve the general environmental performance of combustion or gasification facilities and to reduce emissions to the air, it is necessary to include, within BAT, the following elements in the quality assurance/quality control programs for all the fuels used, as part of the environmental management system (see BAT 1):	(i) initial full characterization of the fuel used including at least the parameters listed below and in accordance with EN standards; ISO, national or other international standards may be used provided that they ensure the provision of data of an equivalent scientific quality. For natural gas, these are: LHV, CH4, C2H6, C3, C4+, CO2, N2, Wobbe index. (ii) regular testing of the fuel quality to check that it is consistent with the initial characterization and with the facility design specifications. (iii) subsequent adjustment of the facility settings as and when needed and practicable (e.g. integration of the fuel characteristics and control in the advanced control system).		The full characteristics of the fuel used will be developed by the supplier (in terms of natural gas deliveries). As regards fuel gas, the analysis of its composition will be carried out by PDHP at least once a day.	NG and FG characteristics are defined in the Project Design Basis. Regular Testing to check consistnecy to be performed during Plant operation	Monitoring by Employer
10	In order to reduce emissions to air or to water during abnormal operating conditions (OTNOC), it is necessary to set up and implement a management plan withing BAT as part of the environmental management system (see BAT 1), commensurate with the relevance of potential pollutant releases, that includes the following elements:	− appropriate design of the systems considered essential for creating conditions other than normal operating conditions and which may affect emissions to the air, water or soil, − establishment and implementation of a specific preventive maintenance plan for the appropriate systems, − review and recording of emissions caused by abnormal operating conditions and associated circumstances and implementation of corrective actions if necessary, − periodic assessment of overall emissions during abnormal operating conditions (e.g. frequency of events, duration, determination/estimation of emissions) and, if necessary, taking corrective actions.		As part of the Integrated Management System, a management plan and operating procedures will be implemented, in which activities and actions will be defined under normal operating conditions and in abnormal (other than normal) operating conditions.	As part of the Integrated Management System, a management plan and operating procedures will be implemented, in which activities and actions will be defined under normal operating conditions and in abnormal (other than normal) operating conditions. ,	
11	BAT are intended to appropriately monitor emissions to the air or to water during abnormal (other than normal) operating conditions.	Monitoring may be carried out on the basis of direct emission measurement or by monitoring of substitution parameters if it is of equal or better scientific quality than direct emission measurement. Emissions during commissioning and shutdown periods may be assessed on the basis of detailed emission measurements carried out for a typical commissioning/shutdown procedure at least once a year, and by measurement results to estimate emissions for each commissioning/shutdown period in the year.		Monitoring of emission to the air under abnormal operating conditions will be based on online measurement or direct measurement of emissions (if required).	Monitoring of emission to the air under abnormal operating conditions will be based on online measurement or direct measurement of emissions, each type according to requirements indicated in i-BAT #4 of this table.	
12	In order to increase the energy efficiency of combustion, gasification or IGCC units operated ≥ 1,500 h/yr, it is necessary to use, within BAT, an appropriate combination of the	a) Combustion optimization. Combustion optimization minimizes the content of unburned substances in fuel gas and solid combustion residues. b) Optimization of the working medium parameters. Operation at the highest possible pressure and temperature of the gas or steam working medium within the limits of, e.g., NOx emission control or energy demand characteristics c) Optimization of the steam cycle. Operation with lower turbine outlet pressure by applying the lowest possible condenser cooling water temperature in design conditions. d) Minimization of energy consumption for auxiliaries (e.g. higher efficiency of the feed water pump). e) Preheating of combustion air. Reuse of part of the heat recovered from the flue gas to preheat the combustion air. f) Preheating of fuel using recovered heat.		The planned development project includes, i.a.: - application of an advanced I&C system, - the use of a back-pressure turbine in the steam system (cogeneration system meeting the conditions of high-efficiency cogeneration), - an economizer that preheats the water feeding the boiler will be used in the boiler system. The planned development project does not provide for the installation of wet FGDP, so the techniques indicated in points m) and n) will not apply. The fuel used in the high-pressure boiler will be the fuel gas obtained in the process of	The CEYHAN planned project includes, i.a.: - application of an advanced I&C system, - an economizer that preheats the water feeding the boiler will be used in the boiler system. The planned development project does not provide for the installation of wet FGDP (Flue gas desulfurization), so the	

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
	techniques given below:	g) Advanced control system. Electronic control of the main combustion parameters allows for improvement of combustion efficiency. h) Feed water preheating during the regeneration process. Preheating of water drained from the steam condenser during the regeneration process before reusing it in the boiler. i) Heat recovery by cogeneration (CHP). Heat recovery (mainly from the steam system) for the production of hot water/steam for use in industrial processes/industrial activities or in the public district heating system network. Additional recoverability of heat from: flue gas, grate cooling and combustion in circulating bed. j) Combined heat and power (CHP) operation readiness k) Flue gas condenser (general use for CHP units provided that there is sufficient demand for low temperature heat). l) Heat storage in the combined heat and power plant operation mode. m) Wet stack (general application for new and existing units equipped with wet FGDP). n) Flue gas discharge through the natural draft cooling tower. Emissions to the air discharged through the natural draft cooling tower rather than through a special stack (applies to units equipped with wet FGDP). o) Predrying of fuel (in the case of biomass or peat). p) Minimization of heat losses. Reduction of waste heat losses, e.g. occurring in slag, or those that can be reduced by isolation of radiation sources. q) Advanced high-strength materials. The use of advanced high-strength materials has been proven to achieve resistance to high temperature and pressure, thus increasing the efficiency of the steam generation/combustion process. r) Modernization of steam turbines includes techniques such as increasing the temperature and pressure of intermediate pressure steam, addition of low pressure turbine and change in the geometry of the turbine rotor blades s) Supercritical and ultra-supercritical steam parameters. Use of a steam cycle including steam reheating systems, where steam can reach pressure above 220.6 bar and temperature above 374°C under supercritical conditions and above 250-300 bar and above 580-600°C for ultra-supercritical conditions.		propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas, thus predrying of fuel will not apply. The technique referred to in point p) applies only to solid fuel fired units and gasification units. The technique specified in point s) applies only to new units with a capacity of ≥ 600 MW operated over 4000 hours per year. The rated thermal power of the boiler which will be installed within the planned development project will be 72.7 MW.	techniques indicated in points m) and n) will not apply. The fuel used in the high-pressure boiler will be the fuel gas obtained in the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas, thus predrying of fuel will not apply. The technique referred to in point p) Not applicable, only to solid fuel fired units and gasification units. The technique specified in point s) applies only to new units with a capacity of ≥ 600 MW operated over 4000 hours per year. The rated thermal power of the boilers which will be installed within the planned development project will be will be 80MW approx.	
13	To reduce water consumption and the amount of contaminated wastewater discharged, one or both techniques given beside must be used within BAT:	*Technique* / *Description* / *Applicability*				
		Water treatment / Other streams of water, including outflow waters from the facility, are reused for other purposes. The degree of recycling is limited by the requirements for the quality of the collected water stream and by the water balance of the facility. / Not applicable to wastewater from cooling systems in the case of presence of water treatment chemicals or high salt concentrations from seawater.		A stream of wastewater from a high-pressure boiler (blowdown) will be directed to the cooling water system.	Waste Water Treatment System is implemented in the Project in order to handle all The wastes from the Unıts	
		Management of bottom ash from the dry slag handling system. / Dry hot furnace ash falls out of the furnace onto the system of mechanical conveyors and is cooled by air. Water is not used in this process. / For fuel combustion plants only		Not applicable. The technique is only applicable to solid fuel combustion plants. The fuel used in the high-pressure boiler will be the fuel gas obtained in the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	**Not applicable.** The technique is only applicable to solid fuel combustion plants.	
14	To prevent pollution of unpolluted wastewater streams and to reduce emissions to water, wastewater streams should be, as part of BAT, separated and treated separately, depending on their pollutant content.	Wastewater streams, which are usually separated and treated, include surface drainage water, cooling water and wastewater from flue gas treatment.		The planned development project includes the design and construction of separate rainwater (clean and oiled), industrial and grey and blackwater collection systems.	Plant will be provided with separate waste water collection systems. These will be: clean rainwater drainage network, oily water drainage network (included potentially contaminated rainwater) , chemical wastewater drainage network	
15	In order to reduce emissions to water from flue gas	Wastewater streams, which are usually separated and treated, include surface drainage water, cooling water and wastewater from flue gas treatment.		Not applicable. No additional flue gas treatment system is planned.	Not applicable.	

