Environmental Impact Assessment
for
TASNEE Petrochemicals
Ethylene and Polyethylene Projects

ATTACHMENT 3:
Environmental Compliance Report
LDPE Project

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Environmental Compliance Report
for
TASNEE Petrochemicals LDPE Project

TASNEE Petrochemicals
Al-Jubail
Saudi Arabia

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0 INTRODUCTION

This report describes the results of a review of the environmental aspects of the design of the TASNEE Petrochemicals LDPE Project in conjunction with the World Bank Group (WB) Environmental Standards and the Royal Commission Environmental Regulations for Jubail and Yanbu Industrial Cities of the Kingdom of Saudi Arabia (KSA). The review has focused on the standards that are relevant for the TASNEE Petrochemicals LDPE Project. A comparison between the relevant standards of the WB, KSA and the design of the plant has been made and the results are presented in this report.

The WB standards have been taken as the starting point for the comparison. Relevant WB standards have been inventoried and listed and KSA equivalent standards have been looked for. The design is compliant with all relevant KSA standards.

The following two situations have been distinguished:

1. A KSA standard is equal to or more stringent than the WB standard
2. A KSA standard is less stringent than the WB standard or no KSA standard has been defined

In situation 1 the design will comply with the WB standards. For situation 2 the contractor's design approach has been indicated.

This report starts with a brief project outline in Chapter 1. In Chapter 2 the relevant standards are listed and in Chapter 3 the review results are discussed. In Chapter 4 the conclusions are summarized and finally Chapter 5 contains a list of references.

Abbreviations/ Acronyms used

EA	Environmental Assessment
EIR	Environmental Information Report
HAP	Hazardous Air Pollutant
KSA	Kingdom of Saudi Arabia
OSBL	Outside Battery Limit
RC	Royal Commission
RCER	Royal Commission Environmental Regulations
VOC	Volatile Organic Compound
WB	The World Bank Group

1 PROJECT OUTLINE

1.1 General Project Outline

TASNEE Petrochemicals intends to expand their existing petrochemical complex at Al-Jubail in the Kingdom of Saudi Arabia. This complex comprises of a 450,000 ton per annum (t/a) propylene and polypropylene facility and will be expanded by adding the following process units:

- 1,000,000 t/a ethylene plant,
- 800,000 t/a polyethylene plant
- 1,800,000 t/a methanol plant with co-production of 365,000 t/a of carbon monoxide
- 504,000 t/a acetic acid plant
- 255,000 t/a vinyl acetate monomer plant
- along with associated utilities and offsites

This project is being developed by TASNEE Petrochemicals together with other partners. This Environmental Compliance Report only refers to the LDPE plant which is part of the polyethylene plant.

1.2 LDPE Plant

The polyethylene plant shall comprise of 2 polyethylene units. One unit shall produce 400,000 t/a of HDPE and the other shall produce 400,000 t/a of LDPE. The LDPE unit shall utilize Basell's Lupotec technology.

Basell's Lupotec technology utilizes a tubular reactor for the production of LDPE. The process essentially involves pressurizing ethylene to 2600-3100 bar and feeding a tubular reactor which typically has an internal diameter of 1.2-3.2 inches and is 1500-2000 meters in length depending on the plant capacity.
Peroxide as initiator is directly fed to the reactor. The feed temperature is raised to 130-180 °C to start the strongly exothermic reaction and cooling is used to prevent the reactants from exceeding 330 °C. Hot water is used in tube jackets generating medium pressure & low pressure steam. Per pass conversion of 25 to 35% is achieved based on grade. To improve heat transfer high gas velocities are used and depending upon the grade the reactor pressure control valve at the end of the reactor is operated in either "kicking" or "non-kicking" mode. The reactor pressure control valve discharges the LDPE/ethylene mixture into a high pressure separator. In the separator most of the ethylene is removed and recycled. The polymer melt is further depressurized to 1 bar in the low pressure product separator. The melt is then sent to the extruder for pelletizing and further degassing.

2 RELEVANT STANDARDS

2.1 World Bank Standards

The World Bank Group's "Pollution Prevention and Abatement Handbook" (Handbook, ref. 1) effective July 1998 contains the relevant WB standards. The Handbook consists of three major sections. The first deals with an overview of key policy lessons in pollution management. The second contains guidelines mainly meant for local government policy makers on establishing a sound environmental policy. The third part contains the Project Guidelines.

