

Environmental Compliance Report for TASNEE Petrochemicals Ethylene 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 Ethylene 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 Ethylene 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 Chapter 3 the review results are discussed. In Chapter 4 the conclusions are summarized. Chapter 5 contains a list of references and Chapter 6 a list of attachments.

Abbreviations/ Acronyms used

BBL	Barrel
EA	Environmental Assessment
EIR	Environmental Information Report
HAP	Hazardous Air Pollutant
KSA	Kingdom of Saudi Arabia
PSA	Pressure Swing Adsorption
RC	Royal Commission
RCER	Royal Commission Environmental Regulations
SCFD	Standard Cubic Feet per Day
TOC	Total Organic Carbon
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 ethylene plant.

1.2 Ethylene Plant

The ethylene unit shall be capable of producing 1,000,000 t/a of polymer grade ethylene and about 280,000 t/a of polymer grade propylene and associated byproducts from the allocated feedstock. The feedstock allocation from Aramco is 55MM SCFD of ethane and 40,000 BBL/day of propane. The mixed C4 byproduct produced shall be hydrogenated and cracked to extinction. Pyrolysis gasoline which is one of the byproducts produced will be transported for sale by pipeline to a third party. A PSA type hydrogen purification system for the production of high purity hydrogen is included for acetylene conversion as well as export to the Polyethylene unit. The ethylene unit also includes a spent caustic treatment facility and a waste oil incinerator.

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 Ethylene 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 Ethylene 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 Ethylene 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 Ethylene 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 Ethylene 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)
<i>Reduction of Air Emissions</i>			
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	Disposal/recycling of spent catalyst according to vendor recommendation. See Table 3 for particulate emissions.
Reduce nitrogen oxide (NO _x) emissions by using low-NO _x burners. Optimize fuel usage.	-	2	Low-NO _x burners are used. Steam system with different pressure levels to maximize energy utilization.
<i>Elimination or Reduction of Pollutants</i>			
Use nonchrome-based additives in cooling water.	-	2	Seawater system uses Hypochlorite Generator for chlorination. Cooling water loop uses nonchrome corrosion inhibitor, scale inhibitor and biocide.
Use long-life catalysts and regeneration to extend the cycle.	-	2	The process sets the type of catalyst.
<i>Recycling and Reuse</i>			
Recycle cooling water and treated wastewater to the extent feasible.	-	2	A closed cooling water system is provided. Wastewater is sent to the RC for treatment.
Recover and reuse spent solvents and other chemicals to the extent feasible.	-	2	No solvents are applied. Other chemicals will be recovered to the extent feasible.
<i>Improved Operating Procedures</i>			
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

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	This facility has no continuous VOC emissions, only fugitive emissions which are expected to be well below 0.6% 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	-
A wastewater generation rate of 15 cubic meters per 100 tons of ethylene produced is achievable with good design and operation.	-	2	Average industrial wastewater discharge rate is 370 m ³ /day (for process units). Capacity is 1,000,000 t/a ethylene. Industrial wastewater generation is 13.5 m ³ per 100 tons of ethylene.

Treatment Technologies – 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	Furnaces and boilers meet WB standard. Waste oil incinerator and spent caustic incinerator meet KSA standard. Waste oil incinerator emission will be evaluated further during vendor selection. For the spent caustic incinerator a BAT analysis is included in Attachment 1.
Nitrogen oxides	300 mg/Nm ³	Boilers and furnaces: 86 ng/J Incinerators: -	2	Low-NO _x burners are used. Furnaces, boilers and incinerators meet WB standard during normal operation.
Sulfur oxides	500 mg/Nm ³	Boilers and furnaces: 340 ng/J Incinerators: 50 mg/dscm	2	Gaseous fuels with negligible S-content are used. Furnaces, boilers and incinerators meet WB standard during normal operation.
Benzene	5 mg/m ³ for emissions; 0.1 ppb at plant fence	- 1.5 ppb	2	No point sources for benzene emissions, only fugitive emissions possible.

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.

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	-
Benzene	0.05	-	2	Pre-treatment standard for discharge to central treatment facilities: 0.134 mg/l
Vinyl chloride	0.05	-	2	Pre-treatment standard for discharge to 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

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	A waste oil incinerator is part of this project.
Spent catalysts are generally sent back to the suppliers.	-	2	Disposal/recycling of spent catalyst according to vendor recommendation.
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

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	-

For this project a perimeter noise survey will be conducted at the property fence line to verify that the noise level does not exceed 75 dB(A). 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	Opacity will be monitored continuously for the boilers.
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/a 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/a 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	The following compounds will be monitored: Furnaces: NO _x . Boilers: NO _x , SO ₂ , Opacity. Waste oil incinerator: CO, NO _x , SO ₂ , PM, O ₂ , Temperature, Waste feed rate, TOC (annually). Spent caustic incinerator: CO, NO _x , SO ₂ , PM, O ₂ , Temperature, Waste feed rate, TOC (annually).
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. Permanent flammable gas detection will be installed.
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	Liquid effluents will be monitored before discharge.
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	When monitoring results indicate that emission standards are exceeded for either air emissions or liquid effluents, appropriate corrective action will be taken.
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 Ethylene 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 Ethylene 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.

Regarding the emission of particulate matter, the waste oil incinerator and the spent caustic incinerator are compliant with the KSA standards but the WB standard is more stringent. For the waste oil incinerator the particulate matter emission will be further investigated during vendor selection. For the spent caustic incinerator a BAT analysis is included in Attachment 1, which shows an emission reduction efficiency of 99.6%.

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.
2. KSA/RC, 2004, "Royal Commission Environmental Regulations 2004, Volume I and II", The Royal Commission for Jubail and Yanbu, Kingdom of Saudi Arabia, 2004.
3. TASNEE, 2005, "Environmental Information Report, TASNEE Petrochemicals Ethylene Project", TASNEE Petrochemicals, October 2005.

6 ATTACHMENTS

Attachment 1: Spent Caustic Incinerator 3PK-3501 BAT Analysis
(as included in the Environmental Information Report, Reference 3)