SYNCHEM FEASIBILITY REPORT

Phase I

FG01-93FE62803

MASTER

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Roles of the Development Consortium Participants

Czech Participants:

	<u>Supplier Of:</u>	<u>Off-Taker Of:</u>
Chemopetrol s.p. -	Residual & Waste Oil	Electricity and Steam
Doly a upravny Komorany s.p.	Local Coal	Electricity
Prvni Severosapadni Teplarenska a.s.		District Heat

Foreign Participants:

	<u>Supplier Of:</u>
Air Products and Chemical, Inc.	Air Separation Facility
General Electric Technical Services Company, Inc.	Combined Cycle Power System
Mission Energy	Project Development
Texaco Development Corporation	Texaco Gasification Power System Technology
Nykomb Synergetics	Project Development and Management Services, Architect Engineering Services

EXECUTIVE SUMMARY

On December 9, 1992, Chemopetrol s.p. ("Chemopetrol"), Doly a upravny Komorany s.p. ("DUK") and Prvi Severosapadni Teplarenska a.s. ("Komorany"), (collectively the "Czech Participants") together with Air Products and Chemicals, Inc. ("Air Products"), General Electric Technical Services Company, Inc. ("GE"), Mission Energy Company ("Mission"), Nykomb Synergetics B.V. ("Nykomb"), and Texaco Development Corporation ("Texaco"), (collectively the "U.S. Participants", and together with the Czech Participants, the "Participants"), entered into a development agreement for the purposes of determining the technical and economic feasibility and overall financeability (the "Feasibility Phase") of an integrated gasification combined cycle ("IGCC") regional energy facility (the "Project") to be located adjacent to the Chemopetrol refinery in Litvinov, Czech Republic (See Map). In addition to being investors in the Project, the overall roles of the Participants are shown on Attachment A.

1.1 PROJECT CONCEPT

As proposed, the Project will utilize Texaco's oxygen-blown coal/residual oil gasification technology to produce a synthetic gas ("syngas") to be used, after removal of contaminants such as sulfur, as fuel in a combined cycle power plant to produce electricity. The Texaco gasification technology ("Texaco Gasification Power System or "TGPS") that will be used in the Project is a technology that has been used commercially around the world for over 40 years.

The Project would use a feedstock comprised of coal supplied by the DUK coal mining company and mined from the Most/Litvinov area together with high sulfur residual oils from the Chemopetrol refinery. When gasified together with oxygen from an Air Products air separation plant, and based on an average yearly consumption of 2100K metric tons per year of coal (as delivered) and 630K tonnes per year of oil, approximately 11 million normal cubic meters per day of syngas will be produced. At its current projected design capacity, when combusted in two General Electric advanced technology Frame 9FA gas turbines, the Project will produce approximately 690MW of electric power; 250 metric tons/hour of steam for process; and 135 thermal equivalent MW of district heat. If, however, the Project Participants are unsuccessful in securing commercial offtake agreements for the total amount of electricity produced or if, at the current projected cost level, total financing requirements can not be met, then the project configuration will be downsized utilizing a configuration operating at approximately 60% of the capacity of the base case design presented in this report.

Based on the current Project design configuration, the Project will supply approximately 135 MW of electric power to the Chemopetrol refinery, 250 MW of electric power to SEZ, the regional distribution company, and the remainder of approximately 305 MW either directly to the National Power Company, CEZ, or for export to a foreign utility through the existing transmission grid in Northern Bohemia.

All steam for process, approximately 250 metric tons per hour, will be sold to the Chemopetrol refinery. The district heat produced, approximately 135 MW thermal equivalent on an annual average basis, will be sold, subject to negotiation of an acceptable agreement, to Komorany, the district heat company, for ultimate distribution through Komorany's pipeline system to the towns of Most and Litvinov.

The Project Participants anticipate that the Project will co-produce electric power, steam and district heat more efficiently than those products are currently produced separately, and will result in savings to those entities purchasing these products over the life of the project agreements. In addition, the Project will allow for the replacement and shutdown of existing, outdated utility generating facilities, resulting in significant improvements in the environment by decreasing the level of emissions in the region.

As currently envisioned (but subject to final offtake negotiations), the Project will meet the following objectives:

- Replace obsolete power/district heat/utility production units in the Most/Litvinov area.
- Sharply reduce sulfur dioxide, nitrous oxides, and particulate emissions in the region, as well as providing Chemopetrol with an economic alternative for the disposal of refinery residues.
- Produce electricity, steam and hot water at prices that are competitive with other alternatives. Produce electricity for the regional and/or national grid and/or for export in a manner that maximizes the efficient utilization of indigenous fuels.
- Provide a reliable source of electricity and steam for the Chemopetrol refinery complex, and a reliable source of hot water or district heat to the municipalities of Most and Litvinov.
- Establish a stand-alone entity, with viable contracts as an underpinning, to construct, own and operate the proposed Project such that non-recourse off-balance sheet financing can be secured.

Commercial operation of the Project is scheduled for 1/1/1998.

1.2 SUMMARY OF RESULTS

In summary, and described in more detail in each respective section that follows, the Feasibility Phase determined the following:

TECHNICAL

The Project as currently envisioned is technically feasible. Based upon a design configuration integrating two General Electric Frame 9FA combustion gas turbines and steam turbines, three Air Products air separation units, four gasification trains designed by Texaco, the proposed method of design of the Project should be capable of achieving the projected performance levels for electricity, steam, and district heat production at a net thermal efficiency of 45% (LHV). The power plant would be designed to a target availability level of 92%.

The results of the gasification evaluation runs conducted at Texaco's Montebello Research Facility in May 1993 confirmed the feasibility of gasifying the Czech coal/high sulfur residual oil feedstock mix. Carbon conversion was in excess of 99% and was tested at coal/resid mixtures of 71/29 to 47/53. Gasifier temperature and limestone requirements varied from 1300-1400°C, and 20-30%, respectively, depending upon the mixture gasified.

The preliminary investment cost estimate, excluding owners cost, offsites and interest during construction, is approximately \$982 million USD (1993 turnkey cost). Cost estimates were based on U.S. Gulf Coast construction and labor estimates, and U.S. design standards together with current market quotes for major equipment such as the power block and air separation units. All-in costs, which include additional costs such as interest during construction, offsites, and owners' cost, are estimated to be \$1450 million in 1993 \$USD.

A downsize plant configuration has also been evaluated on a preliminary basis. Accordingly, if long-term offtake contracts for the amount of export electric power produced in the base case design are unavailable, the Project size will be reconfigured to this downsized case.

CONSENTS AND LICENSES

No fatal flaws were uncovered in the course of determining the extent and requirements of environmental consents and licenses that may be necessary for the Project's construction and operation. However, the legislative framework in the Czech Republic is continuing to evolve. Accordingly, new legislation is not always complete and overall implementation mechanisms and chains of authority are not entirely clear.

Receipt of the Environment Impact Statement ("EIS") from the Ministry of Environment is a pre-requisite for the securing of project financing. The minimum statutory time frame for its issuance is 12 to 18 months following a minimum of 2 to 3 months required for the preparation of the Environmental Impact Assessment ("EIA"). In addition, the Air and Water permits (8-15 months) must be obtained in order to receive permission to begin construction.

OWNERSHIP AND MANAGEMENT

The Project Participants are currently considering the formation of a Czech general partnership, with each Project Participant having a partnership interest in this entity which would design, construct, own and operate the Project. Given current legislation, the Project Participants believe that the general partnership structure, as opposed to other available structures (e.g. joint stock company, limited liability company and limited partnership), will provide the greatest amount of latitude with respect to decisions affecting the overall project structure - i.e. management, voting rights, and transfer of ownership interests.

Accordingly, this general partnership structure allows the Participants to establish within the partnership contract many agreements that might not be possible with a more formal corporate-type structure such as a joint stock company. For example, use of the general partnership structure also gives recognition to the disparate tax circumstances of the various Project Participants. However, pending the final determination of liability and tax issues, this form of ownership may be subject to reconsideration in the future.

COMMERCIAL ARRANGEMENTS

The current pricing proposals for both the offtake and supply agreement term sheets have been based upon the philosophy of avoided cost and foregone "opportunity" costs. Whereas these term sheets have not yet been formally agreed upon, preliminary discussions with external offtakers have indicated pricing levels that are indicative of future market-based levels.

Further negotiations are envisioned with both external offtakers (i.e. - German utility, SEZ) and internal or Participant offtakers and suppliers (i.e.- Chemopetrol, DUK). Pending the outcome of these negotiations, definitive term sheets are not yet available. Moreover, revisions to currently contemplated pricing structures may impact overall project economics and ultimate financeability.

FINANCING

Financeability of the proposed Project will primarily be determined by the final form of the various commercial agreements as well as the success in obtaining appropriate Czech government guarantees.

Concurrent with this report, a Descriptive Memorandum has been prepared. This Descriptive Memorandum is a summary of key project information together with financial cash flow proformas indicating levels of debt service coverage ratios under different economic and operating scenarios.

Following the submission of the application for guarantees from the Czech government, this Descriptive Memorandum will be used to discuss with various financial institutions their potential interest in providing funding for the Project construction and design. The European Bank for Reconstruction and Development, the International Finance Corporation, and the U.S. Export/Import Bank will be the primary focus of this initial solicitation of interest. Preliminary discussions held with each of these institutions have resulted in their recommendations for a reduced size or phased-in project configuration.

PROJECT ECONOMICS

Definitive Project economics will be available upon finalization of the pricing terms for each of the various offtake and supply agreements. However, based on current "target" pricing proposals together with current estimates of capital cost and overall Project performance, preliminary Project economic returns are approximately 17% on an unleveraged or all equity basis, and approximately 25% on a leveraged or debt financed basis assuming a twelve year debt amortization and a debt to equity ratio of 70/30.

1.3 FEASIBILITY PHASE RECOMMENDATION

Based on the foregoing Summary of Results, the current base case Project configuration of two GE Frame 9FA gas turbines is technically feasible for the combined purposes of electricity, steam and district heat production based on the gasification of a feedstock mix comprised of coal and residual/waste oils. In addition, the five day gasification evaluation run at Texaco's Montebello Research facility confirmed the feasibility of co-feeding and gasifying the coal/oil feedstocks.

However, during the course of initial discussions with the various multilateral financial institutions together with various representatives of the EC, financing an amount in excess of \$1000 million USD may be difficult to achieve. Moreover, the level of sovereign guarantees from the Czech government required for such a financing will also be commensurately high.

These financial considerations together with the additional burden of obtaining firm commitments for the offtake of electric power in excess of 500MW currently present obstacles that make it less realistic to expect that the full size project can be implemented. Accordingly, it is the recommendation of the Project Participants that the current Project configuration be downsized through the substitution of the two GE Frame 9FA combined cycle power trains with two GE Frame 9E combined cycle trains, with the option of adding a third train at a later date.

This revised, staged Project configuration will result in a substantial reduction in capital costs, thereby improving the prospects of securing financing. Export electric power production in the downsized case may only require one rather than two utilities as an offtaker. Utilization of residual/waste oil supplies from Chemopetrol will continue as before, and Chemopetrol's steam and electric power requirements will be met.

For the interim phase efforts, the overall integration with Chemopetrol's refurbished T700 (50%) boiler station will have to be evaluated in more detail. A possible revised site location within the Chemopetrol complex itself will also need to be analyzed. A preliminary definition of the stand-alone 2 GE Frame 9E case will follow shortly under separate cover.

1.4 PROGRAM OF FUTURE WORK

Based on the information summarized above and in detail hereinafter, the Project Participants will make a decision for further commitment to final project development efforts subsequent to finalization of this Feasibility Phase. The close of project financing for the Project will then be the milestone concluding the final Development Phase.

The proposed activities through February 1994 are as follows:

- Conclude Feasibility Phase efforts before year-end
 - Internal Project Participant evaluation of Feasibility Phase results to date.
 - Finalize commercial term sheets to include both indicative pricing and contract terms.
 - Complete Descriptive Memorandum and begin in-depth discussions with selected financial institutions.
 - Finalize revised Project configuration and integration with Chemopetrol
- Submit formal Application for Czech Government Guarantees.
- Initiate Permitting Activities for EIA Preparation.
- Initiate contacts with appropriate Czech and U.S. government officials to increase awareness of the Project and to ultimately solicit their support.
- Agree on requirements for the Development Phase to follow.
- Make go/no-go decision for commitment to Development Phase by December 31, 1993.

The Feasibility Phase efforts described in this report indicate the real possibility for a successful and profitable IGCC Project for the Czech Republic. It is therefore incumbent upon all the Project Participants to review and evaluate the information contained herein such that a go/no-go decision can be reached by early next year.

2.1 Project Location & Description

2.1.1 Project Location

* Litvinov in the North Bohemian coal basin in the Czech Republic

2.1.2 Existing Regional Energy Supply and Demand

- * Chemopetrol Industrial Complex at Litvinov
 - Produces steam and electric power for internal needs by burning local brown coal in obsolete environmentally unfriendly facilities (T200 & T700), which will need to be replaced / retrofitted to meet future regulations
 - Produces high sulphur content heavy vacuum residues in refinery operations
- * Komorany District Heat Plant at Most
 - Supplies district heating to the cities of Most and Litvinov as well as other local consumers
 - Cogenerates electric power
 - Burns local brown coal in obsolete facilities with large atmospheric emissions, which will need to be replaced / retrofitted to meet future regulations
- * SEZ / Decin regional supplier and distributor
 - Distributes power which is produced locally as well as power generated by the national supplier CEZ, whose plants also do not meet expected future environmental standards
- * DUK and other brown coal organisations
 - Have large reserves of brown coal and substantial mining operations
 - Operate coal preparation and classification plants
 - Supply the current requirements of Chemopetrol, Komorany and other regional consumers

2.1.3 Environmental Concerns

- * North Bohemia is within the "Triangle of Great Environmental Concern" of Germany /Czech Republic / Poland
- * Czech Ministry of Environment / Clean Air Act requires phasing out of power plants not meeting EEC standards by end of 1997
- * Local environmental authorities require earlier phasing out of local non-retrofitted plant (e.g. T200 & T700) end 1996

2.1.4 Objectives of the SYNCHEM Project

* Overall

- Replace obsolete power / district heat / utility production units in the Most / Litvinov area.
 - Chemopetrol T700 and T200 units
 - Komorany utility plant
 - Dated brown coal fired equipment in old condensing power stations
- A regional perspective on energy, environment, jobs, indigenous resources

* Environmental

- Sharply reduce SO₂, NO_x and particulate emissions in the Most / Litvinov area.
- Dispose of low grade refinery residues of Chemopetrol at no economical or environmental debit.

* Economical

- Produce electricity, steam and hot water to be priced competitively with other alternatives.
- Produce electricity for the regional or national grid and / or for export to maximize efficiency in the use of fuel and investments.

* Reliability

- Provide reliable supply of steam and electricity to the Chemopetrol Complex and heat to the Municipalities of Most and Litvinov.

* Financial

- Secure commercial financing without government subsidies for the final implementation.
- Establish stand alone vehicle for the final project to minimize balance sheet burdens on any one of the stake holders.

(cont'd)

2.1.4 Objectives of the SYNCHEM Project (cont'd)

* National Economy

- Indigenous primary energy resources to be utilized with high efficiency consistent with the most stringent EEC environmental standards
- Resolve Czech petroleum industry residue offtake issue
- Provide long term outlet for local brown coal and secure 25 yr+ planning horizon for DUK jobs
- Major contracts for equipment and services to be placed with Czech vendors

* Development Perspective

- SYNCHEM to bring proven State-of-the-Art Technologies to the Czech Republic in:
 - Fossil fuel conversion
 - Environmental systems
 - Fossil fuel power generation
- SYNCHEM to give Chemopetrol / DUK a scope for development of C₁ Chemistry options, with local coal resources providing a competitive advantage

2.1.5 Description of the Project

- * SYNCHEM is to be an Integrated Gasification and Combined Cycle (IGCC) power plant comprising :
 - A Texaco Quench Gasification unit to gasify a mixture of brown coal and heavy vacuum residues by reaction with oxygen
 - An Air Products air separation unit to supply the oxygen
 - A gas treatment and sulphur removal / recovery unit to process the produced gas
 - A General Electric combined cycle power unit comprising gas turbines fueled by the treated gas, heat recovery / steam generating facilities and steam turbines together with electricity generators
 - Various heat recovery facilities producing hot water for district heating purpose
 - Utility and auxiliary units as required

(cont'd)

2.1.5 Description of the Project (cont'd)

- * SYNCHEM to provide :
 - The balance electric power and steam requirements of the Chemopetrol Litvinov Complex following the shutdown of T200 and 50% of T700 (50% of T700 to be retrofitted with FG desulphurization)
 - The district heating of Komorany following the shutdown of existing facilities
 - Electric power for distribution locally via SEZ and also export elsewhere
- * SYNCHEM to consume as main raw materials :
 - 16-17 MJ/kg (LHV) brown coal
 - High sulphur heavy vacuum refinery residues
 - Fluxing agent such as limestone
- * SYNCHEM to produce as main by-products
 - Sulphur
 - Non-toxic slag suitable as a construction material
- * SYNCHEM is able to meet the most stringent European emission standards

2.1.6 Principal Interconnections

2.1.7 Site Location

Kopeček which is adjacent to the Chemopetrol Industrial Complex and the DUK Herkules coal preparation plant at Litvinov

2.2 Chemopetrol (CHP) Activities in Litvinov

2.2.1 General

- * Chemopetrol operates a major industrial complex at Litvinov comprising :
 - The largest oil refinery in the Czech Republic
 - A major petrochemical complex
 - Production units for catalysts, castings, spare parts, electrical equipment and miscellaneous items
 - Electric power and heating units
- * Chemopetrol employs a work force of about 10,000 at Litvinov
- * The company is in the process of privatization
- * Major products include
 - Engine fuels and other light products from crude oil processing
 - Heavy fuels and tars
 - Ammonia and urea
 - Plastics
 - Petrochemical products

2.2.2 Oil Refining

- * The Refinery has a total capacity to process 5 million tons of crude oil per year
- * The Refinery comprises :
 - The original unit which produced engine fuel from Lignite in the second world war
 - A small, low complexity refinery adapted in 1954
 - An Atmospheric and Vacuum Distillation and Hydro Treater (AVD) Plant with a crude oil processing capability of 1.7 million tons per year, in operation from 1968
 - A Compact Block Refinery Unit with a crude oil processing of 3.3 million tons per year, in operation from 1982
 - A 800000 tons per year Hydrocracker unit which came on stream in 1988
 - For additional information, see Figure 2.2.2-1, List of Main Units and capabilities and Figure 2.2.2-2 and 3, Block diagrams of Main Units
- Refinery production in the year 1992, see Figure 2.2.2-4
- Heavy vacuum residues
 - Currently Chemopetrol produces 320,000 tpa of HVR when processing "Sovjet" crude oil
 - A further 300,000 tpa of higher sulphur (>3%) fuel oil is currently being sold but will be treated as residual oil in the future

Chemopetrol will supply 600,000 tpa of HVR to SYNCHEM

Figure 2.2.2-1

List of Main Products

Chemopetrol Refinery Complex

UNIT	CAPACITY (10 ³ T/YR)	YEAR BUILT OR MODIFIED
<i>Compact Block</i>		
Atmospheric Distillation	3,300	1982
Catalytic Reformer	330	1982
Hydrotreating of Naphtha Redistillation	660	1982
Hydrotreating of Kerosene	330	1982
Hydrotreating of Gas Oil	660	1982
Isomerisation	100	1983
LPG Production	150	1983
<i>Hydrocracker Unit</i>		
Vacuum Distillation	1,500	1988
Cracker Unit	800	1988
<i>AVD</i>		
Atmospheric Distillation	1,700	1967
Vacuum Distillation	850	1967
Redistillation of Hydrotreated product	400	1942
Catalytic Reformer	150	1968
Hydrotreater for Heavy Naphtha	170	1968
Kerosene and Gas Oil	600	1982
Original Hydrocracker	400	1942
Tars Distillation	110	1942
Extraction of Aromatics	60	1968
Solvent Napthas Production	60	1981

2.6 Existing Steam and Electricity Generation at Chemopetrol

2.6.1 T700 (start-up 1962)

• T700 comprises :

- Seven (7) coal fired steam boilers with 125 tph capacity each
- Four (4) double extraction condensing turbines of 25 MW generation capacity each
- One (1) 6 MW back pressure turbine (not currently in use)

• In 1990 T700 supplied the following steam quantities

<u>pressure, bar</u>	<u>Temp, °C</u>	<u>Quantity, ton</u>
22	361	1 146 888
5.8	242	186 072
3.0	171	568 584

2.6.2 T200 (start-up 1941)

• T200 comprises :

- Twelve (12) coal fired steam boilers with 100 tph capacity each
- Seven (7) double extraction turbines of 22.5 MW capacity each
- Two (2) condensing turbines of 16.5 MW capacity each

• In 1990 T200 supplied the following steam quantities :

<u>pressure, bar</u>	<u>Temp, °C</u>	<u>Quantity, ton</u>
30	441	258 696
16	338	1 289 136
3.5	198	125 616
2.5	146	838 896