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	treatment, within BAT it is necessary to use an appropriate combination of techniques within BAT as close as possible to the source in order to avoid dilution.				No flue gas treatment system is included in the CEYHAN Project	
16	In order to reduce the amount of waste sent for disposal from combustion or gasification process and pollution reduction techniques, within BAT it is necessary to organize operations to maximize, in accordance with the priority principle and including the lifecycle of the following elements:	a) waste prevention, e.g. maximizing the proportion of residues that are generated as by-products; b) preparation of waste for reuse, e.g. depending on the specific quality criteria required; c) waste recycling; d) other recovery methods (e.g. energy recovery), by an appropriate combination of techniques such as: a. Production of gypsum as a by-product b. Recycling or recovery of residues in the construction sector c. Energy recovery through the use of waste in the fuel mix d. Preparation of the spent catalyst for reuse		Not applicable. The fuel used in the high-pressure boiler will be the fuel gas obtained in the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas, therefore waste from the combustion process will not be generated.	Licensors´design for PDH and PP units have considered the reduction of waste and pollution and improving energy recovery. During Construction and later during Plant Operation appropiate HSE management plans will be applied to ensure compliance to BAT requirements	Plant Operation HSE management Plans by Employer
17	To reduce noise emissions, it is necessary to use within BAT one of the following techniques or a combination of those:	a. Operational measures. These include: - improved control and better maintenance of equipment, - where possible, closing doors and windows in restricted areas, - operation of equipment by experienced staff, - where possible, avoiding noisy activities at night, - ensuring the reduction of noise emission during maintenance operations. b. Low-noise equipment. This may include compressors, pumps and rotating elements. c. Noise reduction. Noise propagation can be also reduced by inserting obstacles between the emitter and the receiver. Suitable obstacles are, for example, noise protection walls, earth barriers and buildings. d. Noise reduction equipment. This includes: silencers, insulation of equipment, enclosing noisy devices, use of sound insulation of buildings. e. Appropriate location of equipment and buildings. Noise levels may be limited by increasing the distance between the emitter and the receiver and using buildings as acoustic barriers.		At the design stage, optimized selection of equipment and its noise insulation, as well as introduction of noise reduction procedures are planned. In addition, relevant noise emission requirements have been specified for the suppliers. Moreover, the subject of design will also cover the optimized location of equipment being the noise sources. Operating measures to reduce noise (control and adequate maintenance of equipment, operation of equipment by qualified staff) will be applied.	To reduce noise emissions at at the design stage, a predictive noise study will be developed in order to implement within the design the following measures, where applicable: b. Low-noise equipment selection. c. Noise reduction, with noise protection walls, earth barriers and buildings. d. Noise reduction equipment with silencers, insulation of equipment, enclosing noisy devices, use of sound insulation of buildings. e. Appropriate location of equipment and buildings. Noise levels may be limited by increasing the distance between the emitter and the receiver and using buildings as acoustic barriers. During Plant Operation appropiate Noise reduction plans will be implemented.	To be revised/ confirmed by Employer
18 - 23	Applies to hard coal or lignite combustion.			**Not applicable.** The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	**Not applicable.** Only applicable to solid fuel combustion plants (hard coal or lignite).	
24 - 27	Applies to solid biomass or peat combustion.			**Not applicable.** The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	**Not applicable.** Only applicable to solid fuel combustion plants (solid biomass or peat combustion).	
28 - 39	Applies to liquid fuel combustion.			**Not applicable.** The fuel used in the high-pressure boiler will be the fuel gas obtained by the process of propane	**Not applicable.** No liquid fuel is considered , only FG and NG .Only	

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
				dehydrogenation (mainly hydrogen, methane, ethane, butane) supplemented with natural gas.	applicable to liquid fuel combustion plants.	
40	In order to increase the energy efficiency of natural gas combustion, it is necessary to use within BAT an appropriate combination of techniques as given in BAT 12 and a. Combined cycle		Net electrical efficiency: 39-42.5% Unit net fuel consumption: 78-95 % Net mechanical efficiency: No BAT-AEEL	The design of the steam generation station assumes the selection of equipment providing unit net fuel consumption of > 78%. Combined cycle does not apply to boilers.	The design of the steam generation Unit specifies Boiler Fuel Efficiency of 90% mimimun. The steam generation is performed by utility boilers , there is not a Combined cycle in the scope of the CEYHAN Plant.	
41	To prevent or reduce NOx emission to the air from the combustion of natural gas in boilers, it is necessary to use one of the techniques or a combination of those within BAT.	a. Phased feeding of air or fuel b. Flue gas recirculation c. Low NOx emission (LNB) burners d. Advanced control system e. Reducing the temperature of the combustion air		In order to reduce NOx emission in the newly designed boiler, it is planned to use the following techniques: - phased air feeding, - flue gas recirculation, - advanced control system	In order to reduce NOx emission in the newly designed boiler, it is planned to use the following techniques to be confirmed with Vendor final design: a. Phased feeding of air or fuel b. Flue gas recirculation c. Low NOx emission (LNB) burners d. Advanced control system	
		f. Selective non-catalytic reduction (SNCR)		**Not applicable.** Selective non-catalytic reduction will not be applied.	**Not applicable.** Selective non-catalytic reduction will not be applied.	
		g. Selective catalytic reduction (SCR)		**Not applicable.** Selective non-catalytic reduction will not be applied.	**Not applicable.** Selective catalytic reduction will not be applied.	
42	To prevent or reduce NOx emission to the air from the combustion of natural gas in gas turbines, it is necessary to use one of the following techniques or a combination of those within BAT:	a. Advanced control system b. Water/steam addition c. Low NOx emission dry burners (DLN), d. Design for low loads Adaptation of process control methods and related equipment to achieve good combustion efficiency, with variable energy demand, e.g. improving the range of the intake air flow regulation or separating the combustion process into stages. e. Low NOx (LNB) burners applicable to additional after-combustion for heat recovery steam generators (HRSG) in the case of combustion plants comprising a combined cycle gas turbine (CCGT) f. Selective catalytic reduction (SCR)		**Not applicable.** The planned development project does not provide for the use of natural gas fired turbines.	**Not applicable.** The planned development project does not provide for the use of turbines.	
43	To prevent or reduce NOx emission to the air from the combustion of natural gas in engines, it is necessary to use one of the following techniques or a combination of those within BAT.			**Not applicable.** It is not planned to use natural gas in engines.	**Not applicable.** The planned development project does not provide for the use of non-electrical engines.	
44	In order to prevent or reduce CO emission to the air from the combustion of natural gas, it is necessary to guarantee optimum combustion or the use of oxidizing catalysts within BAT.	Indicatively, the average annual CO emission level will generally amount to < 5-15 mg/Nm3 for new boilers.		Optimum combustion will be carried out by an automatic regulation system, the operation of which will be periodically verified according to the manufacturer's recommendations.	Optimum combustion will be carried out by an automatic regulation system, the operation of which will be periodically verified according to the manufacturer's recommendations. Project will comply with BAT (BAT-AELs) for CO emission.	Operation verification by Employer
	Emission levels related to BAT (BAT-AELs) for NOx emission to the air			**Not applicable.** The boiler will be operated as part of the planned development project.	**Not applicable.** The planned development	