Possible relevant guidelines are to be found in:

- Part II: Implementing Policies in Practice
  - The Environmental Assessment Process
- Part III: Project Guidelines
  - Principles of Industrial Pollution Management
  - Monitoring
  - Airborne Particulate Matter
  - Nitrogen Oxides
  - Sulfur Oxides
  - Airborne Particulate Matter: Pollution Prevention and Control
  - Nitrogen Oxides: Pollution Prevention and Control
  - Sulfur Oxides: Pollution Prevention and Control
  - Industrial Estates
  - Petrochemical Manufacturing
  - General Environmental Guidelines

Although the most explicit standards applicable for the TASNEE Petrochemicals LDPE Project can be found in the section on Petrochemical Manufacturing, the section on the Environmental Assessment Process has been reviewed as well.
The other mentioned sections have been reviewed for reference only.

2.2 Kingdom of Saudi Arabia Standards

The relevant standards from the local authorities are contained in the "Royal Commission Environmental Regulations 2004" (RCER, ref. 2). The RCER have been compiled by the Environmental Control Department of the Royal Commission for Jubail and Yanbu Industrial Cities.

The RCER consists of two volumes. Volume 1 provides an overview of the environmental regulatory system and lists the standards and regulations. Volume 2 outlines the requirements for the environmental permit package and contains the forms to be used for the permit application.

For the TASNEE Petrochemicals LDPE Project an Environmental Information Report (ref. 3) has been prepared to demonstrate compliance of the design with the KSA standards and to apply for an Environmental Consent to Construct and an Environmental Permit to Operate.

3 REVIEW RESULTS

3.1 The Environmental Assessment Process

The environmental assessment (EA) process is one of the tools of the World Bank to enhance projects by helping prevent, minimize, mitigate or compensate any adverse environmental or social impacts. The EA process is executed in stages.

Stage 1 is a screening of the project's potential environmental and social impacts and assigns the project in one of three categories:

- Category A: full EA is required
- Category B: no full EA is required, but some environmental analysis is necessary
- Category C: no EA or environmental analysis is required

Since typical category B projects entail rehabilitation, maintenance or upgrading rather than new construction, it can be concluded that the TASNEE Petrochemicals LDPE Project is likely to be classified as a category A project.

The subsequent stages 2 through 5 comprise of scoping, EA report preparation, EA review by the Bank and project implementation.

Although the above procedure will not be followed for the TASNEE Petrochemicals LDPE Project, an Environmental Information Report has been prepared in conformity with the KSA standards.
This Environmental Compliance Report fills the gap between the EA process and the Environmental Information Report.

3.2 Petrochemical Manufacturing

The section of the Handbook on Petrochemical Manufacturing provides the most explicit environmental standards applicable to the TASNEE Petrochemicals LDPE Project.

The relevant standards are presented in the tables below. Also the applicable equivalent KSA standard is presented and the situation is categorized into situation 1 or 2 as explained in the introduction:

1. A KSA standard is equal to or more stringent than the WB standard
2. A KSA standard is less stringent than the WB standard or no KSA standard has been defined

For situation 2 the design needs to be verified to meet the WB standards. If the design meets the WB standards, evidence is provided. If it is not possible to comply with WB standards a sound motivation for this deviation will be provided.

Pollution Prevention and Control

Table 1. Pollution Prevention and Control

WB standard	KSA standard (- = no standard available)	Category	Remarks (- = no remarks)
Reduction of Air Emissions			
Minimize leakage of volatile organics from valves, pump glands (through use of mechanical seals), flanges and other process equipment by following good design practices and equipment maintenance procedures.	RCER section 2.8: Design measures for open-ended valves and pressure relief valves (not for other equipment). Equipment maintenance procedure (monitor and repair program) prescribed in detail.	1	-
Use mechanical seals where appropriate.	-	2	Double mechanical seals will be used in VOC and HAP service.
Minimize losses from storage tanks, product transfer areas and other process areas by adopting methods such as vapor recovery systems and double seals (for floating roof tanks).	RCER section 2.9: Control measures are prescribed for storage tanks depending on tank capacity and true vapor pressure of compound. RCER section 2.10: Vapors generated by loading or unloading VOC's have to be processed by a vapor control system (depending on true vapor pressure of compound and quantity).	1	-
Recover catalysts and reduce particulate emissions.	-	2	No catalyst is used. See Table 3 for particulate emissions.
Reduce nitrogen oxide (NO_x) emissions by using low-NO_x burners. Optimize fuel usage.	-	2	No burners are used.
Elimination or Reduction of Pollutants			
Use nonchrome-based additives in cooling water.	-	2	Cooling water supply and cooling water return is OSBL. In general, TASNEE does not use chrome-based additives in cooling water.
Use long-life catalysts and regeneration to extend the cycle.	-	2	No catalyst is used.
Recycling and Reuse			
Recycle cooling water and treated wastewater to the extent feasible.	-	2	A closed cooling water system is provided (supply and return OSBL). Wastewater is sent to the treatment facility of the complex before being sent to the RC treatment facility.
Recover and reuse spent solvents and other chemicals to the extent feasible.	-	2	Used isododecane (rinsing solvent) is collected in a slop tank and transferred into barrels for disposal.
Improved Operating Procedures			
Segregate process wastewaters from stormwater systems.	RCER section 3.6: First flush (30mm) of rainfall to be collected in a dedicated system, additional rainfall may be directed to the RC storm water drainage system.	1	-
Optimize the frequency of tank and equipment cleaning.	-	2	Tank and equipment cleaning will be minimized to the extent feasible.
Prevent solids and oily wastes from entering the drainage system.	RCER section 3.6: First flush (30mm) of rainfall to be collected in a dedicated system.	1	-
Establish and maintain an emergency preparedness and response plan.	-	2	TASNEE Petrochemicals already has an emergency response plan, which will be adjusted to incorporate the additional units as necessary.