Figure 2.2.2-4
Refinery Production in the year 1992

PRODUCT (tons)		YEAR 1992				INDICES	
		BUS. PLAN	OPER. PLAN	ACTUALS	% OF PLAN MET	92/91	92/90
FUEL GAS		64 240	62 630	65 478	104,5	101,3	130,0
OUT OF WHICH	PROPANE-BUTANE	40 800	40 000	41 640	104,1	104,8	108,9
LIQUEFIED GASES FOR OWN PYROLYSIS		36 000	29 400	27 262	92,7	93,0	49,2
AVIATION GASOLINES		19 700	10 950	12 201	111,4	104,1	49,5
GASOLINES		617 000	690 200	738 850	107,0	129,5	133,0
SOLVENT NAPHTAS		23 960	14 600	16 254	111,3	75,2	41,5
NAPHTAS FOR PETROCH.		560 070	502 380	499 386	99,4	86,2	64,5
OUT OF WHICH	AROMATES	168 070	159 380	153 254	96,2	101,1	70,3
	OWN PYROLYSIS	392 000	343 000	346 132	100,9	80,9	62,2
KEROSENE		47 000	37 900	42 438	112,0	93,8	91,6
DIESEL FUEL		992 100	834 300	883 980	106,0	91,3	79,9
FUEL OILS- TOTAL		380 660	476 400	484 332	101,7	96,9	90,7
OUT OF WHICH	LIGHT	68 000	88 000	91 113	103,5	86,5	64,4
	HEAVY-TOTAL	312 660	388 400	393 219	101,2	99,7	100,2
OUT OF WHICH	TM 3 % S	241 960	270 100	272 311	100,8	91,3	102,9
	SS TO 2 %	/	42 300	41 861	99,0	/	/
	TD OIL	70 700	76 000	77 134	101,5	96,4	74,4
	PETROCHEMICAL	/	/	1 913	/	12,1	7,9
GAS OIL FOR OWN PYROLYSIS		286 800	393 000	386 393	98,3	203,2	119,9
OIL FOR SHELL		351 410	333 530	336 900	101,0	102,4	102,4
MAZOUT FOR HYDROCRACKER		1 306 120	1 322 680	1 263 322	95,5	111,5	96,1
TARS - TOTAL		238 000	227 200	243 762	107,3	120,9	74,0
OIL DISTILLATES		2 000	/	- 654	/	/	/
OIL HYDROGENATES		70 700	64 000	63 620	99,4	89,3	58,8
OUT OF WHICH	SIDE	8 000	7 000	8 390	119,9	97,7	63,6
POWER (thousands kWh)		1 538 000	1 521 000	1 520 151	99,9	102,8	98,6

2.2.3 Petrochemicals and Miscellaneous Products

- * Production in the year 1992, see Figure 2.2.3-1 and 2

2.2.4 Electric Power and Heat Generation

- Chemopetrol operates two major steam and electric power generation units (T200 and T700)
- These units supply the current electric power and steam requirements of the Complex
- There is a connection to the national electrical grid which allows electric power input or export on demand
- Production and consumption figures for 1992, see Figure 2.2.4-1
- For further details, see section 2.6

Figure 2.2.3-1**Petrochemicals and Miscellaneous Products in the year 1992**

PRODUCT (in tons)		YEAR 1992				INDICES	
		BUS. PLAN	OPER. PLAN	ACTUALS	%OF PLAN MET	92/91	92/90
AMMONIA		346 700	333 000	329 969	99,1	103,2	100,1
SULPHUR		31 000	31 490	32 255	102,4	107,1	94,7
CARBON DIOXIDE		74 000	62 500	62 950	100,7	112,1	106,6
N-HEXANE		7 110	7 360	6 409	87,1	97,6	130,9
ETHYLENE		326 500	327 840	325 367	99,2	113,6	83,9
PROPYLENE		174 860	165 000	168 167	101,9	112,0	88,4
C ₄ CUT		108 310	109 470	107 088	97,8	102,4	75,0
BENZENE		124 350	118 590	112 183	94,6	100,8	66,6
TOLUENE		18 300	18 140	18 167	100,1	106,2	87,0
XYLENE		25 420	22 650	22 904	101,1	98,9	80,4
ETHYLBENZENE		101 900	95 420	96 498	101,1	92,8	83,5
SYNTHETIC SPIRIT		47 000	44 960	45 615	101,5	98,9	81,7
OXOPRODUCTS-TOTAL		48 310	46 870	46 930	100,1	98,1	97,3
OUT OF WHICH	BUTANOLS	26 450	25 470	25 648	100,7	96,4	95,4
	OUT OF WHICH N-BUTANOL	15 410	14 625	14 639	100,1	94,6	95,0
	I-BUTANOL	11 040	10 845	11 009	101,5	99,0	96,0
	OCTANOL	21 860	21 400	21 282	99,4	100,2	99,8
PLASTICS		228 100	215 800	214 570	99,4	103,4	92,0
OUT OF WHICH	POLYETHYLENE	111 900	103 200	102 453	99,3	100,5	88,0
	POLYPROPYLENE	116 200	112 600	112 117	99,6	106,1	95,9
MONOVALENT PHENOLS		14 100	16 500	17 354	105,2	101,1	88,6
OUT OF WHICH	PHENOLS	4 000	5 820	5 928	101,9	107,2	95,8
	O-CRESOL	4 200	3 880	3 943	101,6	120,4	93,3
	MP-CRESOL	2 500	2 320	2 555	110,1	61,5	62,9
	TRICRESOL	1 200	2 000	2 140	107,0	216,2	121,9
	XYLENOLS	2 200	2 460	2 737	111,3	85,3	82,2

Figure 2.2.3-2
Petrochemicals and Miscellaneous Products in the year 1992

PRODUCT (tons)	YEAR 1992				INDICES	
	BUSINESS PLAN	OPERAT. PLAN	ACTUALS	% OF PLAN MET	92/91	92/90
OPTOL	120	120	125	104,2	156,2	30,1
UREA	196 300	183 300	179 418	97,9	97,9	91,0
CARBON BLACK	1 140	420	525	125,0	80,3	57,3

CATALYST IN KG						
31-10	10 000	10 000	10 049	100,5	188,6	149,2
31-13	40 000	40 000	40 027	100,1	63,5	199,6
36-30	20 000	20 000	20 053	100,3		100,2
39-05		8 200	8 300	101,2		
44-00		5 000	9 644	192,9	51,9	33,9
46-00	60 000	31 600	30 750	97,3	764,5	146,7
48-00		7 300	7 336	100,5	348,8	38,0 x

CASTINGS IN TONS						
CASTINGS GREY CAST IRON	200	175	158	90,3	85,4	82,7
-"- COPPER AND ALLOYS	5	3	3	93,5	154,9	173,5
-"- LEAD AND ALLOYS	6	4	4	99,7	95,8	122,3
-"- ALUMINUM AND ALLOYS	1	2	3	121,8	397,8	562,3

WASTE MATERIAL COLLECTED IN TONS						
STEEL SCRAP	9 000	9 000	12 525	139,2	100,6	119,0
CAST IRON SCRAP	200	200	148	74,0	52,7	72,9
COPPER AND ALLOYS	40	30	126	420,4	69,2	175,0
ALUMINUM AND ALLOYS	100	100	234	233,9	163,4	143,4
LEAD AND ALLOYS	6	6	11	187,0	81,7	356,2
WASTE PAPER	60	10	13	131,4	91,1	18,2

ENGINEERING PRODUCTION IN THOUSANDS OF KČS						
SPARE PARTS	28 268	26 000	28 121	108,2	107,0	132,7
CHEMICAL EQUIPMENT	5 654	5 200	5 624	108,2	107,0	132,7

Steam and Power Production and Consumption - 1992

INDICATOR		Spec. Unit	HEATING PLANT 200			HEATING PLANT 700			PLANT 05 TOTAL		
			PLAN	ACTUAL	%	PLAN	ACTUAL	%	PLAN	ACTUAL	%
ELECTRIC POWER											
POWER READILY AVAILABLE NO-FR		MW	107,5	109,2	101,6	66,9	65,2	97,5	174,4	174,4	100,0
GENERATED		MWh	940 000	949 771	101,0	581 000	570 380	98,2	1 521 000	1 520 151	99,9
FROM NATIONAL GRID		MWh							22 000	16 264	73,9
SOURCES TOTAL		MWh	940 000	949 771	101,0	581 000	570 380	98,2	1 543 000	1 536 415	99,6
HEATING PLANT CONSUMPT.		MWh	97 444	98 592	101,2	82 154	77 902	94,8	179 598	176 494	98,3
CONSUMED BY CHEMISTRY		MWh							1 347 402	1 341 330	99,5
SOLD OUTSIDE		MWh							16 000	18 591	116,2
OUT OF WHICH: TO NATIONAL GRID		MWh							16 000	12 947	80,9
: TO OTHERS		MWh							—	5 644	—
CONSUMPTION TOTAL		MWh							1 543 000	1 535 770	99,5
HEAT											
STEAM PRODUCT. IN BOILERS t			6 850 760	6 846 456	99,9	4 413 840	4 232 896	95,9	11 264 600	11 079 352	98,4
STEAM OFF-TAKES BY CONSUMERS	30 atp	t	278 280	231 744	83,3				278 280	231 744	83,3
	26 + 18 atp	t	1 415 160	1 365 120	96,5	1 251 360	1 334 280	106,6	2 666 520	2 699 400	101,2
	3,5 + 2,5 atp	t	1 161 360	1 142 664	98,4	753 600	596 112	79,1	1 914 960	1 738 776	90,8
	SECONDARY SOURCES	tnp							3 470 730	3 376 428	97,3
CONDENSATE DELIVERIES	TURBINE	t	261 480	268 776	102,8				261 480	268 776	102,8
	PURIFIED	t	240 840	280 752	116,6				240 840	280 752	116,6
	FEED WATER	t	702 600	756 000	107,6				702 600	756 000	107,6
	DEMI WATER	t	844 920	892 848	105,7				844 920	892 848	105,7
	SOFT WATER	t	1 305 120	1 323 648	101,4				1 305 120	1 323 648	101,4
	HOT WATER	tnp				17 826	15 432	86,6	17 826	15 432	86,6
HEAT PRODUCED		GJ	8 735 758	8 814 908	100,9	6 107 703	5 846 723	95,7	14 843 461	14 661 631	98,8
HEAT CONSUMED		GJ							24 143 461	23 708 946	98,2
FUELS CONSUMED		GJ	22 958 176	23 644 926	103,0	14 413 216	13 545 592	94,0	37 371 392	37 190 518	99,5

2.3 Komorany activities in Most / Litvinov

- Komorany District Heating Company was recently privatized as the Prvni Severozapadni Teplarenska Akciová Společnost. It operates a heating plant at Komorany (near Most) and supplies the cities of Most, Litvinov and Chomutov with district heating. Because of mining activities the pipelines to Chomutov are decommissioned and the town is now being supplied with district heating from the nearby Pronerov I and II Power Plants
- The Komorany Plant was built between 1951 and 1959 as an electric generating plant with an output of 228 MW
- In 1966-1968 the 180 meter high stack was added
- In 1969 the plant was converted to be primarily a district heating plant retaining only 110 MW of power production
- The Plant supplies heating to approximately 50,000 households
- Komorany employs approximately 700 people in the boiler house and 100 people on pipeline maintenance etc
- For further details, see section 2.8

2.4 DUK activities in Most / Litvinov

- * The north Bohemia Coal Basin has been mined since the late 18th century
- * Coal mining has been carried out industrially in the Most / Litvinov area for more than 100 years. Originally underground shaft / chamber methods used, currently open cast mining
- DUK is one of the major mining companies in the region and together with some other local mining companies will be privatized as the Most Coal Mining Company
- The new company will have 16,000 employees
- DUK operates a number of mining areas including the CSA mine at Litvinov. Total reserves of coal are sufficient to extract at the current rate of 6-8 million tons per year up to the year 2060
- DUK operates several coal preparation units including the Herkules Plant at Litvinov which has coal washing, classification / crushing equipment and a heavy media separation unit
- Currently DUK supplies Chemopetrol, Komorany and other local consumers
- SYNCHEM will be supplied with 16 - 17 MJ/kg (LHV) run of mine coal from the CSA mine. Reserves of this coal amount to be about 400 million tons. Current concession is sufficient for supply at a rate of 4 million tons per year up to the year 2010. An extension of the mining concession after year 2010 must therefore be agreed.
- A large scale (100 ton) sample of this coal was pilot plant tested at Texaco Montebello, California.
- The current CSAR mining concession limit protects villages with a total population of about 1500
- An extension of the mining concession has to be obtained from the national and regional authorities.

2.5 CEZ / SEZ Activities

2.5.1 CEZ Activities

2.5.1.1 General

- * CEZ is the primary power generation company in the Czech Republic representing over 80% of the country's generating capacity
- * CEZ owns and operates 22 large power plants of which 16 are coal fired, 5 are hydro powered and one is nuclear
- * CEZ is also the owner and operator of the high voltage power transmission grid
- * CEZ sells the electricity it produces to eight regional power distribution companies and in some cases directly to industrial consumers
- * CEZ also imports and exports electricity
- * CEZ is the largest company in the Czech Republic in terms of total assets and number of employees. For the twelve-month period from 1 May 1992 to 30 April 1993, CEZ posted sales of CEK 51.5 billion, pretax profit of CEK 23.6 billion and profit after tax of CEK 10.6 billion. Total assets as of 30 April 1993 amounted to CEK 86.8 billion and the company had shareholders equity of CEK 73.5 billion. CEK had 15 843 employees on April 1993

2.5.1.2 Power production

<u>Power plants</u>	<u>Installed capacity (MW)</u>	<u>Available capacity (MW)</u>
coal fired	8 467	8 324
nuclear	1 760	1 760
hydro	1 214	1 196
total	11 441	11 280

(cont'd)

2.5.1.2 Power production (cont'd)

- CEZ's 1992 annual production of 47 458 GWh was produced in the proportions shown against the generation methods below

<u>Power plants</u>	<u>GWh</u>	<u>%</u>
coal fired	34 054	71.8
nuclear	12 250	25.8
hydro	1 154	2.4

- CEZ imported 987 GWh and purchased 2 816 GWh of power from the industrial companies with excess capacity.
- The power available for sale was 46 263 GWh, excluding its consumption and transmission losses
- Forecast power production (source: CEZ) :

	Production (GWh)
1993	42 337
1994	42 734
1995	43 841
1996	44 054
1997	43 543
1998	44 151

(cont'd)

2.5.1.2 Power production (cont'd)

- A summary of the major power plants with capacity to generate over 50 MW, their installed capacity, type of fuel used and year in which operations commences are shown below :

- Fossil fuels plants

<u>Power plant</u>	<u>Installed capacity (MW)</u>	<u>Type of fuel used</u>	<u>Start of operations</u>
Prunerov 1	6 x 110	lignite coal	1967-1968
Prunerov 2	5 x 210	lignite coal	1980-1982
Tusimice 1	6 x 110	lignite coal	1963-1964
Tucimice 2	4 x 200	lignite coal	1974-1975
Melnik 1	6 x 55	lignite coal	1961
Melnik 2	4 x 110	lignite coal	1971
Melnik 3	1 x 500	lignite coal	1981
Tisova 1	2 x 50	lignite coal	1958-1959
	2 x 55	lignite coal	1959
	1 x 12	lignite coal	1960
Tisova 2	1 x 100	lignite coal	1960
Hodonin	2 x 50	lignite coal	1954-1958
	2 x 55	lignite coal	- " -
Poilci	3 x 55	hard coal	1957
Chvaletice	4 x 200	lignite coal	1978
Dermarovice	4 x 200	hard coal	1975-1976
Ledvice 1	1 x 200	lignite coal	1967
Ledvice 2	4 x 110	lignite coal	1966-1969
Pocerady 1	4 x 200	lignite coal	1070-1971
	2 x 200	lignite coal	1977

(cont'd)

2.5.1.2 Power production (cont'd)

- Hydroelectric power plants

<u>Plant name</u>	<u>Installed capacity (MW)</u>	<u>Type</u>	<u>Start of operations</u>
Lipno 1. 2	2 x 60	storage	1959-1960
Orlik	4 x 91	storage	1961-1962
Slapy	3 x 48	storage	1954-1955
Stechovice 1. 2	2 x 11.25 2 x 20	pump storage and storage	1943-1947
Dalesice	4 x 112.5	pump storage	1978

- CEZ operates one nuclear power plant at present and a second one is under construction

<u>Plant name</u>	<u>Installed capacity (MW)</u>	<u>Status</u>	<u>Start (or anticipated start) of op.</u>
Dukovany	4 x 440	in operation	1985-1987
Temelin	2 x 981	under constr.	1996-1998

2.5.1.3 Power Transmission

- CEZ owns and operates the Czech Republic's high voltage power transmission grid (220-400kV) and the transformers which reduce such voltage to voltages used by the REPs (110kV)

<u>Voltage</u>	<u>Length</u>
220 kV	1 540 km
400 kV	2 504 km
total	4 044 km

CEZ's total transformer capacity :

<u>Type</u>	<u>Capacity</u>
400 to 220 kV	1 930 MVA
400 to 110 kV	7 320 MVA
220 to 110 kV	4 793 MVA
total	14 043 MVA

In 1992, CEZ sold power to the eight REPs and six major direct industrial consumers. These power sales were :

	<u>GWh</u>
REPs	
PRE (Prague region)	4 046
STE (Central Bohemia)	5 759
JCE (Southern Bohemia)	2 836
ZCE (Western Bohemia)	3 082
SCE (Northern Bohemia) (SEZ)	5 094
VCE (Eastern Bohemia)	5 100
JME (Southern Moravia)	6 923
SME (Northern Moravia)	9 233
Industrial customers	165
total	42 238

(cont'd)

2.5.1.3 Power transmission (cont'd)

- * CEZ is currently a member of the Central Controlling Organisation of the Interconnected Power Systems ("CDO") which includes the Czech Republic, Slovakia, Hungary, Poland, Rumania, Bulgaria, Ukraine Russia and the former GDR.
- * The CDO network was historically separated from the West European power system, UCPTE
- * The CDO network operates with slightly different technical specifications (primarily different mains frequency control methods) from UCPTE
- * The interconnection of the two systems is possible through converters (DC links) where electricity is transformed from AC to DC and then back to AC to allow final transmission
- * CEZ is connected to UCPTE through to 400 kV DC links with the Austrian and German Systems
- * CEZ is planning to shift fully to the UCPTE network in 1996
- * CEZ international (excluding SEP) imports and exports of electricity for 1992 are shown in the table below

	<u>Imports (GWh)</u>	<u>Exports (GWh)</u>
Austria	291	208
Germany	310	104
Italy	-	804
Switzerland	-	282
Croatia	-	139
Others ¹⁾	386	141
Total	987	1 678

1) includes mutual exchanges between CDO member countries

2.5.2 SEZ Activities

- SEZ operates the Northern Bohemia regional 110kV electrical power distribution network (see Figure 2.5.2-1 Main Transmission Lines)
- Current capacity of the network is 900 MW
- Over 90% of this power is supplied from CEZ lines 400/110 kV and 220/110 kV transformers
- The remaining 10% of the power is from local generators
- The capacity of the SEZ grid locally to SYNCHEM and Chemopetrol is such that a maximum net generation export of 310 MW can be absorbed of which 220 MW can be distributed via Vyskov and about 90 MW via Chotejovice

2.6 Existing Steam and Electricity Generation at Chemopetrol

2.6.1 T700 (start-up 1962)

- T700 comprises :
 - Seven (7) coal fired steam boilers with 125 tph capacity each
 - Four (4) double extraction condensing turbines of 25 MW generation capacity each
 - One (1) 6 MW back pressure turbine (not currently in use)
- In 1990 T700 supplied the following steam quantities

<u>pressure, bar</u>	<u>Temp, °C</u>	<u>Quantity, ton</u>
22	361	1 146 888
5.8	242	186 072
3.0	171	568 584

2.6.2 T200 (start-up 1941)

- T200 comprises :
 - Twelve (12) coal fired steam boilers with 100 tph capacity each
 - Seven (7) double extraction turbines of 22.5 MW capacity each
 - Two (2) condensing turbines of 16.5 MW capacity each
- In 1990 T200 supplied the following steam quantities :

<u>pressure, bar</u>	<u>Temp, °C</u>	<u>Quantity, ton</u>
30	441	258 696
16	338	1 289 136
3.5	198	125 616
2.5	146	838 896

2.6.3 Overall Production Statistics in 1990

	<u>T200</u>	<u>T700</u>	<u>Total</u>
Boiler steam output (TJ)	17,000	12,000	29,000
Turbine power output (GWh)	939	603	1,542
Power plant electrical consumption (GWh)	92	80	172
Total power supplied (GWh)	847	523	1,370
Of which			
- to CHP (GWh)			1,357
- to others (GWh)			13

2.7 Chemopetrol Requirements

2.7.1 Expected Future Demand

		Winter max	Winter average	Summer average	Total per year
Power		184 MW	178 MW	170 MW	1,525 GWh
Steam	31 bara, 450 °C	52 t/h	45 t/h	32 t/h	335,000 t
	19 bara, 300 °C	327 t/h	290 t/h	215 t/h	2,208,000 t
	3.5 bara, 180°C	334 t/h	286 t/h	170 t/h	1,995,600 t
	Max demand	713 t/h			

2.7.2 Expected Delivery from Revamped T700 (50%) with T200 Shutdown

		Winter max	Winter average	Summer average	Total per year
Power		54 MW	48 MW	33 MW	357 GWh
Steam	31 bara, 450 °C	nil	nil	nil	nil
	19 bara, 300 °C	77 t/h	78 t/h	105 t/h	802,000 t
	3.5 bara, 180°C	266 t/h	230 t/h	117 t/h	1,520,000 t
	Max delivery	343 t/h			

Note Revamped T700 (50%) comprises :

- 4 new boilers rated for 135 t/h steam @94 bara,540°C
- One line Flue Gas Desulphurization & Baghouse
- New Stack
- New Honeywell TCD 3000 control system
- 4 refurbished extraction condensing turbines and generators

2.7.3 Chemopetrol Requirements to be supplied by SYNCHEM

		Winter max	Winter average	Summer average	Total per year
Power		130 MW	130 MW	137 MW	1,168 GWh
Steam	31 bara, 450 °C	52 t/h	45 t/h	32 t/h	335,000 t
	19 bara, 300 °C	250 t/h	212 t/h	110 t/h	1,406,000 t
	3.5 bara, 180°C	68 t/h	56 t/h	53 t/h	465,600 t
	Max demand	370 t/h			