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
	from the combustion of natural gas in gas turbines				project does not provide for the use of turbines.	
	Emission levels related to BAT (BAT-AELs) for NOx emission to the air from the combustion of natural gas in boilers and engines		10-60 mg NOx /Nm3 (annual average) 30-85 mg NOx /Nm3 (daily average or average value of the sampling period)	Emission levels related to BAT will be maintained.	Emissions to the air will from the combustion of natural gas in the Utility Boilers will comply with BAT (BAT-AELs) for NOx emission.	
45	Applies to the use of gas in spark ignition engines.			**Not applicable.** The planned development project does not provide for the use of spark ignition engines.	**Not applicable.** The planned development project does not provide for the use of spark ignition engines.	
46-51	Applies to the combustion of process gases generated in the production of iron and steel.				**Not applicable.** The planned development project does not provide for the production of iron and steel.	
52-54	Applies to the combustion of gaseous or liquid fuels on offshore platforms.				**Not applicable.** The planned development project does not provide for the combustion of process gases on offshore platforms.	
55	In order to improve the overall environmental performance of combustion of process fuels from the chemical industry in boilers, it is necessary to use an appropriate combination of techniques given in BAT 6 and below within BAT.	Pretreatment of process fuels from the chemical industry Energy efficiency: Net electrical efficiency: 39 -42.5%. Unit net fuel consumption: 78-95%.		The fuel gas and the spent solvent (from the propane dehydrogenation unit) do not require pretreatment. The design of the steam generation station assumes the selection of equipment providing unit net fuel consumption of >78%.	The fuel gas and the spent solvent (from the propane dehydrogenation unit) do not require pretreatment. The design of the steam generation Unit specifies Boiler Fuel Efficiency of 90% mimimun.	
56	In order to prevent or reduce NOx emission to the air while reducing CO emission from the combustion of process fuels from the chemical industry, it is necessary to use one of the following techniques or a combination of those within BAT	a. Low NOx emission burners (LNB) b. Phased air feeding c. Phased fuel feeding d. Flue gas recirculation e. Water/steam addition f. Fuel choice g. Advanced control system h. Selective non-catalytic reduction (SNCR) i. Selective catalytic reduction (SCR)		In order to reduce NOx emission in the newly designed boiler, it is planned to use the following techniques: - phased air feeding, - flue gas recirculation, - advanced control system	In order to reduce NOx emission in the newly designed boiler, it is planned to use the following techniques to be confirmed with Vendor final design: a. Phased feeding of air or fuel b. Flue gas recirculation c. Low NOx emission (LNB) burners d. Advanced control system	
		Indicatively, the average annual CO emission level will generally amount to < 5-30 mg/Nm3 for new boilers. 30-85 mg NOx /Nm3 (annual average) 50-110 mg NOx /Nm3 (daily average or average value of the sampling period)		Optimum combustion will be carried out by an automatic regulation system, the operation of which will be periodically verified according to the manufacturer's recommendations.	Optimum combustion will be carried out by an automatic regulation system, the operation of which will be periodically verified according to the manufacturer's recommendations.	Operation verification by Employer
57	In order to reduce SOx, HCl and HF emission to the air from the combustion of process fuels from the chemical industry in boilers, it is necessary	- Fuel choice - Injection of sorbent into the boiler (to the furnace or to the bed) - Dosing of sorbent to the flue gas duct (flue gas DSI) - Spray dryer absorber (SDA) - Wet cleaning - Wet flue gas desulfurization (Wet FGDP) - flue gas desulfurization (FGDP) based on seawater		Chemical process fuel does not contain sulfur, HCL and HF compounds.	Chemical process fuel does not contain sulfur, HCL and HF compounds.	

BAT No.	Technique	Description	BAT AEL	Description of the method of compliance with BAT, envisaged by the reference project	Description of the method of compliance with BAT, envisaged by the Ceyhan PDH-PP project	REMARKS FOR EMPLOYER CONSIDERATION
	to use one of the following techniques or a combination of those within BAT.					
58	In order to reduce emission of dust, metals contained in dust and trace elements to the air from the combustion of process fuels from the chemical industry in boilers, it is necessary to use one of the following techniques or a combination of those within BAT.	- Electrostatic Precipitator - Bag filter - Fuel choice - Dry or semi-Dry FGDP system - Wet flue gas desulfurization		Dust emission from used fuels from chemical processes is not expected	Dust emission from fuels is not expected to be beyond accepted limits	
59	In order to reduce emission of volatile organic compounds and polychlorinated dibenzodioxines and dibenzofurans to the air from the combustion of process fuels from the chemical industry in boilers, it is necessary to use one of the techniques given in BAT 6 and below or a combination of those within BAT.	- Injection of activated carbon - Cooling injection using wet cleaning/flue gas condenser. - SCR		**Not applicable** - the used fuels from chemical processes are not a source of emission of the pollutants concerned.	**Not applicable** - the used fuels from chemical processes are not a source of emission of the pollutants concerned.	
60-71	Applies to incineration or co-incineration of waste.			**Not applicable.** The planned development project does not provide for incineration or co-incineration of waste.	**Not applicable.** The project scope does not includes incineration or co-incineration of waste facilities.	
72-75	Applies to gasification facilities directly related to combustion plants and IGCC facilities.			**Not applicable.** The planned development project does not provide for gasification.	**Not applicable.** The project scope does not includes gasification or IGCC Units.	

The unit has been designed considering energy efficiency. Consumption of raw materials, energy and utilities will be monitored and emission levels will not exceed regulatory levels.

Table 6 presents an analysis of compliance with the requirements of BAT CWW Conclusions. The requirements of BAT CWW Conclusions apply to the planned PDH unit and PP unit together with their auxiliary systems.