Target Pollution Loads

Table 2. Target Pollution Loads			
WB standard	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
A good practice target for petrochemical complex is to reduce total organic emissions (including VOC's) from the process units to 0.6% of the throughput.	-	2	VOC emission from Regenerative Thermal Oxidizer is less than 5.3 t/a, which is below 0.002% of throughput.
Vapor recovery systems to control losses of VOC's from storage tanks and loading areas should achieve close to 100% recovery.	RCER section 2.9: Control measures are prescribed for storage tanks depending on tank capacity and true vapor pressure of compound. RCER section 2.10: Control efficiency of at least 95% for VOC loading or unloading vapor control systems.	1	-

Treatment Technologies – Air Emissions

Table 3. Air Emissions				
Parameter	**WB standard**	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Particulate matter	20 mg/Nm^3	Boilers and furnaces: 180 mg/dscm Incinerators: 34 mg/dscm	2	No PM emission from Regenerative Thermal Oxidizer.
Nitrogen oxides	300 mg/Nm^3	Boilers and furnaces: 86 ng/J Incinerators: -	2	NO_x emission < 50 mg/Nm^3 for Regenerative Thermal Oxidizer.
Sulfur oxides	500 mg/Nm^3	Boilers and furnaces: 340 ng/J Incinerators: 50 mg/dscm	2	No SO_x emission from Regenerative Thermal Oxidizer.

Treatment Technologies – Liquid Effluents

WB effluent requirements are for direct discharge to surface water. Therefore, comparison is made with the KSA standards for direct discharge to coastal waters (RCER Table 3C). However, for this project wastewater is discharged to the central wastewater treatment facility operated by the Royal Commission. For the effluent standards applicable for this project (RCER Table 3B), no comparable WB standards are available.

Table 4. Liquid Effluents – For Information Only				
Parameter	**WB standard (in mg/l, except pH and temperature)**	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
pH	6 – 9	6 – 9	1	-
BOD	30	25	1	-
COD	150	150	1	-
TSS	30	40	2	-
Oil and grease	10	15	2	-
Cadmium	0.1	0.05	1	-
Chromium	0.1 (hexavalent)	1.0 (total)	2	-
Copper	0.5	0.5	1	-
Phenol	0.5	1	2	-

Table 4. Liquid Effluents – For Information Only				
Parameter	**WB standard (in mg/l, except pH and temperature)**	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Benzene	0.05	-	2	Pre-treatment standard for discharge to RC central treatment facilities: 0.134 mg/l
Vinyl chloride	0.05	-	2	Pre-treatment standard for discharge to RC central treatment facilities: 0.172 mg/l
Sulfide	1	0.1	1	-
Nitrogen (total)	10	10	1	-
Temperature increase	≤ 3 °C	10	2	

Treatment Technologies – Solid Wastes and Sludges

Table 5. Solid Wastes and Sludges			
WB standard	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Combustion of toxic organics is considered an effective treatment technology for petrochemical organic wastes.	-	2	No toxic organics are produced.
Spent catalysts are generally sent back to the suppliers.	-	2	No catalyst is used.
Wherever possible, generation of sludges should be minimized.	-	2	No sludge will be produced.
Sludges must be treated to reduce toxic organics to nondetectable levels.	-	2	No sludge will be produced.
Wastes containing toxic metals should be stabilized before disposal.	-	2	No wastes containing toxic metals will be produced.

Ambient Noise

Table 6. Maximum allowable noise load				
Receptor	**WB standard**	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Residential daytime (07:00 – 22:00)	55 dB(A)	50 dB(A)	1	No residential area located near the facility
Residential nighttime (22:00 – 07:00)	45 dB(A)	50 dB(A)	2	No residential area located near the facility
Industrial	70 dB(A)	75 dB(A)	2	-

The facility will be located within an industrial area and the location of the nearest residential area is approximately 5 km.