2.8 Existing Heat and Electricity Generation at Komorany

2.8.1 Boilers

- The Komorany Plant has a total of 10 boilers as follows (April 93):
 - 6 boilers 110 tph steam generation capacity with ESP unit reconstructed
 - 2 boilers of 90 tph steam generating capacity without ESP unit reconstructed
 - 2 boilers shut down for ESP unit reconstruction

2.8.2 Turbines

- Total 8 turbogenerators with a total generating capacity of 218 MW
- For turbogenerator details, see Figure 2.8.2-1

2.8.3 District / Space Heating

- Production and supply to Most, Litvinov and DUK :

	<u>1992</u>	<u>1993</u>
Production	4040 TJ/yr	4220 TJ/yr
Useful supply	3657 TJ/yr	3852 TJ/yr

- Heating output curve for heating season 1991/92, see Figure 2.8.3-1

2.8.4 Electricity Production

- See curves for the back-pressure and condensing turbine modes of power production for the year 1992, Figure 2.8.4-1

Figure 2.8.3-1**Heating Output Curve for Heating Season 1991 / 1992**

Figure 2.8.4-1

**Back Pressure mode and Condensing Turbine modes of
Power Production for the Year 1992**

2.9 Komorany Requirements

2.9.1 Expected Future District Heating Demand

	1998	Design basis after 1998
Production :	4600 TJ/year	4800 TJ/year

2.9.2 Hot Water Demand

2.9.3 Komorany Future Production

	<u>SYNCHRO Initial Base Case</u> *	<u>SYNCHRO Commercial Supply Case</u> * •	<u>SYNCHRO no District Heat Supply Case</u> * • •
Komorany Retrofit Program	None	Partial	Full
Nº of boilers for :			
- continuous operation	-	2	8
- peak operation	-	2	2
SYNCHRO district heat supplies baseload	190 MW	135 MW	0 MW

*) As presented in this Chapter 2

**) As described in

- Chapter 4 : Commercial Arrangements
- Chapter 8 : Overview of Alternate Cases

• • •) Has been studied but is not part of this report

2.10 IGCC Plant Description (Sizing and Configuration)

2.10.1 Project battery limit and ISBL / OSBL interface

The SYNCHEM project is divided into two parts :

ISBL The IGCC installation processing coal and HVR to electric power, steam and hot water with liquid sulphur and slag as by-products. This represents the Inside Battery Limit (ISBL) installation

OSBL The part of the project falling outside the actual IGCC plant, but which is necessary in order to bring the new installation into operation. This part is described as the Outside Battery Limit (OSBL) installation

(cont'd)

2.10.1 Project battery limit and ISBL/OSBL Interface (cont'd)

Inside battery limit installations

- * Air Separation Unit
- * Coal And HVR Gasification
- * Low temperature Gas Cooling, Syngas Saturation and Expansion .
- * Acid Gas Removal
- * Sulphur Recovery and Tail Gas Treatment
- * Combined Cycle Unit
- * Steam System with Steam Export Facility
- * Hot Water Delivery System
- * Plant Utilities

Outside battery limit installations and activities

- * Electrical High Voltage Interconnections (see section 2.15)
- * Hot Water Pipeline System (see section 2.16)
- * Steam System Interconnections (see section 2.17)
- * Railroad Installation (see section 2.18)
- * HVR system (see section 2.18)
- * Raw Water System (see section 2.18)
- * Site Preparation Activities (see section 2.19)

2.10.2 Background to Data Presentation

- * The heat and material balance (HMB) is calculated for 4 different ambient temperatures representing low ambient (I) , winter average (II), summer average (III) and high ambient (IV).
- * Average of the winter and summer average cases provides base for an approximate annual performance calculation.
- * Data given in this document will refer to these cases or to the yearly average calculated as being $(II + III) / 2$

2.10.3 Feedstock Specifications

COAL

Ultimate analysis, dry basis

C	59.59	w %
H	5.16	"
N	0.89	"
S	1.33	"
O	15.21	"
Ash	17.82	"
Cl	100	w ppm

Moisture in coal (as received)	30	w %
Higher heating value (-"-)	17.526	MJ/kg
Lower heating value (-"-)	16.744	"

HVR

Ultimate analysis, dry basis

C	85.22	w %
H	10.47	"
N	0.59	"
S	3.65	"
O	0.00	"
Ash	0.07	w ppm

Higher heating value	42.100	MJ/kg
Lower heating value	39.879	"

2.10.5 Coal and HVR Gasification

- The gasification unit employs the Texaco Gasification Process (TGP) in the quench mode of operation
- * Coal slurry preparation, gasification and slag handling sections are laid out as 4 parallel 25% capacity trains
- * To reduce coal ash fusion temperature, a flux agent is added to the coal slurry
- * The unit produces a water saturated raw gas free of particulates mainly consisting of CO, H₂ and CO₂ with feedstock sulphur in the form of H₂S / COS
- * The ash in the feedstocks is removed from the process as coarse and fine slag
- The unit does not produce any water effluent leaving ISBL

(cont'd)

2.10.5 Coal and HVR Gasification (cont'd)

Key Data (at - 9°C)

Gasification unit feedstocks

Coal to gasification	269.4 ton/h (30% water)
HVR - " -	80.8 - " -
Water - " - (recycled)	132.7 - " -
Flux - " - (as CaCO ₃)	18.7 - " -
Oxygen - " -	202 885 Nm ³ /h (95% oxygen)

Gasifier product gas (before quenching) ¹⁾

Total gas product (wet)	36567.8 kmol/h
wherof CO	9741.9 - " -
H ₂	10078.6 - " -
CO ₂	5466.5 - " -
CH ₄	26.3 - " -
H ₂ S	166.1 - " -
COS	4.2 - " -
H ₂ O, N ₂ , Ar	to 100 %

Gasifier pressure 66 bar

Gasification unit by-products

Coarse slag	71.3 ton/h (50 w% water)
Fine - " -	22.3 -" (60 w% water)

- 1) The raw gas leaving the TGP unit after the particulate scrubber has a slightly different (<<1%) dry gas content than gasifier product gas

2.10.6 Low Temperature Gas Cooling, Fuel Gas Saturation and Expansion

- * The unit consists of 2x50% capacity trains
- * LTGC cools the raw gas from about 250°C to 40°C
- * Upper cooling section produces 23 and 8 bar steam and supplies heat for the high pressure saturator
- * Lower cooling section supplies heat for steam condensate reheat
- * The raw gas is hydrolyzed to convert most of the COS in the raw gas to H₂S (to simplify sulphur removal)
- * After sulphur removal the clean fuel gas is saturated, heated and expanded before being piped to the combustion turbine
- * BFW at 300°C from HRSG in CC unit is used for expander preheat and saturator circuit make-up water
- * Hot condensate from upper cooling section is recycled to the TGP unit
- * Cold condensate from lower cooling section is, after stripping, recycled to the TGP unit

(cont'd)

2.10.6 Low Temperature Gas Cooling (cont'd)

Key data (at -9°C where applicable) :

* Cooling duty for the cooling train between 250 and 40°C		558.5 MW
* Steam generation	23 bar	385 t/h
	8 bar	218 t/h
* Saturation level downstream saturator		35 %
* Expander data	Pressure in	56 bar
	out	22 bar
	Flow	37954.6 kmol/h
	Power production	30 MW (2x15MW)
* Gas to combustion turbine		
	CO	25.6 mol %
	H ₂	26.5
	CO ₂	11.48
	H ₂ O	35.0
	CH ₄	0.07
	Ar	0.83
	N ₂	0.52
	H ₂ S } COS }	37 ppm (v)
	Flow rate	37954.6 kmol/h
	Pressure	22.1 bara
	Temperature	187.1 °C

2.10.7 Acid Gas Removal, Sulphur Recovery (Claus) & Tail gas Treatment

- The sulphur removal and recovery system consist of
 - a chemical wash system as AGR unit for fuel gas purification
 - an oxygen blown Claus plant
 - a Scot type tail gas treatment (TGT) plant in which also the acid gas from the AGR unit is reabsorbed and therefor concentrated before being sent to the Claus plant together with the tail gas of the Claus plant
- The units consists of 2x50% capacity trains
- The AGR unit is an amin based process with no need for refrigeration
- The AGR plant delivers its acid gas stream to the TGT unit

(cont'd)

2.10.7 Acid Gas Removal, Sulphur Recovery (Claus) & Tail gas Treatment (cont'd)

- The Claus plant uses oxygen as oxidant in its thermal reactor step and downstream a three step catalytic reactor arrangement
- The Claus plant receives its major acid gas feed stream from the stripper in the TGT unit
- The TGT unit removes the sulphur components in the acid gas from the AGR plant (Absorber #1) and from the Claus tail gas (Absorber #2) using an amin solvent
- The absorbed sulphur components are stripped in the TGT stripper and recycled to the Claus plant
- Absorber #1 overhead stream is combined with tail gas from the Claus unit and thereafter hydrogenated to convert various S components into H₂S
- After quench cooling the hydrogenated gas is sent to Absorber #2 in which H₂S is absorbed
- Overhead stream from absorber #2 is routed via a catalytic incinerator to the HRSG stack
- Key data (at -9°C) :

- Overall sulphur recovery rate	> 98.5 %
- Sulphur recovery rate for the Claus + TGT units	> 99.95 %
- AGR unit amine solvent selectivity	
Percent of H ₂ S removed in absorber	99.9 %
CO ₂	20 %
COS	30 %
- H ₂ S concentration in AGR acid gas	12 %
TGT recycle gas	41 %
- Oxygen (as 100% oxygen) consumption in Claus plant	2354 Nm ³ /h
- Fuel gas consumption (LHV) in hydrogenation reactor	0.55 MW
- Sulphur production	5.38 t/h
- Sulphur emission from TGT (as SO ₂)	51 kg/h

2.10.8 Combined Cycle Unit

- The combined cycle unit consists of two GE STAG 109FA (STAG™ = meaning STeam And Gas)
- Each STAG unit is composed of
 - one GE MS 9001 FA gas turbine-generator
 - one Heat Recovery Steam Generator (HRSG)
 - one double flow reheat steam turbine-generator

in combined cycle operation

(cont'd)

2.10.8 Combined Cycle Unit (cont'd)

- Steam for internal use within the gas processing plant is withdrawn from the steam generators within the process plant after which the excess steam is fed to the Combined Cycle Unit steam system
- The combustion turbine (CT) is of the "F" generation with high (1300°C) expansion turbine inlet temperature, giving a high net power efficiency, high (approx 575°C) exhaust flue gas temperature and thus a good base for efficient steam production in the HRSG
- * The CT combustor is designed to minimize NOx formation
- * The CT powers a hydrogen cooled synchronous generator
- * The CT can also operate on distillate as back-up fuel
- * The CT is designed for steam injection in order to keep constant output from the CT at high ambient temperatures
- * The HRSG utilizes CT exhaust to generate and superheat steam and to heat BFW streams
- The HRSG is comprised of low pressure (LP), intermediate pressure (IP), reheat and high pressure (HP) sub-systems
- * The reheat system combines HP turbine outlet steam with IP superheated steam, adds additional superheat and delivers this steam to the IP turbine
- * Superheated HP, IP and LP steam are delivered from the HRSG steam system to CHP
- Part of the BFW for HP steam generation is used for expander preheat and saturator make-up in the LTGC unit (see 2.10.6)
- The steam turbine is a three casing, double flow reheat machine coupled to a hydrogen cooled synchronous generator
- Condensate from the LP turbine condensor is combined with make-up water and thereafter reheated in the LTGC unit after which it is mixed with gas production plant condensate plus CHP return condensate and sent to the deaerator

(cont'd)

2.10.8 Combined Cycle Unit (cont'd)

* Key data (total for both trains)

Key data (total for both trains)	Case			
	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
Ambient temp, °C	- 9	+ 1	+15	+29
<u>Combustion Turbine Data</u>				
Fuel gas to CT (LHV), MW	1446	1436	1428	1417
- " - pressure, bar	20	20	20	20
- " - temp, °C	187	187	187	187
Steam injection,@23bar/>314°C,t/h	0	0	53.3	168.6
<u>HRSG Data</u>				
Flow rate, t/h	4868	4870	4850	4719
Flue gas to stack, °C	124	124	124	124
NOX emission,@15%O2 & dry, ppm	25	25	25	25
<u>Steam Turbine Data</u>				
HP & IP superheat, °C	538	538	538	538
HP turbine inlet flow, t/h	459.4	454.9	453.3	475.9
LP - " - outlet flow, t/h	488.6	580.6	770.1	716.1
LP - " - outlet temp,°C	26	26	33	43
Cooling water temp rise, °C	5.3	6.3	8.3	7.8
Cooling water duty, MW	308	365	478	445
<u>Condensate System Data</u>				
Make-up water to steam system, t/h	438.9	412.0	403.4	506.0
<u>Steam to CHP</u>				
HP, IP, LP steam supply	<u> </u>	see 2.10.9		<u> </u>
Condensate return temp, °C	<u>80</u>	80	80	80
Condensate return flow	<u> </u>	50% of supply <u> </u>		
<u>Combined Cycle Performance</u>				
CT output, MW	550	550	550	550
Steam turbine output, MW	208.0	233.8	276.0	246.8
Auxillary power, MW	11.7	11.8	12.1	12.1
Net output from CC	746.3	772	813.9	784.7

2.10.9 Steam System Principle

- Saturated 4.5, 8 and 23 bar steam is produced within the gas production unit
- Steam not used within the gas production plant and for hot water heating is exported to the CC unit steam system
- Steam for CHP at three pressure levels is exported from the CC unit steam system
- Steam pressure in export pipes must be high enough to overcome pressure losses in the about 2 km long pipe line
- Three back-up steam boilers with capacities corresponding to one CC Unit train out of operation, is provided as shown above
- Regarding OSBL, see 2.17

(cont'd)

2.10.9 Steam System Principle (cont'd)

	Case			
	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
Ambient temp, °C	- 9	+ 1	+15	+29
Steam prod. within process plant				
23 bar, t/h	385	383	381	378
8 bar, t/h	218	216	215	214
4.5 bar, t/h	58	58	53	59
Steam for hot water production				
8 bar, t/h	139	76	0	0
4.5 bar, t/h	75	75	0	0
Steam export to CHP				
31 bar/450°C at CHP	50	45	32	32
19 bar/300°C at CHP	246	212	110	90
3.5 bar/180°C at CHP	66	56	53	52
Back-up boilers fueled with LS fuel oil				
One boiler @34 bar with capacity 26 t/h				
Two boilers @23bar with capacity 74 t/h				

2.10.10 Hot Water delivery System

NOTE: For cases with divided base load between SYNCHEM & Komorany, Peak Boilers are moved to Komorany site

- The hot water production from the gas production plant is based on the quantity and temperature of waste heat available
- Intercoolers within ASU comprises the waste heat sources within the gas production plant
- Steam heaters provides extra heat to the hot water supplied from the ASU in order to reach demanded capacity or/and temperature
- To supply the required heat capacity for the coldest days of the year, four peak boilers are connected in parallel to the IGCC heat sources
- * An accumulator could be provided to even out the daily variations in the grid and make the heat production facility to operate with less variations in load
- Peak boilers are also used as back-up boilers if the IGCC plant can not provide its required capacity
- The capacity of the four back-up boilers is sufficient to., together with one of the IGCC trains, provide maximum required capacity to the heating network
- * Regarding OSBL, see 2.16

(cont'd)

2.10.10 Hot Water Delivery System (cont'd)

Initial Base Case

- For the SYNCHEM Initial Base Case, max supply of district heat, heat deliveries shall be according to the load diagram and the supply and return temperatures on Figure 2.10.10-1

	Case			
	I	II	III	IV
Ambient temp, °C	- 9	+ 1	+15	+29
ASU heat capacity, MW	57	64	46	46
Steam heater capacity				
- 4.5 bar steam, MW	45	45	0	0
- 8 bar steam, MW	79	43	0	0
Peak boiler capacity, MW	277	108	0	0
Return temperature, °C	68	65	60	60
Supply temperature, °C	150	134	90	90

- Daily variation of heat capacity: about 25%
- Back-up / peak boilers fueled with LS fuel oil :
 - N° of boilers : 4
 - Capacity : 91 MW heat production each

Commercial Supply Case

- For the SYNCHEM Commercial Supply Case, see Chapter 4 and 8

Figure 2.10.10-1**Hot Water Demand together with Supply and Return Temperatures**

2.10.11 Plant Utilities, Offsites and Other Services

- The IGCC plant is supported by a number of utility systems as listed bellow
 - a. Plant instrument air
 - b. Potable water
 - c. Raw water, Service water, Fire water
 - d. Clarified water
 - e. Demineralized water
 - f. Sewer system
 - g. Waste water system
 - h. Solids storage run-off
 - i. Cooling water
 - j. Condensate collection
 - k. Flare system
 - l. Electrical system within site
 - m. Coal receiving & Storage
 - n. Flux receiving & storage
 - o. HVR receiving
 - p. Back-up fuel - distillate
 - q. Back-up fuel - LS fuel oil

- * Below follows highlights of certain systems

(cont'd)

2.10.11 Plant Utilities, Offsites and Other Services (cont'd)

c - h Various Water Systems

- * Raw water is used at three quality levels
 - as raw water
 - as clarified water
 - as clarified and demineralized water
- * Figure above shows various water streams handled separately in water purification equipment producing
 - "sludge" which can be added to the coal slurry
 - "plant water effluent" which is mixed with clean Storm Water Runoff and sent to recipient
 - "gasification slurry prep water" used for coal slurry preparation

(cont'd)

2.10.11 Plant Utilities, Offsites and Other Services (cont'd)

I. Cooling Water

Cooling tower consists of 18 cells of the induced draft type

Design Ambient conditions	29 °C 70% relative humidity
Cooling tower range	14 °C
Cooling water temperature	normal 21 to 27 °C maximum 29.4 °C

Make-up water to the cooling water circuit is a combination of clarified raw water and flashed boiler blowdown

k. Flare System

Designed to handle full flow of syngas

Flare dimensions :	height 43 m diameter 1.14 m
Safety area with limited access :	46 m radius around flare

(cont'd)

2.10.11 Plant Utilities, Offsites and Other Services (cont'd)

I. Electrical System within Site (see figure 2.10.11-1)

- Power is distributed within the plant by three double-ended distribution systems

One : STAG 109F N° 1 provides power for :

- its aux substation
- one coal handling system
- two cooling tower substations
- two gasifier systems
- one ASU distribution system

Two : STAG 109F N° 2 provides power for:

- identical to N° 1

Three : A common 33 kV system connected to the 400 kV incoming system provides power for

- one ASU distribution system
- the aux system of the total plant (administration building, warehouse, etc)
- the 7 large ASU compressors

- * The system configuration will allow the use of "across the line" starting of the large compressors and serve as a swing bus to provide power to one of the gasifiers and one of the ASU
- * Production voltage level for the combustion and steam turbines is 15 kV, 50 Hz
- * The various electrical systems inside the plant are
 - 15 kV system for generators
 - 33 kV system for big compressors
 - 11 and 6.6 kV medium voltage system
 - 400 V low voltage system
 - direct current and vital AC systems
- * Step-up transformers from generator level to the voltage level of the receiving grid, see also 2.15

(cont'd)

Figure 2.10.11-1
Electrical Main CKT One Line Diagram

NOTE: Based on GE Main CKT One Line Diagram SK-PSS-05 12 93-1
 Adjusted by NYKOMB (high voltage level, expander added, list of large compressors, N^o of gasifier trains)
 All data are preliminary and subject to change

2.10.11 Plant Utilities, Offsites and Other Services (cont'd)

m. Coal Receiving and Storage

- * Two parallel tracks for unloading of coal trains
- * Two coal trains per day
- * Design unloading time per day: 2.5 hours
- * A simple bottom unloading station taking one car at a time
- * Open coal storage in the form of two 2-day active piles
- * 2 x 100% conveyers from train to piles and 2 x 100% enclosed conveyers from piles to coal bins in the gasification unit
- * Dust collection and suppression system
- * Rain and dust suppression water used as slurry water in the coal slurry preparation section

n. Flux Receiving and Storage

- System is similar to the coal system but 1 x 100% conveyers and one pile is included
- * One train with flux agent per week

o. HVR Receiving

- * Charge oil drum (30 minutes capacity) is provided within the TGP Unit
- Transfer system from CHP, see 2.18

p. Back-up Fuel - Distillate

- * Supply system from main storage, see 2.18

q. Back-up fuel - LS Fuel Oil

- * Supply system from main storage, see 2.18

2.10.12 Project Summary Table (Mass and Energy Data)

- The following table is the summary result of the Phase 1 Feasibility Work as presented by the US Consortium in May 1993
- It should be specifically noted that this design provides the full need for district heat for the towns of Most and Litvinov plus the Mine as per the SYNCHEM Initial Base Case
- Maximum 181 MW of district heat is provided by waste heat plus steam heaters while the rest to the maximum of 458 MW is supplied by oil fired heaters
- The steam delivery to the CHP complex is based on the assumption that CHP revamps 50% of its T700 boiler station and that the remaining need of steam for CHP will be provided by SYNCHEM

Note : The SYNCHEM Commercial District Heat Supply Case provides max 135 MW of base load district heat while the balance of the requirements is supplied by two retrofitted Komorany boilers in base load operation and an additional two retrofitted boilers, assumed to be held by Komorany, for peak load and condensing operation

See Chapter 4 and 8

(cont'd)