Table 6. Analysis of compliance with the requirements of BAT CWW Conclusions

BAT No	BAT	Techniques / AEL	Reference Project Compliance analysis	Compliance analysis for Ceyhan PDH-PP Project	REMARKS FOR EMPLOYER CONSIDERATION
1	In order to improve the general environmental performance, it is necessary, within BAT, to implement and adhere to an environmental management system that incorporates all of the following properties:	(i) commitment of the top management, including senior management; (ii) an environmental policy that includes continuous improvement of the unit by the management; (iii) planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment projects; (iv) implementation of procedures paying particular attention to: a) structure and responsibility; b) recruitment, training, awareness and competence; c) communication; d) employee involvement; e) documentation; f) efficient process control; g) technical maintenance programs; (h) readiness for emergencies and responding thereto; i) ensuring compliance with environmental regulations; (v) verification of performance efficiency and taking corrective actions, with particular emphasis on: a) monitoring and measurement (see also the reference report on monitoring emissions to the air and water by IED-ROM units); b) corrective and preventive actions; c) record keeping; d) independent (if possible) internal and external audit to determine whether the environmental management system complies with the planned arrangements and whether it is properly implemented and maintained; (vi) review, by senior management, of the environmental management system and its continuing suitability, adequacy and effectiveness; (vii) following the development of cleaner technologies; (viii) taking into account, at the design stage of the new equipment unit and throughout its lifetime, the environmental effects resulting from the final decommissioning of the equipment unit; (ix) application of sectoral benchmarking on a regular basis; (x) waste management plan (see BAT 13). In particular, for activities in the chemical sector, it is necessary to take into account the following properties of the environmental management system within BAT: (xi) with regard to units/facilities where different operators operate, establishing rules defining roles, responsibilities and coordination of operational procedures for each operator of an equipment unit in order to strengthen cooperation between different operators; (xii) establishment of waste water and waste gas stream lists (see BAT 2). In some cases, the following elements form a part of the environmental management system: (xiii) an odor management plan (see BAT 20); (xiv) a noise management plan (see BAT 22).	Appropriate management systems operate in the GAP. They will also be implemented in PDH Polska SA. The existing elements of the system will be complemented by the elements required by BAT, i.e. the list of wastewater and waste gas stream and the odor management plan and noise management plan, if necessary.	. PDH-PP CEYHAN Plant Management will implement environmental management system required by BAT, i.e. the list of wastewater and waste gas stream and the odor management plan and noise management plan, if necessary.	Employer to confirm if an Environmental Management policy and Integrated or Environmental Management System is available. If not, Employer to implement an Environmental Management policy and Environmental Management System as requested.
2	In order to facilitate the reduction of emissions to water and air and reduce water consumption, it is necessary to establish and maintain, within BAT, a		The wastewater stream list was prepared at the FEED stage (presented in this report) and it will be further developed.	The wastewater stream list was prepared at the FEED stage and it will be further	

BAT No	BAT	Techniques / AEL	Reference Project Compliance analysis	Compliance analysis for Ceyhan PDH-PP Project	REMARKS FOR EMPLOYER CONSIDERATION
	wastewater and waste gas stream list as part of an environmental management system (see BAT 1) that incorporates all of the following properties: (i) information on chemical production processes, including: a) formulas of chemical reactions, showing also by-products; b) simplified process sequence diagrams showing the origin of the emissions; c) descriptions of the process-integrated techniques, and of the treatment of wastewater/waste gases at source, including their effectiveness; (ii) information on the properties of wastewater streams, as comprehensive as reasonably practicable, such as: a) mean values and variability of flow rate, pH, temperature and conductivity; b) average concentration and values of the given pollution loads/parameters and their variability (e.g. COD/TOC, nitrogen forms, phosphorus, metals, salts, specific organic compounds); c) biodegradability data (e.g. BOD, BOD/COD ratio, Zahn-Wellens test, biological inhibition potential (e.g. nitrification)), (iii) information on the properties of waste gas streams, as comprehensive as reasonably practicable, such as: a) mean values and variability of flow rate and temperature, b) average concentration and values of the given pollution load/parameters and their variability (e.g. VOC, CO, NOx, SOx, chlorine, hydrogen chloride), c) flammability, upper/lower explosive limit, reactivity, presence of other substances likely to affect the waste gas treatment system or safety of the equipment unit (e.g. oxygen, nitrogen, steam, dust).			developed during detailed design in EPC stage	
3	For the relevant emissions to water specified in the wastewater stream list (see BAT 2), within BAT it is necessary to monitor key process parameters (including continuous monitoring of wastewater flow, pH and temperature) at key locations (e.g. wastewater inflow — pretreatment, wastewater inflow — final treatment).		Key parameters of water consumption and wastewater discharge will be monitored in accordance with BAT and internal GAP requirements.	Key parameters of water consumption and wastewater discharge will be monitored in accordance with BAT.	
4	Within BAT it is necessary to monitor emissions to water according to EN standards at least with the minimum frequency given in the conclusions. If EN standards are not available, it is necessary to use within BAT: ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	Daily:total organic carbon (TOC), chemical oxygen demand (COD), total suspended matter, total nitrogen, total inorganic nitrogen, total phosphorus Monthly: absorbable organic halogenated compounds (AOX), metals (Cr, CU, Ni, Pb, Zn and other metals, if applicable) To be determined on the basis of a risk assessment, after preliminary characterization: toxicity (hard roe, daphnia, luminescent bacteria, duckweed, algae)	The wastewater generated will not be introduced directly into the waters. Wastewater will be introduced into the industrial wastewater drainage system of GAP and PDH Polska S.A. and then into the internal mechanical and chemical wastewater treatment plant. The quality of wastewater will be monitored.	The wastewater generated will not be delivered to sea. Wastewater will be collected in the drainage system of CEYHAN PLANT and then treated in wastewater treatment plant. The quality of wastewater Plant effluent will be monitored during plant operation	Monitoring by Employer
5	Within BAT it is necessary to periodically monitor non-point emissions of VOC to the air from the relevant sources using an appropriate combination of techniques I — III, or, when a large quantity of VOC is treated, all techniques I — III.	I. Odor detection methods (e.g. using portable instruments according to EN 15446) in combination with correlation curves for key equipment. II. Optical gas imaging methods. III. Calculation of emissions based on emission factors verified periodically by measurements (e.g. once every two years). When a large quantity of VOC is treated, a useful technique, which is complementary to techniques I-III, is to control and quantify emissions from units on a periodic basis using absorptive optical techniques such as differential absorption lidar (DIAL), or solar occultation flux (SOF).	Equipment with a high level of integrity will be used to prevent non- point VOC emissions. Where non- point VOC emissions are found, these emissions will be monitored in accordance with BAT requirements	Equipment with a high level of integrity will be used to prevent non- point VOC emissions. Where non- point VOC emissions are found, these emissions will be monitored in accordance with BAT requirements Detection and monitoring of VOC will be perfomed during Plant Operation	To be revised /confirmed by Employer
6	Within BAT it is necessary to regularly monitor odor emissions from relevant sources in accordance with EN standards	Emissions can be monitored using dynamic olfactometry in accordance with EN 13725. Emission monitoring may be supplemented by measurement or estimation of exposure to odors or assessing the effects of such exposure.	The process of that unit is designed so that emission of odorous substances is impossible. Small amounts of sulfur compounds existing in the process are adequately neutralized and discharged with the wastewater. If odor	If small amounts of sulfur compounds exists in the process, it will be adequately neutralized and discharged with the wastewater. If odor emissions are found,	