Monitoring and Reporting

Table 7. Monitoring and Reporting			
WB standard	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Air emissions from stacks should be visually monitored for opacity at least once every eight hours.	RCER Table 2D: Opacity should be monitored continuously for combustion devices >73MW heat input capacity.	2	Regenerative Thermal Oxidizer has <73MW heat input capacity so opacity will not be monitored.
Annual emissions monitoring of combustion sources should be carried out for sulfur oxides, nitrogen oxides and relevant organics, with fuel sulfur content and excess oxygen maintained at acceptable levels during normal operations.	RCER section 2.5: The operator of a facility shall undertake annual stack emission testing of the following point sources: a. Affected sources that, before the use of emission abatement equipment, have the potential to emit more than 100 t/y of any air pollutant listed in Table 2A; b. Affected sources that, before the use of emission abatement equipment, have the potential to emit more than 10 t/y of any hazardous air pollutant listed in Table 2C; c. Affected sources combusting hazardous materials. The operator shall at a minimum measure for the applicable parameters that are regulated in Table 2B for the affected sources at the facility. RCER section 2.6: Operators of all point sources listed in Table 2D (includes gas turbines, combustion devices and hazardous waste incinerators) shall install appropriate continuous emission monitoring systems.	2	Regenerative Thermal Oxidizer is an emission abatement technique to destruct VOC's from process waste gasses. No annual emissions monitoring will be carried out, but a performance test at start-up will prove its efficiency. The Regenerative Thermal Oxidizer is not listed in Table 2D, so there is no requirement for continuous emission monitoring.
Leakages should be visually checked every eight hours and at least once a week using leak detection equipment.	RCER section 2.8: The operator of a facility shall monitor all effected components in VOC service or in organic HAP service on a minimum of semi-annual basis. Following two consecutive semi-annual leak detection periods when the number of leaking components is found to be less than 2% of the total, the operator revert to annual leak detection monitoring. Less frequent monitoring of difficult or unsafe to monitor components shall be permitted as determined by the operator, subject to verification and approval by the Royal Commission.	2	Leakages are regularly checked visually by the operators. Monitoring of VOC emissions is conducted according to RCER.
Liquid effluents should be monitored at least once every eight hours for all the parameters cited except metals, which should be monitored at least monthly.	RCER section 3.12: The operator of a facility shall undertake effluent and discharge monitoring of all sources prior to their discharge to either the Industrial Wastewater Treatment Plant, seawater cooling canals, drainage ditches, the Harbor or the Arabian Gulf.	2	No direct discharge of liquid effluents outside the facility of TASNEE Petrochemicals.
Each shipment of solid waste going for disposal should be monitored for toxics.	RCER section 5.2: Before transportation of hazardous and non-hazardous industrial waste the generator shall complete a waste manifest containing compositional data.	1	-

Table 7. Monitoring and Reporting			
WB standard	**KSA standard (- = no standard available)**	**Category**	**Remarks (- = no remarks)**
Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.	RCER section 2.6: The operator of continuous air monitoring systems shall submit a report electronically to the Royal Commission every six months, including the actual monitoring data with results of statistical analysis and an explanation for the occasions when the source emission standards were exceeded and the corrective action taken to prevent recurrence.	2	There are no monitoring requirements for point sources.
Records of monitoring results should be kept in an acceptable format.	RCER section 8.3: Recordkeeping requirements.	1	-
The results should be reported to the responsible authorities and relevant parties, as required.	RCER section 8.2: The operator of a facility shall submit periodic monitoring reports in accordance with any monitoring schedules developed in conjunction with the Environmental Permit to Operate. The operator of a facility shall submit to the Royal Commission all relevant reports and at the specific frequency referenced in Table 8A.	1	-

4 CONCLUSIONS

This report describes the results of a review of the World Bank Group (WB) and the Kingdom of Saudi Arabia (KSA) environmental standards and how these standards are incorporated into the design of the TASNEE Petrochemicals LDPE Project.

Applicable WB standards have been tabled together with the KSA standards. In those cases where WB standards have been defined and either less stringent or no KSA standards are defined, the design approach has been reported.

For the TASNEE Petrochemicals LDPE Project an Environmental Information Report (EIR) has been prepared in conformity with the KSA standards. Since the EIR does not follow the WB procedure for the Environmental Assessment (EA) process, this Environmental Compliance Report has been prepared to fill the gap between the EIR and the EA process.

The comparison between the relevant standards of the WB, KSA and the plant design approach shows that in general either the KSA standards meet the WB standards or that the design approach meets the WB standards.

5 REFERENCES

1. IBRD/WB, 1999, “Pollution Prevention and Abatement Handbook 1998, Toward Cleaner Production”, The International Bank for Reconstruction and Development / The World Bank, Washington, U.S.A., April 1999.
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3. TASNEE, 2005, “Permit Application for LDPE Plant”, TASNEE Petrochemicals, June 2005.