2.10.12 Project Summary Table (Mass and Energy Data) (cont'd)

	Case			
	I	II	III	IV
Ambient temp, °C	- 9	+ 1	+15	+29
<u>Feeds</u>				
Coal consump. (as received), t/day ¹⁾	6466	6422	6388	6338
HVR cosumption, t/day ²⁾	1940	1927	1916	1901
Flux (dry), t/day	449	446	443	440
LSFO, MW (LHV)	308	120	-	-
<u>Products</u>				
Power production				
- Combined cycle, MW	758	783.8	826	796.8
- Expander, MW	30	29.8	29.6	29.4
Power consumption				
- ASU, MW	111.1	111.5	107.5	108.7
- Gas production, MW	14.5	14.5	14.5	14.5
- Combined cycle, MW	11.7	11.8	12.1	12.1
- Rest of plant, MW	6.7	6.7	7.5	7.5
Power production (net), MW	644.0	669.1	714.0	683.4
Hot water production, MW				
- From process plant, MW	180.7	152	44.6	44.4
- From boilers, MW	277.3	108	-	-
Total hot water production, MW	458.0	260	44.6	44.4
Steam production				
- HP, t/h	50	45	32	32
- MP, t/h	246	212	110	90
- LP, t/h	66	56	53	52
Sulphur, t/day	129	128	128	127

1) Coal HHV = 17.526 MJ/kg and LHV = 16.744 MJ/kg

2) HVR HHV = 42.1 MJ/kg and LHV = 39.879 MJ/kg

2.11 Gasification Test results

2.11.1 Objectives

- To demonstrate the feasibility of co-feeding brown coal slurry and HVR to the TGP gasifier
- To demonstrate the requirements to achieve slagging conditions using flux agent
- To verify gasification performance estimates
- To obtain solids effluent streams data
- To obtain environmental data, particularly for metals

2.11.2 Overall results

- HVR and brown coal were fed simultaneously to the gasifier at HVR/coal weight ratios from 29/71 to 53/47 calculated on a dry basis
- Addition of fluxing agent allowed the coal ash slag to be removed from the gasifier reaction chamber
- The slag was easily removed from the lock hopper in a continuous manner
- Gasifier operation was stable at temperatures from 1307°C (at high flux content) to 1404°C (at the low flux content)
- The gasifier operated at carbon conversion above 99.8%
- The produced char (the fine fraction from gasifier) was easily concentrated by settling
- Gasification performance estimates were verified

2.11.3 Test Schedule

- Scoping run
 - Three scoping runs were carried out
 - to test HVR / coal feed system
 - to test burner type
 - to determine quantity of flux required
 - to test the overall facility in preparation for the variable study run which was to follow
- Variable Study Run
 - The variable study run was divided into five periods according to the following table

TEST PERIOD	HOURS OF TEST	NOMINAL HVR/COAL RATIO 1)	NOMINAL %FLUX	GASIFIER TEMP °F/°C	%CARBON CONVERSION	SLAG QUALITY
A	33	34/66	30	2585/1418	99.9	GOOD
B	13	53/47	30	2580/1416	99.9	GOOD
C	26	33/67	30	2385/1307	99.9	GOOD
D	8	29/71	30	2513/1378	99.8	GOOD
E	11	34/66	20	2560/1404	99.9	GOOD

1) Dry basis by weight

Test Period	Objective
A	<ul style="list-style-type: none"> - to demonstrate a steady long term operation - to ensure that slag can be removed
B	<ul style="list-style-type: none"> - to demonstrate 50/50 HVR to coal ratio - to investigate the settling of unconverted carbon, if any
C	<ul style="list-style-type: none"> - to determine minimum stable operating temperature at 30/70 HVR/coal ratio
D	<ul style="list-style-type: none"> - to demonstrate operation at 25/75 HVR/coal ratio
E	<ul style="list-style-type: none"> - to determine minimum stable operating temperature at 30/70 HVR/coal ratio when nominal percentage of flux was lowered to 20%

2.11.4.4 Material and Energy Balances

- Material and Energy balances from the test verified the Estimate of Operation on which the Phase I Feasibility Report has been based

2.11.4.5 Waste Water data

- The process design of Phase I estimated that no waste water will be produced from the TGP section of the SYNCHEM plant
- The MRL pilot unit produced a waste water stream which could not be recycled because of the plant configuration
- The waste water had the following typical values for certain parameters

<u>Component</u>	<u>mg/l (typical)</u>
ammonia	1 700
cyanide	100 1)
flouride	100
formate	150
thiosulphate	300
thicyanate	20
COD	600
TDS	400
TSS	1 000

1) at HVR/coal ratio of 50/50 the value was 450

2.11.4.6 Environmental data

- No component exceeds the Federal Limits of leaching from the coarse and fine slag and the clarifier bottoms (char) for the various metals which has limits.
- Corresponding tests on gas and water streams leaving the facility also falls well within the Federal Limits

2.12 CHP Steam Security

- The steam demand for the CHP complex is described under 2.6 - 2.7
- T700 boiler station at CHP, the SYNCHEM process plant and SYNCHEM back-up boiler operations are fully independent of each other
- T700 and SYNCHEM each contributes 50 ± 3 % of the steam demand during normal operation
- HP steam provided from SYNCHEM with
 - Normal supply: 2 x 50% capacity from train #1 and #2
 - Back-up: 1 x 50% capacity from one back-up boiler
- MP and LP steam partly interchangeable and demand therefore can be served with
 - Normal supply: 4 x 12.5%¹⁾ capacity from four T700 boilers
 - Normal supply: 2 x 25%¹⁾ capacity from train #1 and #2 in SYNCHEM
 - Back-up : 2 x 12.5%¹⁾ capacity from two back-up boilers

1) Approximate figures. Certain variations depending on total CHP steam demand

2.13 Komorany Heat Security

NOTE: For cases with divided base load between SYNCHRO & Komorany, peak boilers are moved to the Komorany site

- The heat demand for the towns of Most and Litvinov plus the Mine is described under 2.8 - 2.9 and 2.10.10
- SYNCHRO process plant and back-up boilers operations are fully independent of each other
- Peak heat demand (458 MW) + 20% redundancy is provided from
 - 2 x 20% from SYNCHRO train #1 and #2
 - 4 x 20% from four peak boilers
- Back-up capacity : 1 x 20% of peak demand
- As shown in previous point, 20% over capacity is provided at maximum heat delivery which corresponds to one SYNCHRO train being shut down

2.14 SYNCHEM Plant Emissions and Regional Environmental Impact

2.14.0 Summary of SYNCHEM Regional Environmental Effects

Air

- The proposed SYNCHEM scheme in its base case including partial revamps in CHP and Komorany, will virtually eliminate releases to air of acidifying substances and particulates for corresponding amount of power, steam and heat

Water

- No release of water pollutants

Land

- Feedstock ashes leave the IGCC system as a ceramic slag
- The slag is:
 - fused
 - non leachable
 - approved as a building material

Greenhouse Effects (CO2)

- Compliance better than Toronto Agreement Requirements

(cont'd)

2.14.0 Summary of SYNCHEM Regional Environmental Effects (.cont'd)

Estimate of the Total Regional Reductions of 1993 Air
Emissions with the SYNCHEM Scheme replacing current
regional means of generation

	<u>tons/year reduction</u>	<u>% reduction</u>
SO2	200 000	98 %
NOx	25 000	80 %
Particulates	100 000	80 %
CO2	3 500 000	> 30 %

2.14.1 IGCC Plant Emissions

2.14.1.1 Liquid Emissions

- Effluent process water needing biological treatment will not be emitted from the plant but will be used as slurry water in the coal slurry preparation section or, after stripping, as BFW make-up
- * Water contaminated by oil or suspended solids such as coal dust will be passed through API-separators, clarifiers, etc., resulting in purified effluent water ready to be sent to the recipient and waste streams such as reclaimed oil

2.14.1.2 Gaseous Emissions

- SO₂, NO₂ and particulate emissions will be emitted from the HRSG stacks only
- Less than 1.5% of the sulphur in the feed will be emitted as SO₂ from the HRSG stack
- * NO_x emissions will be lower than 25 ppm in the flue gas stream (calculated at 15% O₂ and dry basis)
- * The sulphur recovery tail gas treatment unit flue gas will be sent to the atmosphere through the HRSG stack

2.14.1.3 Solids Emissions

- Coarse and fine slag will be emitted from the gasification unit containing the ash from the fuel streams, calcium from the flux agent and unconverted carbon

(cont'd)

2.14.1.4 Key data (at - 9°C)

- Total emissions to the air of SO₂, NO_x, CO, CO₂ and particulates

Total ²⁾	kg/h	t/year (8000h) ¹⁾
SO ₂	144	1152
NO ₂	206	1648
CO	103	824
CO ₂	656 792	5.25 x 10 ⁶
Particulates	23	184

- 1) Assumes mass balance as per - 9°C ambient for the full year. Compare 2.10.12
- 2) Excludes emissions from LS fuel oil fired steam and hot water boilers

- Slag by-products

Coarse slag

Moisture free basis, kg/h	35 595
- Carbon, wt%	0.4
- Ash, wt%	99.6
Water content, wt%	50%

Fine slag

Moisture free basis, kg/h	8899
- Carbon, wt%	3.7
- Ash, wt%	96.3
Water content, wt%	60%

2.14.2 SYNCHEM's Regional Environmental Impact

Note: The regional environmental impact is calculated both for the base case as presented in this chapter 2 as well as for two variants with decreased heat delivery from SYNCHEM and with corresponding heat and power production from Komorany

- * Definition of the variants as well as todays situation :

	<u>SYNCHEM</u>	<u>CHP</u>	<u>Komorany</u>
Today	-	Existing T200+T700	Existing plant
Alternative 1	2 x 9F etc as per chapter 2	T700, 50% in operation	Not in operation
Alternative 2	As Alt 1 but with max 135 MW hot water production	T700, 50% in operation	Partially revamped Komorany plant (4 boilers)
Alternative 3	As Alt 1 but with- out hot water production	T700, 50% in operation	Totally revamped Komorany plant (10 boilers)

- * Power production from SYNCHEM in excess of the previously produced power from CHP and Komorany is viewed as replacing old generating capacity in the region

2.14.2.1 Background Information

The following basis has been used in order to calculate the net regional impact of the three variants

a. Coal / HVR used

	Coal		H V R
	Boilers	SYNCHEM	Boilers/SYNCHEM
C %	30.4	41.71	85.22
H	3.5	10.65	10.47
O	9.7	0.62	0.00
S	1.0	0.93	3.65
N	0.4	0.62	0.59
H ₂ O	25	30.00	-
Ash	30	12.47	0.07
MJ/kg (as received)	11	16.74	39.88

NOTE: it is assumed that the same boiler type coal is used by CHP, Komorany and Power Stations in the region

b. Existing Condensing Generating Capacity in the region to be deemed candidates for closure or secondary dispatch upon start-up of the SYNCHEM Scheme

Net power efficiency : 30 %

SO₂ : sulphur in coal becomes SO₂ emission to the air

NO_x : 280 mg NO₂ / MJ fuel or approx 750 mg/Nm³ @ 6% O₂ (same relative emission as for CHP)

Particulates : 500 mg/MJ of fuel (same level as for T700 before refurbishment)

c. Revamped Boiler Emission Rates

CHP (standard boilers with FGD)

SO ₂ :	400 mg/Nm ³ @ 6% O ₂ (dry) *
NO _x :	750 mg/Nm ³ - " -
Particulates:	25 mg/Nm ³ - " - *)
Solid by-products:	See Komorany below

*) Data from CHP, April 15, 1993

Komorany (FB Boilers)

SO ₂ :	500 mg/Nm ³ @ 6% O ₂ (dry) **)
NO _x :	400 - " - **)
Particulates:	50 - " - **)
Solid Byproducts:	- Ash in coal becomes ash by-product
	- 90% of sulphur in coal becomes gypsum.
	Quantity is calculated as 7 times the amount of sulphur removed

***) Data from Komorany, April 16, 1993

Flue gas volumes

For units burning 11 MJ coals the flue gas volume has been calculated to 415 Nm³/GJ of fuel @ 6% O₂ (dry)

2.14.2.2 Emission Reductions when changing from Today's Situation to Alternative 1,2 and 3 respectively

	Alt. 1	Alt. 2	Alt. 3
New power production in excess of previously produced power by CHP plus Komorany (GWh/year)	3 775	4 475	5 078
Total decrease of emission when changing from today's situation to Variant 1,2 and 3 respectively (kton per year / % decrease)			
- SO ₂	186.5 / 98.4	200.0 / 97.5	211.6 / 96.8
- NO _x	23.5 / 83.1	24.1 / 78.9	24.7 / 75.7
- Particulates	98.7 / 99.7	102.1 / 78.9	100.2 / 99.4
- Ash	2.08x10 ³ / 75.8	2.02x10 ³ / 68.2	1.98x10 ³ / 62.7
- Gypsum	- 64	- 123	- 172
- CO ₂	3.73x10 ³ / 36.6	3.54x10 ³ / 32.1	3.40x10 ³ / 28.9

Note : minus before the figure means increase in emissions

2.14.2.3 Emission Rates Related to Produced Energy

- Reduction of total emissions such as presented in chapter 2.14.2.2 do not relate remaining emissions to the quantity of products
- This chapter relates the production of power and heat to the emission of SO₂ and NO_x from the SYNCHEM plant and from the fully refurbished Komorany plant
- Komorany design data as per information received in meeting April 16, 1993
- SYNCHEM data as from this chapter 2
- Relative emission data

	<u>Komorany</u>	<u>SYNCHEM</u>
- mg SO ₂ /kWh (power + heat)	1 600	130
- mg SO ₂ /kWh (cond. power)	3 000	185
- mg NO ₂ /kWh (power + heat)	1 300	185
- mg NO ₂ /kWh (cond. power)	2 400	260

- Data for CHP's T700 refurbished plant is close to presented Komorany data

2.15 Electrical High Voltage Interconnections

2.15.1 Power Balance

	<u>MW</u>
Total Generation	819
Plant auxillary loads	139
Net SYNCHEM export	680
Supply to CHP	135
Balance export	<u>545</u>

2.15.2 Maximum individual Generator Loads

	<u>MW</u>
Gas turbines	2 x 275
Steam turbines	2 x 138
Expansion turbines	2 x 15

2.15.3 Interconnections

- SYNCHEM generators to feed into 400 kV lines
- New 400 kV lines to CEZ
- New 110 kV connection to CHP
- See diagram, Figure 2.15.3-1

Figure 2.15.3-1

SYNCHEM FEASIBILITY I

Power line interconnections

2.15.4 Scope of Facilities & Works

- 400 kV substation (12 blocks)
- 400 / 35 kV transformers (2x)
- 400 / 15 kV transformers (2x)
- 400 / 15 kV / 15 kV transformers (2x)
- 400 / 110 kV transformers (1x)
- 35 kV substation (20 blocks)
- 110 kV substation (1 block)
- 110 kV cable connection

- 110 kV Cables / lines
- 6.3 kV substation (100 blocks)
- 110 / 6.3 kV transformers (4x)
- 6.3 kV cable connection
- 6.3 kV cables

- 400 kV substation extension at Vyskov
- 400 kV cables / transmissin lines from Vyskov to SYNCHEM

- Protection devices
- Controls / despatching

2.16 Hot Water Pipelines Interconnections

2.16.1 Existing System

2.16.2 Proposed Arrangements for the SYNCHEM Initial Base Case

- Komorany heating and pumping plant to be shut down
- SYNCHEM to provide heat supply and pumping duties
- Pipeline interconnections as shown in diagram, Figure 2.16.2-1, Hot water Pipeline Interconnections
- Preferred alternative is :
 - 1 x DN 700 new feeders from SYNCHEM to Komorany
 - Use of existing pipelines
 - Komorany - Most
 - Komorany - Litvinov
 - Piping interconnections at Komorany

Figure 2.16.2-1
Hot Water Pipeline System Interconnections

NOTE:

For Initial Base Case only

For Alternatives, see 8.2.16

+ = shut off

2.17 SYNCHEM/CHP Steam System Interconnections

2.17.1 Options

- Originally two options considered
- 1A All steam generation to be in SYNCHEM with T700 and T200 shutdown
- 1B Steam generation and supply from SYNCHEM to supplement a 50% revamped T700, i.e. T700R (50%) with T200 fully shut down

2.17.2 Alternative 1A

	<u>pressure</u>	<u>flow</u>	<u>expected rating</u>
(i)	steam 31 bar	52 t/h	450 °C, DN 350 / PN 64 (insulation)
(ii)	steam 19 bar	330 t/h	260 °C, DN 600 / PN 40 (insulation)
(iii)	steam 3.5 bar norm. max.	68 t/h 340 t/h	160 °C, 4 x DN 800 / PN 40 (insulation)

2.17.3 Alternative 1B

	<u>pressure</u>	<u>flow</u>	<u>expected rating</u>
(i)	steam 31 bar	52 t/h	450 °C, DN 350 / PN 64 (insulation)
(ii)	steam 19 bar	250 t/h	260 °C, DN 600 / PN 40 (insulation)
(iii)	steam 3.5 bar	68 t/h	160 °C, DN 800 / PN 40 (insulation)

2.17.4 Specification

- Within CHP all pipes are to be located on a new pipe rack, running above existing CHP pipe racks
- The new pipe rack shall also carry two 110 kV cables, communication / instrumentation cables, return condensate and HVR pipe
- The piping shall be equipped with flanged flexible bellows
- Anticorrosive protection of piping and pipe rack is to be included

2.17.5 Selected alternative

- * Alternative 1B shows a considerable cost reduction compared to 1A due to the reduction in the cost of 3.5 bar steam piping
- * As Alternative 1B suits the selected Base Case this alternative has been chosen
- * Suggested pipeline routing between the Koptecek site (SYNCHEM) and CHP is shown in Figure 2.17.5-1

Pipeline Routing between the Kopecek Site (SYNCHM) and CHP

2.18 Fuel and Services Interconnections and Availability

2.18.1 Heavy Vacuum Residues

- Flow rate 150 t/h
- Pipe rating/specification 130 - 160 °C, DN200/ PN 40 insulated, anticorrosion protected
- Routing On common pipe rack together with steam piping up to suitable point within SYNCHEM and CHP (see Figure 2.17.5-1)

2.18.2 Return Steam Condensate

- Flow rate 400 t/h
- Pipe rating/specification 100 °C, DN 200 / PN 40 insulated, anticorrosion protected
- Routing On common pipe rack together with steam piping up to a suitable point within SYNCHEM and CHP (see Figure 2.17.5-1)

2.18.3 Raw water supply

- Flow rate Temporary during construction : 500 m3/day.
Permanent supply : 2500 m3/h at 4 bara
- Source From reservoir via existing CHP pumping station and new lines to SYNCHEM

2.18.4 Coal Supply

- Annual supply rate (as received) 2,900,000 tons
- Source Komorany and/or Herkules coal preparation plants
- Method By railway (open top wagons)
- Facilities required
 - Single two direction railway spur beside the site (to Komorany and Herkules)
 - Two dead end railway spurs
 - Underground coal loading bunker
 - Stockyard or coal storage bunkers

2.18.5 Limestone / Flux Supply

- Annual supply rate 240,000 tons
- Source to be decided
- Method By railway (open wagons as for coal)
- Facilities required
 - One railway spur (one of the two coal spurs)
 - Underground loading bunker

2.18.6 Slag Disposal

- Annual quantity
 - 750,000 tons (coarse)
 - 225,000 tons (filtercake)
- Distribution DUK and other Mining/Construction companies as road sub-base construction material
- Method By railway (open top wagon)
- Facilities required
 - two dead end railway spurs
 - Rail wagon loading station

2.18.7 Sulphur Export (liquid)

- Annual quantity 50,000 tons
- Distribution Consumers (to be identified)
- Method By road tanker
- Facilities required Road tanker loading station

2.19 Site Preparation

2.19.1 Proposed Site

- See available area for proposed site as shown on a contour map with geological survey probe locations marked, Figure 2.19.1-1

2.19.2 Studies and Investigations

- Reviewed by the Mining Research Institute VUHU / Most based on exploratory boring investigations by Vodnic Stavby / Taplice
- Survey of borehole coordinates and elevations by Geodesy / Liberec
- Review by Matousek Geology and Geotechnics Engineering/ Brno including laboratory soils testing based on site investigations and boring work
- Updating of the 1:600 scale maps of the site by Geodesy / Most
- Studies by DUK and CHP

Map with Geological Survey Probe Locations

2.19.3 Geological Suitability of the Proposed Site Study Conclusions

- * It is possible to construct the SYNCHEM project on the proposed site
- The following are the identified complications within the site and corrective actions :

<u>Complication</u>	<u>Consequential action</u>
- Old underground deep shaft mining chambers exist under the site	- Any underground cavities that still exist under heavy loaded equipment items have to be stabilized by injecting fly ash / water slurry
- The site area has been used to dump overburden from surface mining operations (up to 17.5 m high)	- Remove 1.2 million cubic meter of dumped overburden
- High salts content of the underground water	- Anticorrosion measures to be taken to protect underground structures and systems
- Random earth electrical current in the area	
- Some plots/buildings owned or leased by sitting tenants other than DUK or CHP	- Negotiations with tenants for purchase of their rights and / or relocation

2.19.4 Site Preparation Activities

- * Confirm the site area requirements and site layout based on the overall SYNCHEM requirements including railway sidings and auxillary facility requirements
- * Purchase or lease area. Compensate sitting tenants.
- * Based on final layout, carry out definitive site survey and soil investigations
- * Remove following existing overhead power lines and relocate into an underground cable duct to be constructed along the western site boundary
 - Two parallel 110 kV lines , V141 and V142 linking Vyskow and CHP (SEZ / Decin)
 - Two parallel 35 kV lines, V31 and V32, linking Herkules and Lezaky
 - 35 kV line, V310, linking Herkules and Komorany (DUK)
 - 22 kV line Litvinov - Most
 - 10 kV line Centrum - Quido
- Relocate underground communication cable to the underground power cable duct
- Relocate existing belt conveyor system transporting coal to the Herkules Plant (discontinue existing conveyor system)

(cont'd)