BAT No	BAT	Techniques / AEL	Reference Project Compliance analysis	Compliance analysis for Ceyhan PDH-PP Project	REMARKS FOR EMPLOYER CONSIDERATION
			emissions are found, these emissions will be monitored in accordance with BAT requirements.	these emissions will be monitored in accordance with BAT requirements.	
7	In order to reduce water consumption and wastewater generation, within BAT it is necessary to reduce the amount and/or load of pollutants in wastewater streams in order to increase the reuse of wastewater in the production process and for recovery and reuse of raw materials.		The FEED assumes the maximum possible recovery of water and condensate, i.a., through the selection of appropriate equipment and application of stream returns.	The FEED assumes the maximum possible recovery of water and condensate, i.a., through the selection of appropriate equipment and application of stream returns.	
8	In order to prevent pollution of unpolluted water and reduce emissions to water, within BAT it is necessary to separate unpolluted wastewater streams from wastewater streams requiring treatment.	The existing wastewater collection systems do not allow separation of unpolluted rainwater.	The planned development project includes the design and construction of separate rainwater (clean and oiled), spent cooling water, industrial and grey and blackwater collection systems.	The CEYHAN project considers the design and construction of separate rainwater (clean and oiled), spent cooling water, industrial and grey and blackwater collection systems.	
9	In order to prevent uncontrolled emissions to water, it is necessary to ensure, within BAT, an adequate capacity of the buffer tank of wastewater generated under conditions other than normal operating conditions based on a risk assessment (including, e.g., type of pollution, impact on further treatment and the receiving environment), and take appropriate further measures (e.g. inspections, processing, reuse).	Temporary storage of polluted rainwater requires segregation, which may not apply to the existing wastewater collection systems.	The wastewater will be discharged into the wastewater drainage systems of GAP and PDH Polska S.A. The FEED assumes the construction of two independent connections to the GAP drainage systems. The existing treatment systems provide a high degree of wastewater control and capacities that ensure the retention of wastewater under other than normal conditions	The wastewater will be discharged into the wastewater drainage systems of CEYHAN Plant. The FEED .The waste water treatment systems provide a high degree of wastewater control and capacities that ensure the retention of wastewater under other than normal conditions	
10	In order to reduce emissions to water, it is necessary to use an integrated wastewater management and treatment strategy within BAT, including an appropriate combination of techniques in the below sequence. The integrated wastewater management and treatment strategy is based on the wastewater stream list.	a) Process-integrated techniques - techniques to prevent or reduce water pollution generation. b) Recovery of pollutants at source - techniques to recover pollutants before they are discharged into the wastewater collection system. c) Wastewater pretreatment (1)(2) - techniques to reduce pollutants before final wastewater treatment. Pretreatment may be carried out at source or in combined streams. d) Final wastewater treatment, e.g. by pretreatment and primary treatment, biological treatment, removal of nitrogen, phosphorus and/or final removal of solids before discharge into the water receiver (3).	The FEED assumes the maximum possible recovery of water and condensate, i.a., through the selection of appropriate equipment and application of stream returns. The unit will use pretreatment technology (WAO) and flocculation process. Final wastewater treatment will take place in the GAP treatment systems.	The unit will use pretreatment technology and flocculation process in order to reduce emissions to water . Final wastewater treatment will take place in the CEYHAN treatment systems	
11	In order to reduce emissions to water, within BAT it is necessary to pretreat wastewater containing pollutants that cannot be adequately handled during the final treatment of wastewater using appropriate techniques.	Wastewater pretreatment is carried out as part of a comprehensive wastewater management and treatment strategy (see BAT 10) and is essentially necessary in order to: — protect the final wastewater treatment plant (e.g. to protect the wastewater biological treatment plant against inhibitors or toxic compounds), — remove compounds that have been reduced inadequately during final treatment (e.g. toxic compounds, poorly/non-biodegradable organic compounds, organic compounds that are present in high concentrations, or metals during biological treatment), — remove compounds which are otherwise released into the air from the collection system or during final treatment (e.g. volatile organic halogen compounds, benzene), — remove compounds that have other adverse effects (e.g. equipment corrosion, adverse reactions with other substances, pollution of wastewater sludge). In general, pretreatment is carried out as close as possible to the source in order to avoid dilution, especially for metals. Sometimes wastewater streams of given properties can be segregated and collected in order to undergo special combined treatment.	The FEED assumes the maximum possible recovery of water and condensate, i.a., through the selection of appropriate equipment, i.a. centrifugal separators and application of stream returns. The unit will use pretreatment technology (WAO) and flocculation process. Pretreatment will take place in units located directly at the production facilities. Final wastewater treatment will take place in the GAP treatment systems.	The unit will use pretreatment technology and flocculation process in order to reduce emissions to water . Final wastewater treatment will take place in the CEYHAN treatment systems	
12	In order to reduce emissions to water, it is necessary to use an appropriate combination of final wastewater treatment techniques within BAT.	- pretreatment and primary treatment (balancing, neutralization, physical separation) - biological treatment (activated sludge process, membrane bioreactor) - nitrogen removal (nitrification) - phosphorus removal (chemical precipitation)	Wet air oxidation (WAO) and flocculation processes are envisaged as part of pretreatment. Final wastewater treatment will take place in the GAP treatment systems.	The unit will use pretreatment technology and flocculation process in order to reduce emissions to water . Final wastewater treatment will take place in the CEYHAN treatment systems	

