EXECUTIVE SUMMARY

The Feasibility Study for the Ethylbenzene Production Plant

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

Chem Systems was engaged by Unipetrol to undertake a feasibility study for an ethylbenzene (EB) production plant in Czech Republic. The scope of the assignment and terms of reference for the study are included in the contract entitled "Contract For Consulting Services Between Unipetrol and Chem Systems" July 1999.

Unipetrol's subsidiary company Chemopetrol currently operates an ethylbenzene plant at its Litvinov site and supplies essentially all the output of the plant to another Unipetrol subsidiary company, Kaucuk for production of styrene at its Kralupy site. This feasibility study examines replacing the existing EB plant at Litvinov with a new unit.

Chem Systems sub-contracted the analysis of environmental impact and analysis of local engineering costs (particularly for offsites and infrastructure) to two Czech companies. The evaluation of environmental impact was sub-contracted to Vyzkumny Ustav Anorganicke Chemie, a.s., (WANCH), the Research Institute of Inorganic Chemistry, a joint stock company owned by Unipetrol. The Czech engineering assessment was sub-contracted to Intecha spol. s r.o., an independent engineering and consulting company.

In its interim report Chem Systems evaluated the two potential locations for the new plant, Litvinov and Kralupy, and the two leading technologies for EB production, liquid and vapor phase. The Litvinov site is the location of the existing EB plant and has onsite production of the feedstocks for EB production (ethylene and benzene). The Kralupy site has no on-site feedstock production but has on-site consumption of EB to produce styrene. The interim report is included in the Appendix to this final report. It recommended that the location for the new unit be the Litvinov site and that the liquid phase technology was preferred ' . The interim report did not reach a conclusion on the preferred capacity for the new EB plant.

The report is presented in three main volumes. This volume, Volume 1, presents the financial analysis and overall conclusions of the feasibility study. Volume 11 presents the technical evaluation of the project and Volume III presents a market analysis for EB production in Central Europe.

1.2 PROJECT DESCRIPTION

1.2.1 GENERAL DESCRIPTION

The project evaluated in this feasibility study is to build a new ethylbenzene plant at Litvinov, Czech Republic to replace an existing unit. The existing EB plant has the capacity to produce about 125 000 tons per year of ethylbenzene by the alkylation of benzene over an aluminum chloride catalyst. The existing plant uses obsolete technology and has higher operating costs than the current, world-scale ethylbenzene plants.

The options analyzed in this volume of the report include replacement of the existing unit with a new liquid phase, zeolite catalyst technology plant for the alkylation of benzene. Plant capacities analyzed are:

- 180 000 tons per year of EB
- 300 000 tons per year of EB, and
- 180 000 tons per year, with the capability to be expanded to 300 000 tons per year within 5 years of commissioning.

1.2.2 PRODUCT PRICES

The largest consumer of ethylbenzene from the existing plant is the styrene plant of Kaucuk at Kralupy. The transfer price of ethylbenzene between Chemopetrol at Litvinov and Kaucuk had been taken as a formula price based on the cost of contained ethylene and benzene plus a fixed to E30 per ton premium. This price has been higher than the European market price for much of the petrochemical margin cycle and only below it at the peak of the petrochemical cycle.

The cost of raw materials and the price of products to external customers have been forecast based on representative European market prices (as forecast by Chem Systems) using the methodology described in Volume III - Marketing Study.

1.3 ECONOMIC AND FINANCIAL ANALYSIS

1.3.1 INTRODUCTION

Chem Systems has built a techno-economic model of the "before" and "after" cases to help evaluation of the feasibility of the project. The "before" case assumes continued operation of the existing EB plant at Litvinov and delivery to Kralupy via the pipeline connection. With the exception of the cumene/phenol case, all the analyses are based on the incremental cash flow of a new investment scenario compared to continued operation of the existing plant.

Yield factors and operational parameters for the existing plant were supplied by Unipetrol and have not been independently verified by Chem Systems. The "after" cases analyzed include the three options described in Section 1.2.1 above and additional options identified by Chem Systems and Unipetrol: including the closure of the existing EB plant without replacement; and the alternative investment of building cumene and phenol plants (as an alternative use for the benzene produced at Litvinov). Yield factors and operational parameters for the replacement EB plants were supplied by ABB Lummus in its preliminary design package. Yield factors and parameters for a liquid phase benzene alkylation EB plant based on the Mobil/Raytheon design are not expected to be substantially different from those of the ABB Lummus design.

The techno-economic model simulates continued operation of the existing EB plant for the base year (year 0 = 2000) and for the first two years of the project (years 1 and 2 = 2001 and 2002) during the construction of the new EB plant. It is assumed that the new EB plant is commissioned at the end of project year 2 (2002) with a full year of beneficial operation in project year 3 (2003). The existing EB plant is closed when the new EB plant starts production.

The model builds up costs and revenues based on reference prices supplied by Chem Systems from its forecast of margins and prices conducted as part of its Petroleum and Petrochemicals Economics (PPE) program. The input prices of raw materials to the

ethylbenzene plant were agreed with Unipetrol as: ethylene at the West European contract price less DM60 per ton; and benzene at the West European contract price. Price and cost forecasts are tabulated in Volume III of the report. Three oil price scenarios and two petrochemical cycle/trend scenarios are used in the analysis. The scenarios are described in Volume 111, Section 3.1. The three oil price scenarios that are used in this report are:

a "High Oil" case with crude oil price at $20.0 per barrel (Dubai, FOB Fateh, 1998 dollars) to 2003.
a "Medium Oil" case with the reference crude oil price, Dubai (FOB Fateh) at $15.0 per barrel (1998 dollars) to 2003.
a "Low Oil" case with the FOB Dubai price at a constant $10.0 per barrel (1998 dollars) until 2003.

After 2003, the crude oil price declines slowly in each scenario (in real terms). This longer term decline in price reflects trends in other commodities, which continue to show reductions in real prices due to continuing gains in production efficiency.

The two petrochemical margin scenarios presented are labeled "trend" and "cycle". In the Trend Case the margins associated with each product are based on a relatively constant operating rate after 1999. The resulting margins are to be viewed as the longterm average for the business and do not represent judgement about the outcome in any single year. They form the best view for long term feasibility studies and investment decisions.

In the Cycle case a view is taken of the expected cyclicality of the industry, with margins falling in 2000 and recovering in a cyclical upturn projected to peak in 2003. The average margins for each product over the cycle are taken to be equal to the long-term trend case. This case represents our best view of the prices and margins for the next two to three years. Following that time the outcome of the cycle is speculative since it depends on unforeseen events as well as economic performance and the degree of over or under investment in the industry.

Variable and fixed costs of production are built up from yield factors, plant operating requirements and forecast prices and costs for a thirteen year operating life (from project year 3 to project year 15). Revenues are built up from internal sales to Kaucuk at a formula price and external sales to third party EB consumers at market prices. The transfers to Kaucuk satisfy the current requirements of the styrene plant plus an

anticipated expansion of 10% in 2002. The model does not assume that a second styrene plant is built at Kralupy during the project life.

The output of the model is an after tax incremental expenditure and income stream for project years 0 (the year in which the investment decision is made) through year 15 (the thirteenth year of operation). The differential cash flow stream is calculated from the incremental expenditure and incremental income above that which would have been generated by continued operation of the existing EB plant. The internal rate of return (IRR) and net present value (NPV) of the stream are compared for the options examined.

The full output for each case is printed in the Appendices, Section 4.2 of this volume of the report.