2.19.4 Site Preparation Activities (cont'd)

- Remove 1.2 million cubic meters of dumped overburden and level site
 - Requires :
 - Rail spur + 3 sets switching points
 - 7 m3 power shovel excavator (maximum available)
 - 3 sets of rail wagons (12 x 25 m3 per set)
 - Buldozer
 - Transport to DUK disposal site at Obrancu Miku (2.5 km from site)
 - Maximum removal rate:
 - Based on working 3 shift per day,
 - 7 days per week is 100,000 m3 per month
 - Hence minimum time = 12 months

2.20 Preliminary Plot Layout

Figure below shows a preliminary plot layout at the Kopecek site west of the CHP Complex

2.21 Capital Cost Estimate

2.21.1 Background

- * Investment cost estimate is divided into two major parts following the definitions as per 2.10.1
- * The inside battery limit (ISBL) investment costs are calculated for U.S. Gulf Coast conditions
- * The OSBL investment costs are calculated on a Czech basis by CHP, Komorany and local consultants
- * Below follows battery limit description for system having cost elements both within ISBL and OSBL, e.g. coal supply system, as well as items falling to 100% within OSBL, e.g. site preparation to create a leveled site

2.21.2 Battery Limits Definition Details

- * Coal Supply system
 - coal handling equipment in ISBL
 - rail spur system in OSBL
- * Flux supply system, see coal system
- * Slag delivery system
 - slag handling equipment in ISBL
 - slag dumped into rail cars
 - rail spur in OSBL
- * HVR supply system
 - small running tank plus insulated, heated pipeline to SYNCHRO plant limit included in ISBL
 - pipeline delivery system from tankage within CHP included in OSBL

(cont'd)

2.21.2 Battery Limits Details (cont'd)

- **Electrical system**

- electrical systems within the plant at voltage levels 35 kV, 15 kV and less are ISBL
- battery limit ISBL / OSBL are the disconnectors on the generators and the auxillary supplies at the 15 (alt. 35) kV bus
- battery limit between the SYNCHEM project and the power receiving company is the high voltage transfer line connecting point into the SYNCHEM switch yard
- Energoprojekt, a Czech electrical consultant, has done the cost estimating for necessary new power lines, interconnections into CHP, SYNCHEM and existing grid and included the SYNCHEM part up to the ISBL / OSBL point as described above

- **Raw water**

- raw water tank also serving as fire water tank holding 4540 m3 of water as well as downstream pumps are in ISBL
- pump at raw water terminal plus transfer pipeline to tank is in OSBL

- **Backup fuel - LS fuel oil**

- no holding tank within SYNCHEM is included
- pipeline from SYNCHEM plant limit to users within SYNCHEM included in ISBL
- pipeline delivery system from tankage within CHP included in OSBL

- **Backup fuel - distillate**

- analogue to LS fuel oil

(cont'd)

2.21.2 Battery Limits (cont'd)

- Hot Water

- distribution system to ASU, steam heaters and peak / back-up LS fuel oil fired heaters in ISBL
- pumping station and hot water distribution system to consumers in OSBL
- accumulator for evening out of daily variations in heat demand not included in estimate

- Steam

- pipelines from steam source unit to SYNCHRO plant limit included in ISBL
- pipelines from SYNCHRO plant limit to connection points within CHP included in OSBL

- Condensate - analogue to steam

- Potable water - analogue to steam

- Plant effluent water - analogue to steam

- Site preparation activities

- the OSBL costing exercise includes the work necessary to create a clean, leveled site
- the following items have been identified
 - stabilization of underground cavities from old mining activities
 - remove approx 1.2 million m3 of dumped overburden
 - anticorrosion measures to protect underground structures
 - purchase of land
 - compensate sitting tenants
 - carry out definite site survey and soil investigations
 - remove and relocate existing overhead power lines
 - relocate underground communication cable
 - relocate existing belt conveyor

2.21.3 ISBL Plant Investment

- The capital cost estimate for the ISBL part of the project is
 - based on US Gulf coast conditions
 - for January 1993 cost level
- The total cost is presented in Table 2.21.3-1
- The following costs are not included in the 2.21.3-1 (ISBL) Investment Summary
 - site preparation, clean leveled site is assumed
 - licences and process design packages charges
 - catalyst and chemicals
 - warehouse spares (installed spares are included)
 - sales tax or inport duties
 - owners cost
 - interest during construction

Table 2.21.3-1
Capital Cost / ISBL

Cost Estimate Summary Table
Cost for US Gulf Coast in 1000 US\$

	Equip	Bulk Matl	SubCon tracts	Field Labor	Field Distrib	Design Allow	Conting	Total Cost
1 OXYGEN PLANT	87,500	5,500	900	6,900	7,600	0	5,700	114,100
2 GASIFICATION	87,332	23,947	2,445	10,986	19,226	13,848	18,008	175,791
3 SULFUR REMOVAL & RECOVERY	20,981	13,632	795	5,155	9,021	5,765	6,190	61,539
4 EXPORTS	16,063	8,186	526	2,068	3,619	2,845	3,820	37,127
5 POWER GENERATION	234,971	5,845	22,547	4,076	7,171	35,663	23,776	348,657
6 AIR, WATER, STEAM	10,803	8,948	433	6,974	12,205	4,327	5,375	49,065
7 TRANSMISSION AND DISTRIBUTION	26,465	13,782	807	3,444	6,028	6,223	7,082	67,660
8 WASTE WATER TREATING	1,312	1,007	850	816	1,428	641	719	6,773
9 FEEDSTOCK AND PRODUCT HANDLING	0	97	21,810	77	135	2,648	3,965	28,732
10 BALANCE OF PLANT	337	4,005	1,107	1,160	2,030	922	1,426	10,986
11 SITE WORK AND BUILDINGS	0	0	10,050	0	0	829	1,751	12,630
SUBTOTAL FIELD COSTS	485,764	84,949	62,270	41,656	68,462	73,711	77,810	883,061
FIELD MANAGEMENT COSTS								24,605
CONTRACT ENGINEERING								75,129
OWNERS COSTS								EXCLUDED
TOTAL COST								982,795

2.21.4 OSBL Plant Investment

- * The capital cost estimate for the OSBL part of the project has been carried out under the responsibility of CHP using inhouse data and local Czech consultants
- * The cost data is
 - based on Czech conditions
 - 2nd quarter 1993 cost level
- * The following cost items have been specified

Item	MMCEK
Rail spur system	30
Electrical interconnections to 400kV grid ¹⁾	515
Cost of land, 180,000 m2 @1000CEK/m2	180
Site preparation to create a clean, leveled site	145
Raw water connection	10
Interconnection to CHP (steam, condensate, HVR, back-up fuels)	460
Hot water interconnections ²⁾	350
	<hr/>
	1690

1) excl. high voltage switch gear (400kV) at the SYNCHRO site

2) incl. 1 x Ø700 pipeline SYNCHRO - Komorany plus pumping station at SYNCHRO (6 pumps)

- * The following costs are not included in the above specified investments
 - owners costs
 - interest during construction

2.22 Engineering, Procurement and Construction (EPC) Arrangements

2.22.1 General

- * The overall IGCC unit can be considered to comprise the following units as shown on the attached figure 2.22.1-1 :

Air Separation Unit	ASU
Process Plant Unit	PPU
Sulphur Removal and Recovery Unit	SRRU
Combined Cycle Unit	CCU
Utilities and Offsites Unit	OSU

(cont'd)

2.22.1 General (cont'd)

- * The SYNCHEM project is being developed by a Consortium comprising the following parties. In addition to possible equity participation the special contribution to the project of each partner i.e. to be taken into consideration as follows:

Chemopetrol	Offtake of Steam and Electric Power Supply of HVR Process and Utility Plant Operation Expertise
Komorany	Offtake and District Heating Utility Plant and Distribution System Expertise
DUK	Supply of Coal Logistic Expertise
Mission Energy	Utility Company Power Generation Expertise Project Development
Texaco	Provision of Gasification / PPU Technology Process Plant Operation Expertise Project Development
GE	Provision of CCU Equipment Power Plant Grid and Interconnect Expertise Project Development
Air Products	Provision of ASU Technology and Equipment Process Plant Operation Expertise Project Development
Nykomb	Project Development Architect Engineering and Consultancy Services

(cont'd)

Figure 2.22.1-1 Basic Block Flow Diagram

Figure 2.22.1-2 Diagram of Project Risks & Contributions of Stakeholders

2.22.2 Contracting Philosophy

2.22.2.1 Owners requirements

In general terms the contracting philosophy selected should be that which gives the plant owner the maximum assurance of achieving

- a) Minimum Capital Cost within Budget
- b) Project Completion on Schedule
- c) Plant Quality and Performance as specified

2.22.2.2 Financing Requirements

For the implementation of limited recourse financed projects, financial solutions favor :

- Single point turnkey responsibility
- Fixed price lump-sum turnkey (LSTK) contracts
- Significant penalties for non-achievement of Completion Schedule and Plant Performance Parameters
- LSTK contractor with strong balance sheet

2.22.2.3 Advantages of LSTK Approach

- Contractor takes Completion risk
- Contractor is liable for cost overruns
- Contractor pays penalties for delays in completion and plant performance

2.22.2.4 SYNCHEM Contracting Philosophy

Taking into account the special features of the SYNCHEM project the following "hybrid" approach is proposed and will be further developed in future phases of the project development

- Owner's group (Owners) retains control of critical project factors :
 - Basic Plant Specification
 - Approval of Principal Contractors
 - Design review authority for operation / maintenance features (in cooperation with selected operating entity)
- * Project design / construction / start-up will be managed by a consortium (the "Turn-key Consortium") of some of the owner companies in combination with a main contractor. The EPC contractor will be selected by the consortium, subject to approval by the Owners
- * The Turn Key consortium (TKC) will contract with the Owners on a lump-sum, fixed price basis contractually identical to the LSTK approach.
- * The TKC will design and build the facility to a Front-end Engineering and Design package (FEED) developed by the Owners, perhaps with support from an Owners' Engineer organization
- * Financial risk sharing for liquidated damages provided to the Owners in the turn key contract will be allocated and contracted among the TKC members (including the EPC contractor)
- Perceived advantages of the TKC approach :
 - Provides for direct, broad involvement of major suppliers of technology/equipment in the project execution
 - Provides for more efficient allocation of risk among parties best positioned to manage those risks
 - Provides lenders with a number of large well-known international corporations supporting project completion
 - Provides Owners with the same risk management package as an LSTK

2.22.3 Key Elements in both LSTK and TKC arrangements for the SYMCHEM Project

- * FEED Package Incorporates :
 - Overall integration
 - Basic design of PPU
 - Overall Specification ASU/SRRU/OSU/CCU
 - Battery Limit/Interface parameters for all units and external interconnections
- * Outline of all Owner's requirements Including :
 - Technical
 - Commercial
 - Legal
 - Nominated Suppliers and Terms for Incorporation
- * At least two and preferably three main contractor bidders will be evaluated in order to obtain competitive offers
- * Owner and TKC to negotiate on the level of liquidated damages to be applied for late completion and deficient plant performance

2.22.4 Project Implementation Strategy

* See diagram below

* BY MAIN CONTRACTOR

SYNCHM IGCC PROJECT PROJECT IMPLEMENTATION STRATEGY

FEED PACKAGE: OVERALL IGCC/PPU/SRRU/OSU
DESIGN AND SUPPLY PACKAGES: ASU/CCU
MAIN CONTRACTOR: ENG&PROCT OF PPU/SRRU/OSU
PLUS ALL SITE CONSTRUCTION

2.23 Program of Future Work

- Select final configuration
- Optimize configuration
- Proceed with Development efforts
- Details as per Chapter 9

3. CONSENTS AND LICENSES

Table of Contents

- * Consents and Licenses
- * Figure 3-1 Consents and Licenses Time Table
- * Attachment 3-1

CONSENTS AND LICENSES

3.1 OVERVIEW

In order to build and operate the Synchem project, it will be necessary to secure a range of environmental consents and licenses. The most significant of these are the consents required under the Act on Environmental Impact Assessment ("EIA") 244/1992, compliance with the Building Regulations, the Clean Air Act 309/1991 and subsequent revisions, the Water Act 138/1973 and subsequent revisions and the Waste Act 238/1991 and subsequent revisions.

With the exception of the Water Act, all of the legislation pertinent to the procurement of the requisite consents and licenses has been effected since the "Velvet Revolution" in 1991. Most of the legislation has been drawn up with reference to EEC directives and guidelines and practice in other EEC countries and the United States. Prior to this spate of legislation, general practice was to give a low priority to environmental standards, which has resulted in the current environmental problems experienced by many of the ex-Communist countries.

The following discusses the applicable legislation and the current status and future activity for the Synchem project with respect to planning permission, atmospheric emissions, water and waste. Figure 3.1 identifies the individual consents and licenses necessary for project implementation together with an anticipated schedule for preparing and securing each. Please note that the schedule is based on 1) the assumption that the Czech government will provide assistance to ensure the completion of the regulatory process within the minimum specified time frame, and 2) conditional municipal waivers for 1997 will be secured to coincide with the national environmental deadline of December 31, 1998. A summary of key issues are as follows:

- ★ Environmental issues have previously been given low priority
- ★ New legislation with only limited testing of how it functions in practice
- ★ Implementation mechanism between authorities not entirely clear
- ★ Potential communication gap between authorities on local and national level
- ★ Close of project financing will be contingent upon receipt of the EIA
- ★ Start of construction will require prior receipt of the Air Permit. Requirements thereof may entail design modifications, thereby impacting overall costs and ultimate close of financing
- ★ Critical path items for an early 1998 startup are:
 - Environmental impact assessment
 - Document is prepared October - November 1993

Figure 3-1 Consents and Licenses Time Table

E.I.A. : Environmental Impact Assessment

M.O.E : Ministry of Environment

Attachment 3-1

Site preparation activities time schedule

Action Item

1.	Decision to initiate preliminary environmental data gathering	September	1993
2.	Ecological audit documentation to be elaborated	Oct.-Nov.	1993
3.	Ecological audit approvals	Oct.Nov.	1994
4.	Site approval and Building Regulations Application Preparation	April	1994
5.	Preparatory documentation for official site approval	June	1994
6.	Official site approval to be issued	Oct.-Nov.	1994
7.	The one - stage project for all networks and systems transfer and site preparation to be elaborated	August	1994
8.	Preparatory works permission to be issued	November	1994
9.	Overburden soil removal to be commenced	December	1994
10.	Completed Building Permit Application	September	1995
11.	Overburden soil removal to be finished and all networks and systems to be transferred	December	1995
12.	Project elaboration for the purpose of construction permission	September	1995
13.	Construction permission to be issued	January	1996

The time schedule is based on the assumption that networks and systems transfer will be performed simultaneously with overburden soil removal during 12 months period (it has not been investigated in detail).

Preparatory civil works will be commenced till official site approval for regional power plant construction is issued.

- Submission before year end 1993
- MOE review completed during 1994
- MOE statement issued end 1994
- Air emission and water discharge permits issued by January 1995
- Overburden removal to start May-June 1994
- Project Development Phase concluded during 1994, including financing
- 35 month project execution including 5 months commissioning period

3.2 PLANNING PERMISSION

3.2.1 SUMMARY

Planning permission is secured by means of a positive determination from the Ministry of Environment to an Environmental Impact Assessment submitted on behalf of the project, and compliance with the Building Regulations. The application submitted to the local Building Office cannot be considered until the Environmental Impact determination has been made.

The Ministry of Environment requires a minimum of 15 months to make a determination regarding the Environmental Impact Assessment. Permission in accordance with the Building Regulations is in the order of 12 months.

3.2.2 APPLICABLE LEGISLATION

The Act on the Environment 17/1992 establishes that an Environmental Impact Assessment must be carried out for certain new developments, inclusive of power generation facilities producing in excess of 100 MW. The Act on Environmental Impact Assessment 244/1992 specifies the measures which must be undertaken in compliance therewith. An Environmental Impact Assessment must be compiled and submitted to the Ministry of Environment giving details of the new development and outlining its impact to air, land, water, existing infrastructure, inhabitants and ecosystems, and the measures to be implemented to mitigate such impact. This information must be submitted by an authorized expert, authorized in compliance with the Public Notice of the Ministry of Environment of October 1, 1992 on Qualification for Environmental Impact Assessment and Expert Opinion. Information submitted is reviewed by the relevant local and national authorities, Ministry of Environment and aired at a public hearing, following which the Ministry of Environment issues an Environmental Impact Statement either in favor or against the project.

Following the Environmental Impact Statement, the project can then apply to the local Building Office under the Building Regulations for a Building Permit.

3.2.3 STATUS

Both representatives from the U.S. consortium and Chemopetrol have met with the Ministry of Environment to discuss the above authorization procedure. The indications are that there should be no problems in obtaining the permits within the statutory timeframe providing that the application is fully comprehensive and there is no substantial opposition at the public hearing. However the statutory timeframe of 18 months for the Ministry to issue the authorization means that this is a key critical path activity.

3.2.4 FUTURE ACTIVITY

Chemopetrol has received a proposal from Ecoconsult Pons to undertake the activities required for the Environmental Impact Assessment. Although this is fully comprehensive of the activities which require completion, no price estimate has been received for the full scope of work.

The next step should be to obtain a firm scope of work and fixed price and authorize the Environmental Impact assessment to be completed and ready for submittal to the Ministry of Environment within 3 months of authorization.

It would be logical that Chemopetrol take the lead role in this activity, having obtained all of the relevant technical information from the U.S. partners. Although we may not yet have determined the final plant size and configuration, this should not be a delaying factor. It is common practice to submit an application which details the "worst case" scenario, with a range of other potential options.

Chemopetrol has significant experience in obtaining Building Permits for other projects constructed on the refinery site. It would therefore be logical for Chemopetrol to utilize their own experience and existing contacts within the local Building Office to obtain the necessary Building Permits for the Project once the Environmental Impact Assessment has been prepared.

3.3 ATMOSPHERIC EMISSIONS

3.3.1 SUMMARY

The Most/Litvinov area is one of the most heavily polluted areas in Europe due to the effects of post World War II industrial developments, large reserves of indigenous high sulfur, low heat value coal and the number of aging power and district heating stations in the area which are fired with this coal. Air emissions legislation which has been passed since 1991 recognizes the problems which have resulted from past policies, but does not appear to have considered the intermediate term effects of aggressively tight compliance deadlines.

Requirements for all plants to comply with new plant standards by December 31, 1998, at the latest, and in the cases of Chemopetrol and Komorany, well in advance of this will preclude the possibility of constructing new plant in favor of short term retrofit measures, unless the deadlines are relaxed.

We do, however, have the advantage that the Project will be replacing an existing facility and will greatly contribute to a reduction of emissions in what is a highly sensitive and heavily polluted area.

3.3.2 APPLICABLE LEGISLATION

The Clean Air Act 309/1991 and Supplement to the Clean Air Act of April 1992 stipulate that the approval of both the Czech Inspection and Ministry of Environment is necessary for "locating and approving construction and operation of large pollution sources", "projects introducing new productions and technologies in large pollution sources" and "the manufacture, import and transport of equipment, materials or products which may pollute the air." There is no standard application form to obtain approval, and no minimum timeframe in which either of these organizations must issue a decision. Information submitted in compliance thereof should include technical and operational information with regard to the plant, demonstrate best available technologies with regard to cost and provisions for future reductions and include a justification for the most advantageous solution with regard to air protection and an "expert opinion" from an individual approved by the Ministry of Environment.

Restricted operation and shutdown are the penalties for non-compliance and a deadline of December 31, 1998 is established for existing plants to conform with new plant standards.

The Measures of the Federal Committee of the Living Environment of 1 October 1991 establish emissions limits for selected pollutants in selected technologies. Limits are established for solid fuel, gaseous fuel, waste incineration and special waste. In the absence of any specific limits for IGCC technology, it has been decided that the Project will be designed to achieve 98.5% sulfur recovery and 25 ppm NO_x at 15% O₂, which is well within all specified limits.

The Act on the State Administration of Air Protection and Charges for Pollution of Air 389/1991 establishes the administrative roles of the Ministry of Environment and Czech Inspection, giving the Czech Inspection the powers to establish pollution charges, to be paid monthly based on the volume of pollutants emitted, the powers to set limits for existing sources and the period in which these must be obtained. The Ministry of the Environment is empowered with the right to alter any limits by issuing a Public Notice.

The Decree of the Ministry of Environment 41/1992 establishes regions for special air protection and principles for creation and operation of smog regulation systems.

The district of Most is included on the list of regions requiring special measures, together with the identification of Chemopetrol and Komorany as selected pollution sources subject to regulation.

3.3.3 STATUS

Representatives from the U.S. consortium have met with the Ministry of Environment to discuss the above authorization procedure. The Ministry of Environment representatives have been very positive with regard to the Project, but have not yet determined how to proceed in the absence of specific IGCC limits. One option mentioned would be to issue legislation relating thereto. They will require more detailed technical information with regard to the project.

Chemopetrol has an ongoing relationship with the local Czech Inspection and has discussed the project with its local contacts. However, Chemopetrol was served with a compliance order by the Czech Inspection in 1991 which establishes an improvement program for both T 200 and T 700. In order to comply, Chemopetrol is proceeding to install dust and fly ash systems on all T 700 boilers by 1994 - 1995, shut down T 200 by the end of 1996, and close 2 T 700 boilers in 1997. The compliance order has not been furnished to the U.S. consortium.

3.3.4 FUTURE ACTIVITY

We need to ascertain the precise details of Chemopetrol's compliance order and reapproach the Ministry of Environment and Czech Inspection with the details of the T 700/Synchem scheme which will be adopted in order to obtain a compliance order which will specifically relate to Chemopetrol's long term solution in terms both of schedule and long term emissions. Once this has been obtained, we can then proceed with the above authorization procedure.