BAT No	BAT	Techniques / AEL	Reference Project Compliance analysis	Compliance analysis for Ceyhan PDH-PP Project	REMARKS FOR EMPLOYER CONSIDERATION
		- final removal of solids (coagulation and flocculation, sedimentation, filtration, floatation) B26			
13	In order to prevent waste formation or, where this is not possible, to reduce the amount of waste sent for remediation, within BAT it is necessary to adopt and implement a waste management plan as part of an environmental management system (see BAT 1) in which waste prevention, preparation for reuse, recycling or other recovery shall be ensured (in the given sequence).	It is necessary to adopt and implement a waste management plan within BAT as part of an environmental management system (see BAT 1) in which waste prevention, preparation for reuse, recycling or other recovery shall be ensured (in the given sequence).	The waste management plan will be developed and approved as part of the integrated permit procedure.	The waste management plan will be developed and approved as part of the integrated permit procedure.	
14	In order to reduce the amount of wastewater sludge requiring further treatment or remediation and to reduce its potential environmental impact, it is necessary to use one of the below techniques or a combinations of those within BAT.	- conditioning - compacting/dewatering - stabilization - drying	The FEED assumes the maximum possible recovery of water and condensate, i.a., through the use conditioning and compacting/dewatering processes.	The unit will use pretreatment technology and flocculation process in order to reduce emissions to water . Final wastewater treatment will take place in the CEYHAN treatment systems	
15	In order to facilitate the recovery of compounds and reduce emissions to the air, it is necessary to consider emission sources and to treat emissions within BAT, where possible.	It is necessary to consider emission sources and to treat emissions within BAT where possible	Emissions to the air will be reduced by the use of fuel gas and natural gas as fuel. In addition, as part of the propane dehydrogenation unit, where adequate protection is required, wet cleaning (removal of sulfur and chlorine compounds) was applied. Gases from the ventilation of tanks and units and those released in emergency situations will be burned in the flare.	Emissions to the air will be reduced by the use of fuel gas and natural gas as fuel. In addition, Vents from tanks and units and those released in emergency situations will be burned in the flare. Besides Contaminated gas will be treated in PDH 01-PK-401 Vent Gas Treatment Package and N-VIRO Unit(UOP Technology)	
16	In order to reduce emissions to the air, it is necessary to use an integrated waste gas management and waste gas treatment strategy, including process-integrated techniques and waste gas treatment techniques within BAT.	The integrated waste gas management and waste gas treatment strategy is based on the waste gas stream list (see BAT 2), giving priority to process-integrated techniques.	As part of the reduction of emissions to the air, an integrated waste gas treatment strategy (use of sodium lye for wet cleaning) will be applied, including a process- integrated technique (use of lye at the demineralized water preparation station).	Emissions to the air will be reduced by the use of fuel gas and natural gas as fuel. In addition, Vents from tanks and units and those released in emergency situations will be burned in the flare. Besides Contaminated gas are treated in PDH 01-PK-401 Vent Gas Treatment Package and N-VIRO Unit(UOP Technology)	
17	In order to prevent emissions to the air from the flare, it is necessary to apply combustion in the flare only for safety reasons or for non-routine operating conditions (e.g. start-up and shutdown), using one or both of the below techniques within BAT.	a) Proper design of the equipment unit b) Management of the equipment unit	In order to prevent emissions to the air, correct design and management of the equipment unit was applied (e.g. use of safety valves with a high level of integrity, application of advanced process control). The flare will operate exclusively in non- routine situations and in case of failure. For safety, the flare will be equipped with a “candle” to ensure ignition of gases if necessary.	In order to prevent emissions to the air, correct design and management of the equipment unit was applied (e.g. use of safety valves with a high level of integrity, application of advanced process control). The flare will operate exclusively in non-routine situations and in case of failure. For safety, the flare will be equipped with a “candle” to ensure ignition of gases if necessary	
18	In order to reduce emissions to the air from the flare, in case combustion is unavoidable there, it is necessary to use one or both of the below techniques within BAT.	a) Proper design of the equipment for combustion in the flare b) Monitoring and recording of data within flare management	The flare will operate in non-routine situations and in case of failure. The constant flow rate of discharge gases from the PP unit (containing approximately 96% of nitrogen) was taken into account in the flare design. For safety, the flare will be equipped with “pilot” burners to ensure gas ignition if necessary.	The flare will operate in non-routine situations and in case of failure. The constant flow rate of discharge gases from the PP unit (containing approximately 96% of nitrogen) was taken into account in the flare design. For safety, the flare will be equipped with “pilot” burners to ensure gas ignition if necessary.	
19	In order to prevent or, where this is not possible, to reduce non-point VOC emissions, it is necessary to use one of the below techniques or a combination of those within BAT.	Equipment unit design techniques a) Reduction of the number of possible emission sources b) Maximization of process-related sealing measures c) Selection of equipment with a high level of integrity d) Improvement of maintenance activities by providing access to elements where potential leaks may occur. Techniques related to the construction of equipment units/equipment, assembly and start-up thereof e) Provision of strictly defined and comprehensive procedures for the construction and assembly of the equipment unit/equipment. This includes the use of the designed gasket stress for flanged connection. f) Ensuring solid start-up procedures for the equipment	Non-point emission sources will be reduced and measures to prevent non-point emissions will be taken. Equipment with a high level of integrity will be used. Elements where potential leaks may occur will be identified and access to these elements will be provided for proper maintenance. Manuals will be available for each piece of equipment/instrument that is part of the unit. Procedures for start-up and stopping equipment and procedures for decontamination of the unit prior to handover for overhaul will be developed. Appropriate technical support and timely replacement of	Non-point emission sources will be reduced and measures to prevent non-point emissions will be taken. Equipment with a high level of integrity will be used. Elements where potential leaks may occur will be identified and access to these elements will be provided for proper maintenance. Manuals will be available for each piece of equipment/instrument that is part of the unit. Procedures for start-up and stopping equipment and procedures for decontamination of the unit prior to handover for overhaul will be developed. Appropriate technical support and timely	

BAT No	BAT	Techniques / AEL	Reference Project Compliance analysis	Compliance analysis for Ceyhan PDH-PP Project	REMARKS FOR EMPLOYER CONSIDERATION
		unit/equipment and procedures for inspection transfer in accordance with design requirements. Techniques related to operation of the equipment unit g) Ensuring appropriate maintenance and timely replacement of equipment h) Use of a risk analysis based leak detection and repair (LDAR) program i) To the reasonable extent, prevention of non-point VOC emissions, collection thereof at source and treatment	equipment will be ensured. An inspection and overhaul program will be developed	replacement of equipment will be ensured. An inspection and overhaul program will be developed Besides Contaminated gas will be treated in PDH 01-PK-401 Vent Gas Treatment Package and N-VIRO Unit(UOP Technology)	
20	In order to prevent or, where this is not possible, to reduce odor emissions , it is necessary to develop, implement and regularly review the odor management plan within BAT as part of the environmental management system (see BAT 1), which includes all of the following elements:	(i) report containing relevant actions and schedule; (ii) odor monitoring report; (iii) report on the response to identified odor incidents; (iv) odor prevention and reduction program, aimed at identifying odor sources, measurement/estimation of odor exposure, identification of the proportion of the individual sources, and introduction of prevention or reduction measures. The related monitoring is described in BAT 6.	This technique is applicable where an arduous odor can be expected or found to occur. The process of that unit is designed so that emission of odorous substances is impossible. Small amounts of sulfur compounds existing in the process are adequately neutralized and discharged with the wastewater. Where odors are found, an odor management plan shall be developed and implemented, including all the elements required by BAT. This plan will be part of an integrated management system	If small amounts of sulfur compounds exists in the process, it will be adequately neutralized and discharged with the wastewater. If odor emissions are found, these emissions will be monitored in accordance with BAT requirements.	
21	In order to prevent odor emissions during wastewater collection and treatment and sludge treatment, or, where this is not possible, to reduce them, it is necessary to use one of the below techniques or a combination of those within BAT:	a) Minimization of the residence time b) Chemical treatments c) Optimization of aerobic decomposition d) Casing e) Pipe end techniques	Wastewater will be pretreated in units located directly at the production facilities. The design of pretreatment of spent sodium lye assumes storage of this wastewater under anaerobic conditions.	Wastewater will be pretreated in units located directly at the production facilities. The design of pretreatment of spent sodium lye assumes storage of this wastewater under anaerobic conditions.	
22	In order to prevent or, where this is not possible, to reduce noise emissions , it is necessary to develop and implement a noise management plan as part of the environmental management system within BAT (see BAT 1), which includes all of the following elements:	(i) report containing relevant actions and schedule; (ii) noise monitoring report; (iii) report on the response to identified noise incidents; (iv) noise prevention and reduction program designed to identify noise sources, measure or estimate noise exposure, determination of the share of the individual sources and implementation of prevention or reduction measures	This technique is applicable where an arduous noise can be expected or found to occur. Detailed modeling of noise taking into account the noise generated by the existing GAP equipment was developed within the EIA report. If noise is found in noise-sensitive areas, a noise management plan containing all the elements required by BAT will be developed and implemented. This plan will be part of an integrated management system.	The project has Noise limits (specifications/ Philosophies/ Plan) that must be fulfilled by the equipment suppliers, the noise limits will be required during requisition stage, and the vendor must submit a Noise Data Sheet to ensure the compliance with the project specifications/ Philosophies. Additionally, a project deliverable, is the Noise Study which identify the noise sources and also consider the required measures for noise reduction	
23	In order to prevent or, where this is not possible, to reduce noise emissions, it is necessary to use one of the below techniques or a combination of those within BAT.	a) Appropriate location of equipment and buildings. b) Operational measures c) Low-noise equipment d) Noise control equipment e) Noise reduction	At the design stage, optimized selection of equipment and its noise insulation, as well as introduction of noise reduction procedures are planned. In addition, relevant noise emission requirements have been specified for the suppliers. Moreover, the subject of design will also cover the optimized location of equipment being the noise sources. To sum up, the design assumes application and location of acoustic power reduction equipment ensuring compliance with the noise emission limits in sensitive areas, in the vicinity of the plant during day and night time. Operational measures to reduce noise (control and adequate maintenance of equipment, operation of equipment by qualified staff) will be applied.	The project has Noise limits (specifications/ Philosophies/ Plan) that must be fulfilled. Additionally, a project deliverable, is the Noise Study which identify the noise sources and also consider the required measures for noise reduction	