3.4 WATER

3.4.1 SUMMARY

The Project will utilize raw water provided by Chemopetrol for steam production, demineralized water for use in the cooling tower and potable water supplies. Discharges will consist of effluent from the steam supply, which will be treated by the project prior to return to Chemopetrol, cooling tower blowdown, effluent from the sulfur recovery and domestic sewage.

3.4.2 APPLICABLE LEGISLATION

Both the Water Act 138/1973 and the Act on State Administration in Water Management 458/1992 establish the framework under which the abstraction and disposal of water are administered. For administrative purposes, the Czech

Republic is split into 5 river catchment areas, each with its own Water Management Authority and district administrative offices. Town mains and sewage are administered by local water boards which may be subject to privatization in the future.

The Water Act 138/1973 requires the approval of the relevant Water Management Authority for new developments, construction works on water courses and the construction of long distance pipelines. The Project would be required to provide a specialized Environmental Impact Assessment to the Water Management Authority as part of the Application to abstract/discharge, outlining the impact of the plant upon water conditions. There is no fixed time period in which the Water Management Authority may determine the application. Fees payable are related to the volume of water used.

It is expected that the Water Act will be redrafted in the next 12 months. However, no draft for discussion has been issued to date.

The Czech Government Decree of 26 February 1992, determining indices for permissible levels of water pollution establishes maximum pollutant limits for industrial waste, sewage and town waste water and empowers the Water Management Authorities with the discretion to either tighten or relax these limits, dependent on specific circumstances.

Regulation 42/1976 will require the Project company to appoint a Water Manager once the Project becomes operational.

3.4.3 STATUS

Representatives from the U.S. consortium have met with the Ministry of Environment to introduce the Project to them and discuss the above authorization procedure. Provided that we adhere to this procedure, we would not anticipate any problems in obtaining the necessary authorizations. Discussions have taken place with Chemopetrol with regard to water balance and possible utilization of Chemopetrol's existing infrastructure. However, until the Project technical solution has been decided upon, and the water balance finalized, no firm commitments can be made.

3.4.4 FUTURE ACTIVITY

The optimum solution would be for the Project to use as much of Chemopetrol's existing infrastructure for water supplies as is practical, within the limits of Chemopetrol's existing permits. Although the Project will have to obtain authorization from the Water Management Authority, it would be preferable for the Project not to have to obtain its own easements, bearing in mind potential land ownership issues. Suitable contractual arrangements should be negotiated with Chemopetrol to achieve this structure.

3.5 WASTE

3.5.1 SUMMARY

Waste produced prior to and during the construction of the Project will primarily result from the removal of overburden from the site, and during the operational phase from the slag produced by the gasifier. It is currently intended that DUK will remove the site overburden for use as landfill, except for that which may be contaminated, which must be disposed of separately and paid for according to rates set by Government Decree from time to time. It is intended that the slag produced by the gasifier will be sold for commercial use.

3.5.2 APPLICABLE LEGISLATION

The Waste Act 238/1991 invests ultimate decision making authority in relation to waste with the Ministry of Environment. Nine Ministry of Environment regional waste offices are established to act in a supervisory role, supplemented by district authorities who issue permits for the transportation and disposal of waste. The project will be required to apply for such permits.

The Provision for the Categorization and Catalogue of Waste pursuant to Clause 2.1 of the Waste Act, the Charges for Deposit of Waste 62/1992, The State Administration of Waste Management 311/1991, the Government Decree on Treatment of Waste 513/1992, the Government Decree on Maintenance of Records of Waste 521/1991 and the Public Notice on Waste Management Programs specify that waste must be stored, treated and deposited according to fixed classifications. Each company is required to prepare and gain approval of a waste management program, notify the local building office and subsequently maintain waste records.

3.5.3 STATUS

Representatives from the U.S. consortium have met with the Ministry of Environment to introduce the Project to them and discuss the above authorization procedure. Provided that we adhere to this procedure, we would not anticipate any problems in gaining the necessary authorizations. DUK has already provided a plan for consideration for the overburden removal and disposal. Potential purchasers of the gasifier slag have yet to be identified.

3.5.4 FUTURE ACTIVITY

The first priority will be to finalize a means of removal of the overburden, having identified any areas of contamination which will require separate disposal. Once the precise quality of the slag has been ascertained, potential purchasers should be approached with a view of establishing supply contracts. All other waste should be permitted and disposed of in accordance with the above procedure.

**COMMERCIAL
ARRANGEMENTS**

4. COMMERCIAL ARRANGEMENTS

4.1 Contract Principles and Objectives

The Project Participants have endeavored to develop commercial offtake and supply agreements with the underlying objective of ensuring project financing, providing a competitively priced and reliable supply of product for our customers, and provide the Project's investors a reasonable return on their investment.

4.1.1 Offtake

Consistent with this objective, for the revenue or offtake side, the stability of the revenue stream is one of the most important considerations in the development of contract terms necessary to obtain financing. Some of these key terms are:

Pricing

Pricing for offtake product sales has based upon avoided cost concepts what is the cost of obtaining the product from the next best available environmentally acceptable alternative (e.g. existing facilities, new incremental facility, third party, etc). Avoided cost does not necessarily imply actual costs of production from the facility to the extent that the costs of production from the Project are lower than the next best alternative, this reduced cost will allow for the sharing of these benefits between the offtaker and the seller.

Pricing is typically comprised of three elements:

Capacity: Repayment to seller for capital costs incurred for making production capacity available to offtaker.

Fixed O&M: Recovery of fixed costs to operate and maintain the facility, including items such as labor, land rental maintenance, etc.

Variable Energy and Operating Cost: Recovery of feedstock/fuel costs such as coal, residual oil, etc, and costs incurred in the production of product sold, including items such as chemicals and catalyst, water etc.

Total Product Pricing would be equal to the sum of the four components above.

4.1.1 Offtake (cont'd)

Term

An operating period of 25 years, i.e. to ensure also return to the equity investors.

Take

Minimum take-or-pay obligations to ensure plant utilization and debt service coverage.

Performance Guarantees

At the highest level possible (i.e. - the parent company or host government for a state-owned entity) are required to ensure performance and fulfilment of contractual obligations.

Assignment

Contracts must be assignable to lenders as security.

Taxes

Adverse impact of changes in tax regulations must be mitigated.

4.1.2 Supply

A reliable and secure source of raw materials and labor necessary for the Project Participants to operate the facility in order to meet their contractual obligations to the various offtakers is essential.

Pricing

Rather than an avoided cost basis, pricing for suppliers was based on opportunity costs - what is the next best market for their sale of their product - including not only considerations of price but items such as term, minimum purchase obligations, etc.

Other terms such as Term, Take, Performance, etc, are similar to those described for the offtake contracts.

4.1.3 Other

General terms that would be applicable to every agreement are as follows:

1. Force Majeure - different definition for seller/buyer
2. Dispute Resolution/Arbitration/Local law
3. Governing Law (Czech/English/U.S.)
4. Assignment (consideration in particular being given to the requirements of the lending institutions)
5. Term and Termination Events (consideration being given to breach of fundamental/material terms)
6. Conditions Precedent
7. Tax and VAT (or any other duties payable at the place of manufacture/supply)
8. Limitations of Liability for Non-Supply
9. Changes in production/performance costs due to external events (i.e. increased capital and/or operating costs resulting from change in law or regulation)
10. Warranties of product quality

4.2 Contract Philosophy

Based on the commercial principles and objectives outlined in the previous section, the following summarizes the key elements of the project Participants contracting philosophy:

- * Firm capacity commitments and price structures for 25 year term for both offtakes and supplies.
- Offtake by partners to be priced at least to meet, preferably to improve on costs from alternative supply modes.
- * Attractive variable pricing for the offtake and minimum steam offtake commitment aims to ensure a base load for plant operation.
- Link variable revenue streams with variable expenses to maintain profit margin.
- * Balance, to the extent possible, variable and fixed cash inflows vs outflows for each offtake commitment, by matching price/cost terms and escalator and currency arrangements.
- Imbalances between capital related cash in and outflows may dictate front-end payment profiles and escalator and currency arrangements.
- * Ensure recovery of fixed operating and maintenance expenses together with recovery of capital investment at an appropriate discount rate reflective of Project Participants' cost of capital
- * Potential for improved project earnings through
 - Output capacity improvements
 - Plant availability improvements
 - Operating efficiency improvements
 - Financing terms

4.3 Key Contract Definitions

Coal supply

- * DUK, DHL and DLM mines to be combined in company - MUS
- * DUK, DHL and DLM will become a joint stock company to be privatized.
- * The mines are located in the Most, Komorany, Litvinov area.

Refinery Heavy Oil Residues HVR/Vistar supply

- * Chemopetrol (CHP) petrochemical complex in Litvinov.
- * Privatization of refinery separate production units are in process.
- * Supply generated by the refinery distilling and/or future residual oil upgrading units.

Steam and Electricity offtake

- * CHP, see above.
- * Synchem and remaining and retrofitted part of CHP present power plant, T700, supply all steam and power for petrochemical production units.

Local grid Electricity offtake

- * Severoceske Energitické Zavody, SEZ, located in Decin.
- Power distributor in the North Bohemian region
- * Planned to become joint stock company and be partly privatized
- * Owning and operating local 110 kV grid
- Capacity for local producers 1998 and onwards 320 MW.

cont'd

4.3 Key Contract Definitions (cont'd)

Cross Border Electricity offtake

- * To be selected.
- * Cross Border transmission options - connect to Czech national grid and use the 600 MW DC link to Bavaria, or construct new DC link to the north.

Optional Heat offtake

- * Komorany heat and electricity generating plant in Komorany.
- * Privatized joint stock company.
- * To take heat supply combined with partial plant retrofit.

Limestone supply

- * Regional limestone mine or Czech steel mill (slag) to be selected.

Operation and Maintenance

- * To be selected.

Site Aquisition/Lease

- * CHP, see above.

4.4 Summary of Term Sheet Structures

Table of Contents

- 4.4.1 Commercial Offtake and Supply Product Structure**
- 4.4.2 Fixed and Variable Cash Flow Balance**
- 4.4.3 Commercial Offtake and Supply Cash Flow Structure**
- 4.4.4 Offtake and Supply Escalation Strategy**
- 4.4.5 Offtake and Supply Currency Strategy**
- 4.4.6 Support Strategy during Capacity Outage Periods**

4.4.1 Commercial Offtake and Supply Product Structure

SYNCHEM FEASIBILITY I

3) Base case 1B heat supply is 190 MW. By reducing to 135 MW, approx 15 MW power capacity is added

4.4.2 Fixed and Variable Cash Flows Balance

		MCEK/year, 1993 Money Value (non-inflated)			
		<u>Capital</u>	<u>O & M</u>	<u>Variable</u>	<u>Total</u>
INFLOWS	C H P	1,700	270	550	2,520
	S E Z whereof spot	1,750	300	570	2,620
	Cross boarder Utility whereof spot	2,210	380	720	3,310 ²⁾
	As available power, net 3)			60	60
	Komorany option	575			575
	Sulphur			60	60
	Total Offtake	<u>6,235</u>	<u>950</u>	<u>1,960</u>	<u>9,145</u>
OUTFLOWS	Supply Debt Service Equity Return }	-6,225	-950	-1,970 ¹⁾	-9,145
		<u><u>-6,225</u></u>	<u><u>-950</u></u>	<u><u>-1,970</u></u>	<u><u>-9,145</u></u>
BALANCE		+ 10	0	- 10	0

1) Including 5 year licence fee annualized over 25 years

2) At SEZ pricing

3) Net of assumed purchase of back-up power during plant outage periods

4.4.3 Commercial Offtake and Supply Cash Flow Structure

SYNCHEM FEASIBILITY I

OutflowsInflows

SYNCHEM

4.4.4 Offtake and Supply Escalation Strategy

SYNCHEM FEASIBILITY I

4.4.5 Offtake and Supply Currency Strategy

SYNCHEM FEASIBILITY I

4.4.6 Support Strategy during Capacity Outage Periods

4.4.6.1 Conceptual Plant Utilization Scheme

- 1) Full planned power, steam (and heat) capacity
- 2) Full planned steam (and heat) capacity and partial power capacity

4.4.6.2 Capacity Outage Back-up Strategy

- Steam:
- T700 back-up
 - back-up boilers
 - power capacity -> steam capacity
 - turn down consumption

- Power :
- turn down SEZ / Cross border (and CHP) offtake capacity
 - back-up capacity from SEZ / Cross border

- Heat :
- back-up capacity from Komorany

4.5 Programme of Future Work

To conclude the Feasibility Phase efforts, finalization of all draft term sheets is critical, without an agreement in principle on key terms and conditions by the parties hereto, an assessment of the overall viability and ultimate financeability of the Project is not possible. Therefore, the following program of future work is proposed :

1. Negotiate Cross Border power supply option.
2. Confirm impact from revised project base case characteristics and target feedstock flexibility.
3. Determine availability targets for the individual offtake contracts for steam and power
4. Finalize back-up requirements and structures for steam and power offtake.
5. Finalize terms of agreement on
 - Coal supply from MUS
 - HVR/Vistar and back-up fuels supply from CHP
 - Steam and power sales to CHP
 - Power sales to SEZ
 - Power sales Cross Border
 - Optional heat sales to Komorany
 - Limestone/Slag-scrap supply
 - Site lease
 - Operation and Maintenance (prospects)
 - Sulphur (prospects)

**OWNERSHIP AND
MANAGEMENT**

OWNERSHIP AND MANAGEMENT

5.1 OWNERSHIP

There are basically four structures for Project ownership available to the Participants under the Czech Commercial Code:

- **Joint Stock Company ("akciová společnost" or "a.s.")**: a joint stock company is a rather formal structure, and is regulated in some detail by the Commercial Code. This form is similar to the public limited company in the U.K., the corporation in the U.S. and the société anonyme in the French Civil Code and the Aktiengesellschaft under German law.
- **Limited Liability Company ("společnost s ručením omezeným" or "s.r.o.")**: as with the JSC, the limited liability company is subject to significant regulation to the Commercial Code. It is roughly equivalent to the private limited company in the U.K., a closed corporation in the U.S., a société à responsabilité limitée under French law, or Gesellschaft mit beschränkter Haftung under German law.
- **General Commercial Partnership ("veřejná obchodní společnost" or "v.o.s.")**: the general commercial partnership is very similar to partnership structures in other western countries. The Commercial Code gives the members of a GCP great latitude in designing the structure to fit their particular requirements.
- **Limited Partnership ("komanditní společnost" or "k.s.")**: the limited partnership requires at least one general partner, and may have as many limited partners as desired. This structure is very similar to limited partnerships in the U.K. and the U.S., and as with the GCP gives the members wide discretion in fashioning an organizational form appropriate for their special needs.

5.2 PROJECT ENTITY/COMPANY

The Project Participants have concluded that the most flexible form of legal entity to be utilized for ownership of the Project is the general partnership. Utilizing such a structure will give the members of the project great latitude with respect to their internal agreement on many matters affecting the project structure, such as management, voting rights, and transfer of ownership interests. As a result of using this structure, the members will be able to establish within the partnership contract many agreements which might not be possible should a more formal corporate-type structure be used. Use of a general partnership also accommodates the disparate tax circumstances of the various project participants.

Based on the foregoing, it is envisioned that the partners in the proposed general partnership would be special purpose subsidiaries of each respective Project participant. This is depicted graphically on Attachment 5.2.1. The overall Project structure including external interfaces is shown on Attachment 5.2.2.

5.3 MANAGEMENT

The general partnership would be managed by a Management Committee which would consist of representatives of each of the partners. The Management Committee would delegate certain of its powers either to certain of the partners or to individuals who would be responsible for carrying on the day-to-day activities of the partnership. A proposed management structure together with functional groups necessary for the development, construction, and operation of the Project is shown on Attachment 5.3.

5.4 PARTNERSHIP AGREEMENT

The formal partnership agreement is envisioned to encompass the following key conditions:

- Formation of partnership - intent of partners name and place of business, etc.
- Contributions of the Partners - Initial capital requirements, additional funding provisions, ownership interest, etc.
- Management - Management Committee structure, authorization and voting procedures, officers, etc.
- Tax and Fiscal matters - Partnership treatment, allocation of income/losses, accounting records, etc.
- Transfer of Partnership Interest - Transfer restrictions/procedures change in ownership, etc.
- Defaults and Remedies - Default of partner, cure provisions, etc.
- Resolution of Disputes - Arbitration - Arbitration procedures
- Contributions to Partnership and Liabilities of Partners - contributions, indemnification issues, etc.
- Termination - Events determining termination, distribution of assets thereafter, etc.
- General Provisions - Interpretation, force majeure, notices, etc.

Attachment 5.2.2 Proposed Synchem Project Structure

**SYNCHEM PROJECT COMPANY
GENERAL PARTNERSHIP**

**SPECIAL PURPOSE
SUBSIDIARIES OF:**

**33%
Ownership**

Czech Sponsors

Chemopetrol s.p.
Dolní úpravný Komeraný s.p.
První Severosápadní
Topkarenské a.s.

**67%
Ownership**

Foreign Sponsors

Air Products and Chemical, Inc.
General Electric Technical
Services Company, Inc.
Mission Energy Company
Nykomb Synergetics B.V.
Texaco Development Corporation

Potential

International Finance Corporation
European Bank for Reconstruction
and Development

SYNCHEM IGCC PROJECT

Proposed Project Structure

5.5 PROGRAM OF FUTURE WORK

- **Confirm selection of general partnership structure as most desirable given flexibility and tax implications liability.**
- **Determine key elements of partnership agreement**

PROJECT CAPITALIZATION AND FINANCING

6.1 OVERVIEW

The estimated capital cost of the Synchem project in 1993 US\$ is in excess of \$1.4 billion including capitalized interest. A summary of these expenditures is included in Attachment 6-1.

The Synchem project will be financed with both debt and equity funds. The loans will be structured as a true project financing with cash flows from product offtake and project assets providing debt service and collateral, respectively. To date, preliminary discussions have been held with the World Bank-IFC, EBRD, U.S. Exim and commercial banks. The commercial banks have indicated a need for assurances as to the price and long term availability of coal and residual fuel supplies, and as to the performance of Czech public sector and partly privatized entities under offtake contracts. A summary of the proposed capital structure for the Synchem project is shown in Attachment 6-2.

Assuming a 70/30 debt to equity ratio, there will be a need to raise in excess of \$1015 million in loans and \$435 million in equity capital. As outlined in the Synchem project joint development agreement, the Czech participants will have the option to assume up to a 33% equity interest (\$144M) with the Foreign or U.S. participants assuming the remaining 67% (or greater) equity interest (\$291M) in the Project.

We expect that the participants, commercial sources of finance and multilateral agencies will all be sources for project financing. Some of the institutions which are likely to have an interest in the Project funding are listed in Section 6.4 including an estimate of the loan term and an identification of those banks which require sovereign guarantees. The current Feasibility Phase of the Project allows for the investigation of financing alternatives. The summary that follows is a listing of possible options for raising the required project capital:

EBRD/IFC - The principal institutions currently lending beyond 10 years in the Czech Republic are the International Finance Corporation ("IFC") and the European Bank for Reconstruction and Development ("EBRD"). We understand that the IFC will lend out to 12 years and that the EBRD will lend out to 12 years for private sector projects and out to 15 years for public sector projects. Presumably, the Infrastructural nature of the Synchem project and the ownership status of the Czech participants would qualify Synchem for 15 year funding from the EBRD. It is assumed that between them, the IFC and the EBRD could provide those loans maturing beyond 10 years.

Currently, the maximum "A" loan funding being provided by the IFC is \$100-\$125 million. The DM200 million "A" loan provided by the IFC in the Skoda/VW financing represents the largest single commitment ever made by the IFC. The

EBRD has recently advised that the maximum amount it could lend to any one borrower is currently about \$180 million. The presence of the EBRD/IFC in this transaction could also help to mobilize commercial bank finance, particularly if the Project participants can successfully negotiate a "B" loan structure whereby all senior lenders can be afforded preferred creditor status.

The World Bank's Expanded Cofinancing Operations ("ECO") program provides for loan guarantees which would cover political risks (i.e. feedstock availability/cost and product offtake performance) about which commercial lenders have reservations. However, the World Bank's charter requires that its guarantees be counter-guaranteed, dollar-for-dollar, by the host government.

EIB - Another potential source of longer term financing is the European Investment Bank ("EIB"), which can provide loans up to 10-12 years for industrial projects and 12-15 years for infrastructure projects, including energy. It is estimated that approximately \$40 million could be obtained from this source.

Export Credit Agencies ("ECAs") - U.S. Exim is open for business in the Czech Republic and could be a useful source of fixed interest rate funds. This funding source is dependent upon U.S. content and is usually subject to relatively short maturities. Support from Exim can take several forms including providing direct loans or loan guarantees. This support will be subject to obtaining sovereign assurances from the Czech Government.

Commercial Banks - The shorter maturities could in theory be provided by commercial banks under IFC and EBRD "B" loans and by ECAs. As in the large financing that has recently been structured for Skoda/VW, the commercial banks could also provide debt financing directly. The commercial lenders will require sovereign guarantees. This type of debt is particularly helpful if the foreign exchange risk (i.e. convertibility, devaluation, and repatriation) can be minimized or mitigated. Optimal terms are likely to be secured if the Czech parties which are key sources of project offtakes and supply are backstopped through performance guarantees provided by the Czech Government.

Bilateral Agencies - Although not yet fully investigated by the Synchem team, such agencies as Overseas Private Investment Corporation ("OPIC") could be a useful source of both insurance coverage and financing. The positive environmental impact of the project should assist in securing any financing available, but the amount will not be significant in comparison with other potential financiers.

Local (Czech) Sources - The lack of depth in the Czech financial markets is a significant limitation but this should not preclude careful consideration of financing a portion of local costs in local currency. For example, a modest index-linked medium-term bond may be attractive to some financial institutions which are seeking a hedge against inflation.