14.3 Comparison of the proposed technique with the best available techniques (Article 66 section 5 of the EIA Act) — handling and storage terminal

Table 7 below summarizes the requirements and BAT guidelines contained in the individual documents relating to the handling and storage terminal.

In particular, the BAT reference document on the best available techniques for emissions from storage, July 2006, was taken into account.

Table 7. BAT analysis for the handling and storage terminal

BAT guidelines	Referenced Project Proposed solutions according to the terminal concept	Ceyhan PDH-PP Project Proposed Solutions
BREF requirements for emissions from storage		
BAT for correct designing of tanks should take into account: ❖ Physico-chemical properties of substances; ❖ Degree of provided instrumentation and information on deviations from normal process conditions (alarms); ❖ Deviation protection system (safety instructions, locking systems, leak detection and reduction, etc.) ❖ Maintenance and control plans ❖ Prevention of emergency situations including distances from other tanks, effective fire protection;	All described elements of the correct tank designing were and will be kept. The Projmors offshore terminal concept (and update by Biproraf) including appendices (i.a. HAZID reports of August 2016, as well as fire protection guidelines for the updated terminal concept of 2018 and control system assumptions) meet the requirements described in BAT.	❖ All described elements of the correct tank designing were and will be kept. ❖ In addition, storage tank to be installed, largely taking account of past experience of the product (construction materials, quality of valves, types of pumps, etc.) ❖ The necessary action items specified in the HAZOP/SIL recommendation prepared during FEED phase shall be implemented during EPC period and those meet requirements described in BAT.
BAT for the tools used for establishing proactive risk based maintenance and development plans	As a result of the HAZOP analysis, several necessary actions (in the scope of the Investor and the EPC contractor activities) related to the above-mentioned maintenance plans and management of terminal overhauls were identified.	Company shall apply following risk-based tools to prioritize mainteanance activities in such a way as to meet risk-based safety/reliability goals ❖ Risk Based Inspection (RBI) ❖ Reliability, Availability and Maintainability (RAM) ❖ Reliability Centered Maintenance (RCM) ❖ Safety Instrumented Funtion (SIF)
BAT for the location of the tanks conclude that in the case of liquefied gases, one can consider buried, mounded or spherical tanks, depending on the volumes stored.	The tanks in the storage terminal are round, above-ground cryogenic (atmospheric) tanks. Their location is also intended to increase safety in the event of fire hazards on adjacent plots or transmission infrastructure.	❖ The propane tank in the tank farm west (Unit 41B) is round, above-ground double wall full containment - refrigerated (atmospheric) tank. Its location is also intended to increase safety in the event of fire hazards on adjacent plots or transmission infrastructure. ❖ The propylene tank in the tank farm east (Unit 41A is spherical, above-ground, pressurized storage tank. Its location is also intended to increase safety in the event of fire hazards on adjacent plots.
BAT for VOC monitoring should include regular calculation of volatile organic compound emissions. These emissions should be monitored from time to time to ensure constant improvement of calculation methods.	The technical assumptions of the terminal and propane and ethylene storage facilities comprise provision of the necessary measuring instrumentation, including instrumentation for monitoring of the concentrations of these substances in the terminal area — to detect the hazards of their possible explosive mixtures with the air.	The technical assumptions of Jetty / Receiving Terminal (Unit 43), Tank Farms West (Unit 41B) and Tank Farm East (Unit 41A) facilities comprise provision of the necessary measuring instrumentation, including instrumentation for monitoring of the concentrations of these substances in the tank farm areas — to detect the hazards of their possible explosive mixtures with the air.
BAT for the prevention of incidents and accidents covers the use of a safety management system.	The company will implement a modern safety management system. According to the act on crisis management, the terminal unit will be the so called critical infrastructure and appropriate security and safety systems will be implemented in accordance with these principles. These systems will include, among other things, a zone around the terminal in which no unauthorized persons may be present during loading/unloading operations. Due to the location of the facility and confidentiality considerations, these issues are not discussed in detail here.	❖ The company take all precautions necessary to prevent and limit the consequences of major accident hazards involving dangerous substances. ❖ Jetty / Receiving Terminal (Unit 43), Tank Farms West (Unit 41B) and Tank Farm East (Unit 41A) facilities are critical infrastructures holding large quantities of dangerous substances; thus, company will have a safety management system to implement a major accident prevention policy (MAPP). ❖ Through integration of safety management system with other processes within the storage facility, safe operation will be ensured
Within BAT it is necessary to implement and comply with appropriate organizational measures and to enable staff education and training to ensure safe and reliable operation of the unit.	The scope of the EPC contractor constructing the new unit shall not only include development of appropriate unloading/loading procedures, but also implementation of a comprehensive training program for new staff, as regards the unit operation and emergency prevention rules.	❖ During EPC Phase, EPC Contracotr, Licensor & Vendor will provide training of Employer's operating and maintenance personnel for integrated PDH-PP including Utilities&Offsites. ❖ Company shall apply implementation of a training program for its employees, as regards the unit operation and emergency prevention rules. Employees shall be educated about hazards (the inherent properties of a chemical) to the workforce and potential consequences for the environment.
BAT for tank corrosion prevention comprises the use of appropriate construction methods, preventive maintenance and cathodic protection.	The storage and handling facility will be designed to meet the best international requirements and standards, including so as to provide adequate corrosion prevention systems. Minimum requirements for structural steel, corrosion protection solutions and test/monitoring procedures for general repairs have been established for the storage of propane and ethylene.	Jetty / Receiving Terminal (Unit 43), Tank Farms West (Unit 41B) and Tank Farm East (Unit 41A) facilities will be designed to meet the international requirements, standards and good engineering practices including following corrosion prevention solutions; - Protective coating between the metal parts and oxidizing elements in the environment - Cathodic Protection