6.2 FUNDING REQUIREMENTS

In pursuit of financing for the Synchem project, it estimated that the following debt structure is possible:

Equity	\$	435 (US 1993 \$MM)
Financing:		
IFC		100
EBRD		180
EIB		40
Commercial Banks & ECAs		695
Total Capitalization	\$	1,450

Attachment 6-3 summarizes the project Loan Drawdown Schedule in current US \$MM. This exhibit should be helpful in identifying the annual loan guarantee requirement for the Synchem project.

6.3 PRELIMINARY FINANCING PLAN

	1993 <u>US \$MM</u>	% <u>Equity</u>	% <u>Cost</u>
<u>Owner's Equity</u>			
Czech	\$144	33%	10%
Foreign (U.S.)	<u>291</u>	67	<u>20</u>
Total Equity	435		30
<u>Borrowed Funds</u>			
Multi-lateral Agencies (IFC/EBRD/EIB)	320		22
Commercial Lenders & Export Credit Agencies	<u>695</u>		<u>48</u>
Total Debt	1015		70
	<hr/>		<hr/>
Total Capital	\$1,450	100%	100%

6.4 SOURCES OF DEBT FINANCING

<u>Source</u>	<u>Term</u>	<u>Require Sovereign Guarantees</u>
World Bank		
International Finance Corporation (IFC)	12 Years	No
European Bank for Reconstruction and Development (EBRD)		
Private	12 Years	No
Public	15 Years	No
European Investment Bank		
Industrial	12 Years	No
Infrastructure	15 Years	No
Export Credit Agencies (ECA)	8 1/2 Years*	Yes
Commercial Banks	7-8 Years	Yes

* 12 Years or longer sometimes possible for power projects.

6.5 PROGRAM OF FUTURE WORK

Financial structuring is a key element in the Development Phase activity. The following steps will need to be completed before financial closure (exclusive of permitting and commercial issues):

1. Negotiation and finalization of Czech governmental guarantees.
2. Initiate discussions with US government to determine level of support they would be interested in providing.
3. Secure Project Financial Advisor.
4. Project Pro Forma finalization.
5. Development and publication of a Project Descriptive Memorandum for submission to lending institutions to enable proper project review.

6. Initiation of Project specific discussions with lending institutions:
 - A. Multilateral - IFC
EBRD
World Bank
EIB
 - B. Export Credit Agencies - US Exim
Other Applicable Agencies
 - C. Bilateral Agencies - OPIC
MIGA
 - D. Commercial Banks - Foreign (US and other)
Czech
7. Finalization of Project financial structure.
8. Financial Close.

SYNCHEM PROJECT

SUMMARY OF CAPITAL EXPENDITURES

Expressed in 1993 US \$MM					
	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	Total <u>U.S. \$MM</u>
Preliminary Engineering	5				5
Environmental Permitting	3				3
Bid Detailed Engineering	1				1
Detailed Engineering		43	32		75
Long Lead Purchasing		140			140
Bid Construction		1			1
Construction			421	315	736
Start-Up				10	10
Post Start-Up (Punch List)				20	20
Offsite Costs			38	28	66
Initial License Fees	9	10		9	28
Owners Cost	4	4	4		12
Financing Fees		24			24
Import Duties				12	12
Working Capital				27	27
Capital Cost Excluding Capitalized Interest	22	222	495	421	1160
Interest During Construction (IDC)	2	17	73	139	231
Debt Service Reserve				59	59
Total Capitalized Cost	<u>24</u>	<u>239</u>	<u>568</u>	<u>619</u>	<u>1450</u>

SYNCHEM PROJECT

PROPOSED CAPITAL STRUCTURE

	1993 <u>U.S. \$MM</u>	% of <u>Equity</u>	% of <u>Cost</u>
<u>Owner's Equity</u>			
Czech	\$ 144	33%	10%
Foreign (U.S.)	291	67	20
Total Equity	435		30
<u>Borrowed Funds</u>			
Multi-lateral Agencies (IFC/EBRD/EIB)	320		22
Commercial Lenders & Export Credit Agencies	695		48
Total Debt	1015		70
Total Capital	\$1,450	100 %	100 %

Attachment 6-2

SYNCHEM PROJECT

LOAN DRAWDOWN

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>Total in Current U.S. \$MM</u>
Capitalized Cost Excluding IDC Expressed in 1993 US \$MM	22	198	475	421	1136
Interest During Construction (IDC) Expressed in 1993 U.S. \$MM	2	17	73	139	231
Financing Fees		24			24
Debt Service Reserve				59	59
Total Capitalized Cost in 1993 U.S. \$MM	<u>24</u>	<u>239</u>	<u>568</u>	<u>619</u>	<u>1450</u>
1994 Current US \$MM with 5% Inflation	23				23
1995 Current US \$MM with 5% Inflation		224			224
1996 Current US \$MM with 5% Inflation			582		582
1997 Current US \$MM with 5% Inflation				516	516
Interest During Construction (IDC)	3	18	83	162	266
Financing Fees		24			24
Debt Service Reserve				69	69
Total Current Year Loan Drawdown	<u>26</u>	<u>266</u>	<u>665</u>	<u>747</u>	<u>1704</u>

PROJECT ECONOMICS

7.1 INTRODUCTION

This section contains financial projections for the project which are based on anticipated contractual arrangements as well as certain other assumptions as of October 1, 1993. Accordingly, these projections are subject to further change pending finalization of various commercial term sheets and should be used for illustrative purposes only. No representations are made as to the accuracy or reasonableness of these projections. Each Participant should therefore make their own analyses and evaluation of the Project.

The base case depicted herein forecasts the expected results of construction and operation for the period 1994 through 2022. Selected alternative or sensitivity cases are also presented to facilitate analysis of the Project. However, unless otherwise noted, the discussion below relates to the base case.

7.2 ASSUMPTIONS

General Assumptions

- General inflation is assumed to be 5% per annum.
- Construction and term interest is forecasted to be 12%, inclusive of fees/spreads. Interest on Czech-based borrowings are forecasted at 16%.
- Rate of exchange is assumed to be 30 kcs per U.S. \$
- Project availability (electric power) is assumed to be 91.7%, or 8030 hours per year. Steam and district heat availability is assumed to be 100% based on Synchem's peak back-up boilers ownership.

Prior to Commercial Operation

- Cumulative operating expenses during start-up are assumed to be paid with Project Debt.
- Construction financing is assumed to be 100% and covers interest expense, insurance, etc. during the construction period.
- Loan drawdowns including financing costs, are assumed as follows:

<u>Year</u>	<u>Amount</u> <u>(U.S. \$000)</u>
1994	26,000
1995	266,000
1996	665,000
<u>1997</u>	<u>747,000</u>
Total	\$1,704,000

- Upon term loan conversion, the Project Participants are assumed to jointly contribute up to \$511,000,000 in equity. No additional equity is assumed to be contributed by the Participants.

After Start of Commercial Operation

After completion of construction, revenues are generated primarily from the sales of export electricity to SEZ and a foreign utility; steam and electricity to Chemopetrol; and district heat to Komorany. Other revenues of a smaller magnitude are interest earnings from reserve account deposits and sulfur sales.

The majority of expenses are for purchases of coal and heavy vacuum residual oil feedstocks. Other expenses include operations and maintenance, emissions fees, catalyst and chemicals, limestone, property taxes and insurance.

Revenues

Export electricity - Based on the current term sheet proposals, 250 MW and 307 MW of firm capacity would be sold to the foreign utility and SEZ, respectively. The 1993 price to foreign utility is assumed to be \$0.0606 per kwh, of which \$0.0364 is for capacity, \$0.0052 for fixed O&M, and \$0.0190 for variable expenses. The model assumes that the capacity element of \$0.0364/kwh escalates yearly, at 2%, whereas the fixed O&M and variable expense component escalate with general inflation, or 5% per annum.

The 1993 price to SEZ is assumed to be \$0.0512, of which \$0.0266 is capacity, \$0.0056 fixed O&M, and \$0.0190 variable expenses. The model assumes that the capacity element escalates at 4% per annum, whereas the remaining components escalate with general inflation, or 5% per annum.

Chemopetrol Steam and Electricity - Revenues from the sales of approximately 2,225,000 tonnes per year of steam and 135 MW of electric power to Chemopetrol are comprised of several components:

1. Non-escalating capacity component of 1600 million kcs in 1993 terms;
2. An escalating capacity component of 450 million kcs in 1993 terms;
3. An escalating fixed O&M recovery payment in 1993 of 270 million of kcs
4. A variable expense component of approximately 250 million kcs in 1993 terms. With the exception of the non-escalating capacity component, all other elements of pricing are assumed to escalate at the general inflation rate of 5% per annum.
5. An escalating variable charge for condensing electric energy of approximately 265 million Kcs in 1993 terms.

Komorany District Heat - Sales of approximately 135 MW thermal equivalent of district heat is assumed at an all-in price of \$19.2 million in 1993 terms. Escalation thereafter is at the general inflation rate of 5% per annum.

Sulfur sales - The model assumes the sale of approximately 47,000 tons of sulfur per year at a 1993 price \$50 per ton, escalated for future years at the general inflation rate.

Interest Revenues - The model assumes interest earnings at the rate of 6% on the yearly balance of funds included in the Debt Service Reserve (1998 beginning balance equal to approximately 6% of outstanding loan balance).

Expenses

Note: Unless otherwise stated all expenses escalate at the general inflation rate of 5% per annum.

Coal	The model assumes the purchase of approximately 2.3 million U.S. tons per year (as delivered) of coal at a 1993 price of \$12.66 per ton.
HVR	Approximately 690,000 U. S. tons per year of heavy vacuum residual/visbreaker is assumed to be purchased at a 1993 cost of \$30 per ton.
Other Fuels	To achieve the assumed availability factors, approximately 33,000 and 9,000 U.S. tons per year of low sulfur fuel oil ("LSFO") and distillate, respectively, are consumed at the cost, in 1993 terms, of \$72.23 and \$161.17 per ton, respectively.

Operation and Maintenance

In 1993 terms, annual operations and maintenance expenses including spare parts and labor is assumed to be \$25.7 million.

Nonfuel Variable Expenses

Other non-fuel variable expenses including limestone and water purchases, slag disposal costs, and catalysts and chemicals is forecasted at \$7.0 million per year in 1993 terms.

Emission Fees

Emissions fees for SO₂, NO_x and particulates totalling \$195,000 in 1993 terms is expensed yearly.

Purchased Electricity

In order to fulfill an obligation to provide 1,168 GWH/Yr of power to Chemopetrol, it is required that 83.9 GWH/Yr of electricity needs to be purchased at off peak periods at \$0.058 per KWH in 1993 terms.

Non-Controllable Expenses

Non-controllable expenses of \$6.3 million in 1993 terms including insurance, real and personal property taxes is assumed incurred each year. In addition, for the first five years of operations, an escalating (with general inflation) running royalty fee of \$4.6 million per year in 1993 terms is assumed.

Financing

Project debt is assumed amortized over a twelve year term commencing with the first year of operations. Amortization is based on a fixed principal - repayment assumption.

For convenience, debt service coverage ratios are also shown.

7.3 ALTERNATIVE CASES

Case 2 Case 2 assumes a 10% increase in capital costs.

Case 3 Case 3 assumes a 25% reduction in the average sales price of merchant (non Chemopetrol) electricity sold

- Case 4 Case 4 assumes a full life availability of 85% for electric power production.
- Case 5 Case 5 assumes an increase of 2% in interest rates.
- Case 6 Case 6 assumes an increase in output of 20 MW net due to optimization benefits.

7.4 FINANCIAL PRO FORMAS

For the pricing and cost assumptions discussed previously, the project has a 17% internal rate of return (IRR) on an unleveraged basis (i.e., if the project were 100% equity financed). At a 10% discount rate, the unleveraged net present value (NPV) is \$725 MM, for an investment (on a 100% equity financed basis) of \$1,318 MM. The present worth index (PWI), which is the ratio of the NPV's positive to negative cash flow is 1.7 on an unleveraged basis. The present worth payback (PWP), which is the time required to recover investments on a discounted basis, is 14 years (see Table 7.4.1).

For the 70% debt financed case (leveraged economics), the IRR for equity investors is 25.3% in the base case. The net present value to the equity investors (at a 10% discount rate) is \$789 MM, on an equity investment of \$511 MM. The PWI to the equity investors for the leveraged case is 3.2, with a PWP of 11 years.

The summary of the base case economics as well as alternative cases is presented in Table 7.4.2.

On a project levelized basis, approximately 25% of the projects revenues are derived from Chemopetrol, while 30% are from domestic power sales, 38% from foreign power sales, 6% from district heating sales, and less than 1% from the sale of sulfur (Figures 7.4.3 and 7.4.4). Approximately 72% of the costs of the project are capital related, on a levelized basis, while coal accounts for 9%, HVR for 6.4%, distillate and low sulfur fuel oil for 1%. Operations and maintenance and other controllable expenses account for 9%, and non-controllable expenses 3%.

Because of the relative importance of capital costs, the project economics are very sensitive to capital cost variances. This is illustrated in alternative case 2, where a 10% increase in capital cost erode the unleveraged IRR from 17.0% to 15.8%, and the leveraged IRR on equity from 25.3% to 22.5%. This importance of capital related charges also makes the projects leveraged returns very sensitive to borrowing rate. In case 5, an increase of 2% in the borrowing rate results in a decrease in leveraged IRR from 25.3% down to 23.0%.

Furthermore the project is very sensitive to revenues/pricing from each of the three major offtakers, Chemopetrol, Domestic Power Sales, and Foreign Power Sales, which together represent more than 93% of the projects revenues. As case 3 illustrates, a reduction of 25% in price for Domestic/Foreign Power sales reduces the unleveraged IRR from 17% to 13.8%, and the leveraged returns on equity from 25.3% to 17.9%.

SUMMARY OF ECONOMIC SENSITIVITIES

Unleverage

Table 7.4.1

	<u>NPV (@10%)</u>	<u>IRR</u>	<u>Present Worth Index</u>	<u>Present Worth Payback</u>
Base Case	\$ 725 MM	17.0%	1.7	14 Years
10% Increase in Basic Capital Costs	\$ 673 MM	15.8%	1.6	15 Years
25% Decrease in Power Price to BWE & SEZ	\$ 380 MM	13.8%	1.4	17 Years
Reduction in Power Availability from 91.7% to 85%	\$ 719 MM	16.7%	1.7	14 Years
Increase of 2% in Borrowing Rates	\$ 725 MM	17.0%	1.7	14 Years
Increase of 20 MW Available to BWE	\$ 733 MM	17.1%	1.7	14 Years

SUMMARY OF ECONOMIC SENSITIVITIES

Leveraged

Table 7.4.2

	<u>NPV (@10%)</u>	<u>IRR</u>	<u>Present Worth Index</u>	<u>Present Worth Payback</u>
Base Case	\$ 789 MM	25.3%	3.2	11 Years
10% Increase in Basic Capital Costs	\$ 713 MM	22.5%	2.8	13 Years
25% Decrease in Power Price to BWE & SEZ	\$ 410 MM	17.9%	2.1	16 Years
Reduction in Power Availability from 91.7% to 85%	\$ 755 MM	23.0%	2.9	12 Years
Increase of 2% in Borrowing Rates	\$ 722 MM	23.0%	2.9	12 Years
Increase of 20 MW Available to BWE	\$ 810 MM	25.6%	3.2	11 Years

FIGURE 3A

Revenues

FIGURE 3B

Expenses

SUMMARY OF KEY ASSUMPTIONS

<u>Chemopetrol Base Facility & Other Charges</u>	1993	1996	
Capacity - Non Escalating (after Start-Up) MMS/Yr	\$53.33	\$68.07	
Capacity - Escalating	MM \$/Yr	\$15.00	\$19.14
O&M	MM \$/Yr	\$9.00	\$11.49
Variable Charge - Steam/Power	\$/Ton	\$3.48	\$4.44
Variable - Condensing Power	\$/KWH	\$0.0100	\$0.0128
			2,452 Ktons/Yr

<u>Purchased Power</u>			1998
Energy/Variable	GWH/Yr	83.9	(\$/KWH) \$0.0319
Capacity Reserved	MW	70.0	(\$/KW/Yr) \$51.05

Project Life:	25 years.	Start-Up Date: Jan. 1988
Exchange Rate:	30 KCS/US\$	VAT: "PASS-THROUGH"
Inflation: Capex	5% (Czech Republic)	
Inflation: Revenues	5% (Czech Republic)	
Inflation: Costs	5% (Czech Republic)	
Depreciation:		
Book Depreciation:	Straight Line (Czech Schedule).	
Tax Depreciation:	Accelerated Method (Czech Schedule).	
Insurance: OPIC & MIGA		
Aggregate Premium:	2% of \$150 MM maximum coverage.	
@ 1/1/1993	\$3 MM/yr.	

Capital/Financing: Capital Investment		Capital Investment	Capital Investment
Capital Costs w/o Fin.	\$1,302 \$ MM (1/98)	"AS SPENT"	"OVERNIGHT"
Working Capital:	\$27 \$ MM (1/98)	Capital Costs	\$1,302 \$ MM (1/98)
Import Duties:	\$16 \$ MM (1/98)	Working Capital:	\$27 \$ MM (1/98)
Financing Fee:	24 \$ MM (1/98)	Import Duties:	\$16 \$ MM (1/98)
Debt Service Reserve:	69 \$ MM (1/98)	Escalator/Inflation:	\$0
IDC:	\$288 \$ MM (1/98)	Total:	\$1,345 \$ MM (1/98)
Total Financeable	\$1,704 \$ MM (1/98)		\$1,096 \$ MM

		Term Loan	
Equity/Debt Ratio:	30% 70%	Term Loan Repayment:	Fixed Principal
\$ MM (1/98)	\$511 \$1,183	Term Loan - Debt Service Period:	12 years

Construction Loan:	Debt	Interest Rate	Term Loan		
	100%	12%	Finance Sourcing:	Amount	Interest Rate
*(As Spent)	\$1,608	\$ MM (1/98)	- International L-T Debt:	98.43%	12%
			- Czech L-T Debt:	0.00%	16%
Working Capital:	30 (Day Supply)		- Working Capital (Czech)	1.57%	16%
				100%	

*Interest rate build up includes interest premium + swap fees + spread.

<u>Tax Assumptions:</u>	<u>Tax Rate</u>	<u>Withholding Rate</u>
Czech Partnership	45%	-
Czech Corporation	45%	25% Czech Shareholder 0% Foreign Shareholder

<u>Real Estate Taxes:</u>	\$213,139	\$ U. S.
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*(200,000 sq. meters x 10 Industry Factor x 2.5 Location Factor)

PRODUCTION: BASE YEAR -- 1998				PRODUCTION PRICING ASSUMPTIONS: BASE YEAR -- 1998		
ELECTRIC POWER TO:	QWH/YR*	%	MW elec.	ELECTRIC POWER TO:		
Chemopetrol: Period 1	1,084	19.5%	135	Chemopetrol: Base	AVERAGE PRICE (\$/KWH)	\$0.000
Chemopetrol: Period 2	0	0.0%				
Utility -- SEZ Period 1	2,008	36.1%	250	Utility -- SEZ (Base)	AVERAGE PRICE (\$/KWH)	\$0.084
Utility -- SEZ Period 2	0	0.0%				
Utility -- BWE Period 1	2,465	44.4%	307	Utility -- BWE (Base)	AVERAGE PRICE (\$/KWH)	\$0.071
Utility -- BWE Period 2	0	0.0%				
Total Output:	5,557	100%	692			

(* Based on 24 hr/day x 334 day/yr.)

STEAM TO:	KTons/Yr	GWH/YR*	MW th	MW elec.	STEAM TO CHEMOPETROL:		
CHEMOPETROL:					Base Load HP: Capacity	(\$/Ton)	\$0.00
Base Load	2,452	1,674	191	64	Energy	(\$/Ton)	\$0.00
					Base Load MP: Capacity	(\$/Ton)	\$0.00
					Energy	(\$/Ton)	\$0.00
					Base Load LP: Capacity	(\$/Ton)	\$0.00
					Energy	(\$/Ton)	\$0.00
(* Based on 24 hr/day x 365 day/yr.)							

<u>DISTRICT HEAT TO:</u>	<u>GWH/YR*</u>	<u>MW th</u>	<u>MW elec.</u>	<u>DISTRICT HEAT TO:</u>		
Komorany	1,183	135	45.0	Komorany – Base: Capacity	(\$/MMBTU)	\$0.00
				Energy	(\$/MMBTU)	\$0.06

(* Based on 24 hr/day x 365 day/yr.)