BAT guidelines	Referenced Project Proposed solutions according to the terminal concept	Ceyhan PDH-PP Project Proposed Solutions
BREF requirements for emissions from storage		
		- Maintenance and test/monitoring for general repairs have been established for the storage of propane, propylene or other chemicals.
BAT for operational procedures and instrumentation to effectively prevent tank overflow.	The design assumptions comprise all the necessary assumptions for instrumentation systems, including independent filling level measurement systems and control systems to prevent these levels from being exceeded.	❖ All the necessary measure for instrumentation and automation systems will be taken including standalone high level instrumentation (HHLL:high high liquid level) and control systems to prevent these levels from being exceeded. ❖ Tanks in storage facilities in fully automated operation are equiped with Automated Overfill Prevention Systems (AOPS), namely, termination of filling operation is activated by standalone high level signal and achieved by automatic closure of receipt valve or shutdown of upstream pump. ❖ The necessary action items specified in risk analysis performed to determine the safety integrity level (SIL) during FEED phase shall be implemented during EPC period to ensure that the tank is adequately protected against the severity consequence of overfilling.
BAT for leak detection instrumentation and automation	The technical design of the terminal includes assumptions concerning the best methods for testing propane and ethylene emission levels and leak detection	❖ Propane Tank in Tank Farms West (Unit 41B) will be double wall full containment (refrigerated storage) and and annular space between inner and outer walls will be equiped with continous temperature monitoring sytem for leak detection. ❖ For elimination of risk of emission or pollution of ground water following a spill in tank farms, company shall apply a leak detection and monitoring & repair programme which is system of procedures a storage facility utilizes to locate and repair leaking components. In this regard, all field-erected tanks must be internally and externallyinspected by a certified tank inspector in accordance with Internatioanl Standards (such as API STD 653)
BAT for the implementation of fire protection measures comprise fire retardant coatings or linings, firebreaks or water cooling systems.	A comprehensive fire protection plan will be prepared, which will be implemented after further arrangements with the competent authorities. This will take place during the detailed design stage, in order to ensure comprehensive action covering the entire unit (including transfer system).	❖ All described elements of the fire protection in storage facility will be implemented. - The active fire fighting system will mitigate damages from fires by taking such measures as extinguishing, controlling fire intensity and/or fire exposure protection. - The passive fire protection systems such as the fireproofing (fire retardant coatings or linings) , impounding, separation that provides a degree of fire resistance for protected substrates and assemblies in storage facilities.
BAT for vapor treatment comprise the application of the vapor balancing or treatment at significant emissions from the loading and unloading of volatile substances to (or from) lorries, barges and vessels.	The unit is provided with vapor balancing and cleaning systems. Technical details of these solutions will be determined in cooperation with companies that operate propane and propylene vessels to ensure that the terminal equipment is compatible with vessels' vapor capture and cleaning systems	❖ Vapor evaporated from refrigerated Propane Tank or its connecting piping in Tank Farms West (Unit 41B) will be recovered through boil-off gas liquefaction system and sent back to storage tank. Vented vapor from boil-off gas liquefaction system, which cannot be liquefied, will be oxidized by LP Flare - South (Unit 42). ❖ Vapor emision (saturated vapors) from a fixed roof tanks in storage facilities, caused by addition of stock or temperature and pressure changes. Vapor emission control for fixed roof tanks include vapor balancing, conversion to an internal floating roof tank, and the installation of vapor destruction system (flare).
BAT for valves, pumps and compressors used in storage and handling facilities include correct material selection, monitoring of equipment most at risk of leaks, supervision (inspection) of correct fastening to frame/plates, correct design of suction systems, alignment of the shaft and casings, and correct selection of controllers for that equipment.	Measures in this respect will be carried out by the selected EPC contractor under the supervision of the contract engineer chosen by the investor. In addition, a key part of the unit will also be subject to technical supervision procedures (carried out by TDT).	❖ Emission sources such as valves, pumps, tanks, pressure relief valves, flanges, compressors used in storage facility will be selected through considering - determination of vapor emission sources in order to identify risk of leaks in each specific case, - selection of material of construction resistant to service. - use of low-leakage valves, - use of low leak pumps (e.g. seal-less designs, double seals, or good mechanical seals), - use of high integrity sealing materials in flanges, - routing pressure relief valves with potential vapor emissions to flare, - routing compressor vents with potential for vapor emissions back to process or when not possible to flare for destruction, - ensuring gaskets are selected and installed appropriately and bolted flange connections are assebled/loaded/tighted corectly. ❖ Other measures shall be taken based on the international requirements, standards and good engineering practices under supervision of PMC of Company
BAT for accidental leaks prevention and control is an appropriate combination or choice of, i.a., the following methods: · launching a formal Leak Detection and Repair (LDAR) program to search for leakage points on pipelines and equipment and achieve the highest emission reduction per unit cost, carrying out gradual repair of leaks in pipelines and equipment including immediate minor repairs of leaks exceeding a specified low threshold and intensified during repairs at	A detailed operating manual for the detection and removal of leaks will be developed for the unit, in accordance with the principles applicable at GAP. The technical design includes the use of equipment compliant with BAT requirements.	❖ Company will ensure selection of adequate emission reduction technologies during the EPC phase of the Project compliant with BAT requirements. . ❖ Accidental leaks prevention and contol study to identify process elements with the highest potential for fugitive loss will be applied ❖ Leak detection and repair (LDAR) programme will be applied by Company based on a component and service database in combination with the potential or accidental leak assessment and measurement.

BAT guidelines	Referenced Project Proposed solutions according to the terminal concept	Ceyhan PDH-PP Project Proposed Solutions
BREF requirements for emissions from storage		
exceeding a specified upper threshold. The exact leakage threshold for which repair should be started should depend on the production plant situation and the type of repair required, · when it is not possible to bring large leaks under control in any other manner, the existing equipment should be replaced with better equipment; · the technical specification of new units should include high resistance to accidental leaks, · the following or corresponding equipment with high resistance to accidental leaks shall be used: - valves: low nominal leakage valves equipped with double sealing. Bellows sealing in the case of high risk; - pumps: double sealing with liquid or gas barrier or pumps not requiring sealing; - compressors and vacuum pumps: double sealing with liquid or gas barrier or pumps not requiring sealing, or single sealing with the same emission level; - flanged connections: minimize their number, apply effective gaskets; - open ends: on rarely used components, attach blanking flanges, covers or plugs; for sampling points use a closed flushing circuit; optimize the size and frequency of sampling for sampling and analysis systems; minimize the length of sampling lines or install casings; - safety valves: install the safety diaphragm in the equipment upstream (observing all safety rules).		
BAT for wastewater emission prevention and minimization are an appropriate combination or choice from the following methods: A. identify all sources of wastewater and characterize their quality, quantity and variability, B. minimize the amount of water introduced into the process, C. minimize pollution of process water with raw materials, product or waste, D. maximize the reuse of the same water, E. maximize recovery/retention of substances from non- reusable mother liquors.	For the sea terminal, very detailed technical assumptions have been prepared with respect to rainwater. The system of water supply and wastewater drainage shall ensure strict control over these streams, enabling optimization of their use. The plant will partially use GAP water and sewerage systems. Emission minimization will be achieved in detailed designs , which will determine these methods for each wastewater stream.	❖ For Jetty / Receiving Terminal (Unit 43), Tank Farms West (Unit 41B) and Tank Farm East (Unit 41A) facilities, proper drainage systems shall be created which will remove the underground, surface and waste waters from the area. ❖ All the wastewater to be generated within storage facilities will be collected in accordance with the provisions of the “Drainage and Wastewater Gathering Philosophy” and “Specification for Drainage” and will be treated in WWTP to be constructed in the Project site. ❖ Emission minimization will be studied in detail during EPC phase, which will determine these methods for each wastewater stream.