PROJECT ECONOMIC INDICES: JOINT VENTURE				PRODUCTION:		QWHYR		PRODUCTION %		REVENUES	
Loan Repayment Method: Fixed Principal				- A.) POWER (External Sales)		4,473	53%				70%
				- B.) Chemopetrol (Power)		1,084	13%				24%
				- C.) Chemopetrol (Steam)		1,674	20%				
Discount Rate: 10.00%				- D.) DIST. HEAT:		1,183	14%				7%
				TOTAL:		8,414	100%				100%
NO FINANCING				FINANCING							
NPV:	\$752 MM \$ U. S.				\$769 MM \$ U. S.						
DCF-ROI:	18.95%				25.25%						
PWI:	1.7				3.2						
PWP: (yrs)	14				11						
						Capex w/o Financing		Capex w Financing			
				Price per KW (\$ MM):		\$1,294			\$1,580		
								Total Investment			
								\$1,674			

PROJECT ECONOMIC INDICES: JOINT VENTURE		
Loan Repayment Method: Fixed Principal		
Discount Rate: 10.00%		
NO FINANCING		
NPV:	\$752 MM \$ U. S.	
DCF-ROI:	18.95%	
PWJ:	1.7	
PWJ: (yrs)	14	
FINANCING		
		\$789 MM \$ U. S.
		25.25%
		3.2
		11

SYNCHRO PROJECT -- CZECH REPUBLIC

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C:\123R3\WKS\CZECH\SYNCTX7C.WK3 Worksheet B

Plant Operating Parameters (A*)							ENERGY BALANCE	
Fuels	Btu/lb	KTons/Yr	KTons/Yr	KTons/Yr			Million	
		DRY BASIS	WET BASIS	Sensitivity			MMBTU/Yr	GWH/Yr
GASIFIERS (B*)								
Coal-Brown	10,766	1,615	2,306	100%			34.76	10,183
HVR	18,103	893		100%			25.09	7,349
		2,308					59.86	17,532
Boilers (C*)								
LSFO (Boilers)	17,950	32.9		100%			1.18	346
Distillate: Turbine (D*)	19,460	9.3		100%			0.36	106
TOTAL FUELS INPUT		2,350					61.4	17,984

PRODUCTION								
POWER: AVAILABILITY @ 92%	MW	Months/Yr	Op Factor	Hrs/Yr	MW	Op Factor	Million	
					Sensitivity	Sensitivity	MMBTU/Yr	GWH/Yr
Chemopetrol: Period 1	135	12	91.7%	8,030	100%	100%	3.70	1,084
Chemopetrol: Period 2		0	0.0%	0	100%	100%	0.00	0
Utility - SEZ Period 1	250	12	91.7%	8,030	100%	100%	6.85	2,008
Utility - SEZ Period 2		0	0.0%	0	100%	100%	0.00	0
Utility - BWE Period 1	307	12	91.7%	8,030	100%	100%	8.42	2,465
Utility - BWE Period 2		0	0.0%	0	100%	100%	0.00	0
TOTAL	692		91.7%				19.0	5,557.0

STEAM TO CHEMOPETROL: AVAILABILITY @ 100%								
Base Load	Btu/lb	KTons/Yr	MW th	MW elec.	KTons/Yr		Million	
					Sensitivity		MMBTU/Yr	GWH/Yr
HP 31 bar(a) 450 C	1,317	372	33		100%		0.98	287
MP 19 bar(a) 300 C	1,182	1,554	121		100%		3.61	1,058
LP 3.5 bar(a) 180 C	1,069	528	38		100%		1.12	329
Total Steam	3,547	2,452	191	64			5.72	1,674

DISTRICT HEAT: AVAILABILITY @ 100%								
	Hrs/Yr	MMBTU/Hr	MW th	MW elec.			Million	
							MMBTU/Yr	GWH/Yr
Komorany - Base	8,760	461	135.0	45.0			4.04	1,183

TOTAL POWER/ENERGY OUTPUT:							28.72	8,414
OVERALL FUEL UTILIZATION EFFICIENCY:	46.8%		HHV					

Additional Power Purchases for Chemopetrol					Sensitivity			
	Energy				100%		GWH/Yr	83.9
	Capacity Reserved				100%		MW	70.0

OTHER				KTons/Yr	KTons/Yr
EMISSIONS (E*)					Sensitivity
SO2				1.17	100%
NOx				5.85	100%
Particulates				0.20	100%
TOTAL EMISSIONS:				7.22	
OTHER				KTons/Yr	Million MMgal./Yr
Sulphur Produced	k/Tons			47	100%
Limestone Flux Purchased	k/Tons			164	100%
Slag Produced	k/Tons			390	100%
Water Purchased	MMgal.			940.00	100%
Catalyst & Chemicals (F*) Purchased					100%

ASSUMPTIONS:

(A*): PLANT OPERATING PERFORMANCE 92% AVAILABILITY (334 DAYS).

(B*): GASIFIERS/TURBINES PRODUCTION AVAILABILITY @ 90% (327 DAYS).

(C*): BOILERS PRODUCTION AVAILABILITY @ 8% (31 DAYS).

(D*): DISTILLATE FOR TURBINE PRODUCTION AVAILABILITY @ 2% (7 DAYS).

(E*): EMISSIONS ASSUMED @ 92% OF SYNGAS PROD. WE ARE USING 90% SYNGAS PROD.

(F*) See TGPS Prelim. Design & Proj. Anlys. Phase 1, Feas. Study: Sect. #4, pg.69.

FUELS: KTons/Yr: See Technical Detail p.3 (Project Summary Table). TPD is in metric basis.

For Coal & HVR calculation, the average of Case 2(Summ) & Case 3 (Wnt) was taken @ 334 days = (92.5%) plant operating availability. 70% of coal amount was taken to convert wet basis of coal in Technical Detail to dry basis. (For Coal, HVR, Distillate & LSFO see G. Gardner hand written calc. - enclosed).

STEAM MWe:

HEAT MWe: (See G. Gardner hand written calc. - enclosed).

(See G. Gardner hand written calc. - enclosed).

PRICING ASSUMPTIONS:				
FUELS				
Coal-Brown (WET Basis) (\$/Ton)	\$12.66	\$16.15	5.0%	100.0%
HVR* (\$/Ton)	\$30.00	\$36.29	5.0%	100.0%
Distillate (Turbine) (\$/Ton)	\$101.17	\$205.70	5.0%	100.0%
LFO (Boilers) (\$/Ton)	\$72.23	\$92.19	5.0%	100.0%
Coal-Brown: 1993 Price @ \$0.003 KWH				
Price: @ \$30.00/Ton to reflect COAL BTU EQUIVALENT price.				
Coal Pricing is on a wet basis; thus coal is purchased as Delivered.				
Rotterdam Spot Price 1993 (#2 Fuel Oil - Gasoil)				
Rotterdam Spot Price 1993 (#6 Fuel Oil - 3.5% SFO)				
LFO (Boilers)				

POWER				
Escalator Sensitivity				
1998 \$				
Capacity	(\$/KWH/Month)	\$0.00000	0.0%	100.0%
Energy	(\$/KWH)	\$0.00000	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$0.00000	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Chromopetrol: Period 2				
Capacity	(\$/KWH/Month)	\$0.00000	4.0%	100.0%
Energy	(\$/KWH)	\$0.00000	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$4.76333	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Utility - SEZ Period 1				
Capacity	(\$/KWH/Month)	\$21.89867	4.0%	100.0%
Energy	(\$/KWH)	\$0.02425	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$4.76333	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Utility - SEZ Period 2				
Capacity	(\$/KWH/Month)	\$0.00000	4.0%	100.0%
Energy	(\$/KWH)	\$0.00000	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$0.00000	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Utility - BWE Period 1				
Capacity	(\$/KWH/Month)	\$28.88367	2.0%	100.0%
Energy	(\$/KWH)	\$0.02425	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$4.68968	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Utility - BWE Period 2				
Capacity	(\$/KWH/Month)	\$0.00000	2.0%	100.0%
Energy	(\$/KWH)	\$0.00000	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$0.00000	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%

EMISSIONS				
Base Year	Escalator	Sensitivity		
1998				
SO2	(\$/Ton)	\$38.61	5.0%	100.0%
NOX	(\$/Ton)	\$30.89	5.0%	100.0%
Particulates	(\$/Ton)	\$115.81	5.0%	100.0%
OPERATIONS & MAINTENANCE:				
Maintenance/Materials*	(\$M/Yr)	\$15.04	5.0%	100.0%
Salary Expense*	(\$M/Yr)	\$2.92	5.0%	100.0%
Spares Parts*	(\$M/Yr)	\$14.87	5.0%	100.0%
Other Expenses ??????	(\$M/Yr)	\$0.00	5.0%	100.0%
OTHER				
Supplies Produced	(\$/Ton)	\$63.81	5.0%	100.0%
Limestone Flux Purchased	(\$/Ton)	\$7.10	5.0%	100.0%
Slag Produced	(\$/Ton)	\$3.85	5.0%	100.0%
Water Purchased	(\$/Ton)	\$0.73	5.0%	100.0%
Catalyst & Chem. (First Yr) @ 334 days	?	\$1.39	5.0%	100.0%
Purchased Power	?	\$2.23	5.0%	100.0%
Energy/Variable Charge	(\$/KWH)	\$0.0319	5.0%	100.0%
Capacity Reservation Fee	(\$/KWH/Yr)	\$51.05	5.0%	100.0%
Non-Controllable Expenses				
Insurance (2% of \$150 MM Max Cov)	(\$M/Yr)	\$2.55	5.0%	100.0%
Running License Fees*	(\$M/Yr)	\$5.85	5.0%	100.0%
Property Tax	(\$M/Yr)	\$213.14	5.0%	100.0%
Real Prop. & Personal Prop. Insur.*	(\$M/Yr)	\$3.96	5.0%	100.0%
STEAM TO CHEMOPETROL*				
Base Year	Escalator	Sensitivity		
1998				
Base Load HP: Capacity	(\$/Ton)	\$0.00	5.0%	100.0%
Energy	(\$/Ton)	\$0.00	5.0%	100.0%
Base Load MP: Capacity	(\$/Ton)	\$0.00	5.0%	100.0%
Energy	(\$/Ton)	\$0.00	5.0%	100.0%
Base Load LP: Capacity	(\$/Ton)	\$0.00	5.0%	100.0%
Energy	(\$/Ton)	\$0.00	5.0%	100.0%
DISTRICT HEAT**				
For Calculation of \$/MMBTU \$/TON \$/KWH: See below.				
Komorany - Base: Capacity	(\$/MMBTU)	\$0.00	0.0%	100.0%
Energy	(\$/MMBTU)	\$6.06	5.0%	100.0%
** Reflects a 1993 price @ \$4.20/MMBTU = Komorany's avoided cost of \$18.17 MM (\$75 MMKCS) per year.				
1998				
Escalator	Sensitivity			
1998				
Base Year	Escalator	Sensitivity		
1998				
Capacity	(\$/KWH/Month)	\$28.88367	2.0%	100.0%
Energy	(\$/KWH)	\$0.02425	5.0%	100.0%
Fixed O&M	(\$/KWH/Month)	\$4.68968	5.0%	100.0%
Varib O&M	(\$/KWH)	\$0.00000	5.0%	100.0%
Chromopetrol Base Facility & Other Charges				
Capacity - Non Escalating (after Start-Up) MMS/Yr		\$53.33		
Capacity - Escalating	MM \$/Yr	\$15.00		
O&M	MM \$/Yr	\$11.49		
Variable - Condensing Power	\$/KWH	\$3.48		
Variable - Steam/Power	\$/Ton	\$0.0128		
Salary Expense: @ \$2.00/hr. for Czech Labor * 8hr/day * 260 wk/days * 185 staff * 1.5 Benefit factor (1993).				
* Salary: 2% of \$150 MM Maximum Coverage.				
* Running License Fees: For 5 years after start-up in 1998.				
* Other: all prices from NYKOMB price - feasibility study (Except Catalyst & Chemicals).				
* Maintenance/Materials: Includes cost for District Heat start-up.				
* Real Prop. & Personal Prop. Insur.: assumed @ 1/2 of 1% of hard capital costs, as calculated on capex investment spreadsheet (Cell F:D2).				
*** Assuming 1168 GWH total Power Provided, and credit of 56 kwh/Tonne HP Sim, 79 KWH/Tonne MP Sim, 160 KWH/Tonne LP Sim				

UNIT - BWT Period 1		UNIT - BWT Period 2		UNIT - BWT Period 3		UNIT - BWT Period 4		UNIT - BWT Period 5		UNIT - BWT Period 6		UNIT - BWT Period 7		UNIT - BWT Period 8		UNIT - BWT Period 9		UNIT - BWT Period 10		UNIT - BWT Period 11		UNIT - BWT Period 12		UNIT - BWT Period 13		UNIT - BWT Period 14		UNIT - BWT Period 15		UNIT - BWT Period 16		UNIT - BWT Period 17		UNIT - BWT Period 18		UNIT - BWT Period 19		UNIT - BWT Period 20		UNIT - BWT Period 21		UNIT - BWT Period 22		UNIT - BWT Period 23		UNIT - BWT Period 24		UNIT - BWT Period 25		UNIT - BWT Period 26		UNIT - BWT Period 27		UNIT - BWT Period 28		UNIT - BWT Period 29		UNIT - BWT Period 30		UNIT - BWT Period 31		UNIT - BWT Period 32		UNIT - BWT Period 33		UNIT - BWT Period 34		UNIT - BWT Period 35		UNIT - BWT Period 36		UNIT - BWT Period 37		UNIT - BWT Period 38		UNIT - BWT Period 39		UNIT - BWT Period 40		UNIT - BWT Period 41		UNIT - BWT Period 42		UNIT - BWT Period 43		UNIT - BWT Period 44		UNIT - BWT Period 45		UNIT - BWT Period 46		UNIT - 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UNLEVERED CASE

LEVERED CASE

TOTAL CAPITALIZED INVESTMENT

1,318 1998 \$

1,608 1998 \$

DEPRECIATION CALCULATION:

UNLEVERED CASE

LEVERED CASE

UNLEVERED CASE

LEVERED CASE

BOOK DEPRECIATION STRAIGHT LINE		BOOK DEPRECIATION STRAIGHT LINE	
LIFE (YRS) CLASS -	15	LIFE (YRS) CLASS -	15

TAX DEPRECIATION DOUBLE DECLINING BALANCE		TAX DEPRECIATION DOUBLE DECLINING BALANCE	
LIFE (YRS) CLASS -	15	LIFE (YRS) CLASS -	15

TAX YR	CALENDAR YEAR	FACTOR	\$U.S.	FACTOR	\$U.S.	FACTOR	\$U.S.	FACTOR	\$U.S.
1	1998	0.034	44.8	0.034	54.7	0.066667	87.9	0.06667	107.2
2	1999	0.069	90.9	0.069	111.0	0.124440	164.0	0.12444	200.1
3	2000	0.069	90.9	0.069	111.0	0.115556	152.3	0.11556	185.9
4	2001	0.069	90.9	0.069	111.0	0.106667	140.6	0.10667	171.6
5	2002	0.069	90.9	0.069	111.0	0.097778	128.9	0.09778	157.3
6	2003	0.069	90.9	0.069	111.0	0.088890	117.1	0.08889	143.0
7	2004	0.069	90.9	0.069	111.0	0.080000	105.4	0.08000	128.7
8	2005	0.069	90.9	0.069	111.0	0.071110	93.7	0.07111	114.4
9	2006	0.069	90.9	0.069	111.0	0.062220	82.0	0.06222	100.1
10	2007	0.069	90.9	0.069	111.0	0.053330	70.3	0.05333	85.8
11	2008	0.069	90.9	0.069	111.0	0.044440	58.6	0.04444	71.5
12	2009	0.069	90.9	0.069	111.0	0.035556	46.9	0.03556	57.2
13	2010	0.069	90.9	0.069	111.0	0.026667	35.1	0.02667	42.9
14	2011	0.069	90.9	0.069	111.0	0.017778	23.4	0.01778	28.6
15	2012	0.069	90.9	0.069	111.0	0.008889	11.7	0.00889	14.3
16	2013								
17	2014								
18	2015								
19	2016								
20	2017								
21	2018								
22	2019								
23	2020								
24	2021								
25	2022								
26	2023								
27	2024								
28	2025								
29	2026								
30	2027								
1									

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI								
1	SYNCHRO PROJECT -- CZECH REPUBLIC										11	of	13	C:\12\13\WKS\CZECHSYNCTXT\WC3 Worksheet J																													
2	14-Nov-93 05:01 PM																																										
3	TAX LIABILITY CALCULATION -- CZECH REPUBLIC (UNLEVERED CASE)																																										
4																																											
5	INCOME TAX RATE:																																										
6	45% (1993 - 2022)																																										
7	U.S.																																										
8											1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	TOTAL		
9	OPERATING INCOME -- BEFORE DEPREC.										0	0	0	0	0	331	348	356	369	380	392	404	418	429	443	457	472	486	504	521	536	557	578	598	617	636	651	665	700	735	12,622		
10	LESS: BOOK -- SL DEPRECIATION (CZECH)										0	0	0	0	0	(44.8)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	(90.9)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1,318)			
11																																											
12	TAXABLE INCOME										0	0	0	0	0	286.5	258.8	267.1	277.8	289.0	300.8	312.7	325.3	336.4	352.1	366.4	381.2	396.8	412.9	429.6	536.3	556.7	575.8	595.7	616.6	636.3	651.0	664.8	700.3	735.1	11,305		
13	BOOK TAXES PAYABLE 45%										0	0	0	0	0	(128.9)	(115.0)	(120.2)	(125.0)	(130.0)	(135.3)	(140.7)	(146.4)	(152.3)	(158.4)	(164.9)	(171.6)	(178.5)	(185.6)	(193.4)	(242.2)	(250.9)	(258.1)	(266.1)	(277.0)	(287.2)	(297.4)	(308.1)	(319.2)	(330.8)	(5,067)		
14																																											
15	OPERATING INCOME -- BEFORE DEPREC.										0	0	0	0	0	331.3	347.8	356.0	368.7	379.9	391.5	403.8	418.2	429.3	443.0	457.3	472.2	487.7	503.9	520.7	538.3	556.7	575.8	595.7	616.6	636.3	651.0	664.8	700.3	735.1	12,622		
16	LESS: TAX -- ACCEL DEPRECIATION: (CZECH)										0	0	0	0	0	(87.9)	(184.0)	(182.3)	(140.8)	(128.9)	(117.1)	(105.4)	(93.7)	(82.0)	(70.3)	(58.6)	(46.9)	(35.1)	(23.4)	(11.7)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1,318)			
17	TAXABLE INCOME										0	0	0	0	0	243.4	163.8	205.7	228.2	251.0	274.4	298.2	322.5	347.3	372.8	399.7	429.3	459.5	490.4	509.0	536.3	556.7	575.8	595.7	616.6	636.3	651.0	664.8	700.3	735.1	11,305		
18	INCOME TAXES PAYABLE 45%										0	0	0	0	0	(109.5)	(82.7)	(92.6)	(102.7)	(113.0)	(123.5)	(134.2)	(145.1)	(156.3)	(167.7)	(179.4)	(191.4)	(203.6)	(216.2)	(229.1)	(242.2)	(250.9)	(258.1)	(266.1)	(277.0)	(287.2)	(297.4)	(308.1)	(319.2)	(330.8)	(5,067)		
19																																											
20	INCOME TAXES										0	0	0	0	0	(109.5)	(82.7)	(92.6)	(102.7)	(113.0)	(123.5)	(134.2)	(145.1)	(156.3)	(167.7)	(179.4)	(191.4)	(203.6)	(216.2)	(229.1)	(242.2)	(250.9)	(258.1)	(266.1)	(277.0)	(287.2)	(297.4)	(308.1)	(319.2)	(330.8)	(5,067)		
21	BOOK TAXES										0	0	0	0	0	(128.9)	(115.0)	(120.2)	(125.0)	(130.0)	(135.3)	(140.7)	(146.4)	(152.3)	(158.4)	(164.9)	(171.6)	(178.5)	(185.6)	(193.4)	(242.2)	(250.9)	(258.1)	(266.1)	(277.0)	(287.2)	(297.4)	(308.1)	(319.2)	(330.8)	(5,067)		
22	DEFERRED TAXES										0	0	0	0	0	19.4	32.9	27.6	22.3	17.1	11.8	6.5	1.3	(4.0)	(9.3)	(14.6)	(19.8)	(25.1)	(30.4)	(35.6)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(0)		
23																																											
24																																											
25																																											
26																																											
27	TAX LIABILITY CALCULATION -- CZECH REPUBLIC (LEVERED CASE)																																										
28																																											
29	INCOME TAX RATE:																																										
30	45% (1993 - 2022)																																										
31	TAX YEAR																																										
32											1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	TOTAL		
33																																											
34	OPERATING INCOME -- BEFORE DEPREC.										0	0	0	0	0	331.3	347.8	356.0	368.7	379.9	391.5	403.8	418.2	429.3	443.0	457.3	472.2	487.7	503.9	520.7	538.3	556.7	575.8	595.7	616.6	636.3	651.0	664.8	700.3	735.1	12,622		
35	PLUS: INTEREST ON (DEBT SVC RES)										0.0	0.0	0.0	0.0	0.0	3.9	3.6	3.2	2.9	2.5	2.2	1.8	1.5	1.1	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24		
36	LESS: INTEREST EXPENSE										0	0	0	0	0	(141)	(129)	(117)	(106)	(94)	(82)	(70)	(59)	(47)	(35)	(23)	(12)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(918)
37	LESS: BOOK -- SL DEPRECIATION (CZECH)										0	0	0	0	0	(54.7)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	(111.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1,608)		
38	LESS: INTEREST ON WORKING CAPITAL LOAN										0	0	0	0	0	(3.00)	(2.88)	(2.78)	(2.64)	(2.52)	(2.40)	(2.28)	(2.16)	(2.04)	(1.92)	(1.80)	(1.68)	(1.56)	(1.44)	(1.32)	(1.20)	(1.08)	(0.96)	(0.84)	(0.72)	(0.60)	(0.48)	(0.36)	(0.24)	(0.12)	(39)		
39																																											
40	TAXABLE INCOME (Book)										0.0	0.0	0.0	0.0	0.0	136.6	106.3	130.1	152.3	175.0	196.1	221.7	245.8	270.5	295.7	321.4	347.8	375.2	391.5	408.5	537.1	555.8	574.8	594.9	615.9	637.7	660.5	684.3	708.1	735.0	10,063		
41	ADJ FOR LOSSES(+)/LOSSES CARRY FORWARDS(-)										0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
42	ADJUSTED TAXABLE INCOME										0	0	0	0	0	136.6	106.3	130.1	152.3	175.0	196.1	221.7	245.8	270.5	295.7	321.4	347.8	375.2	391.5	408.5	537.1	555.8	574.8	594.9	615.9	637.7	660.5	684.3	708.1	735.0	10,063.2		
43	BOOK TAXES PAYABLE 45%										0.0	0.0	0.0	0.0	0.0	(61.9)	(48.7)	(58.5)	(68.9)	(78.7)	(88.1)	(99.8)	(110.9)	(121.7)	(133.0)	(144.6)	(156.9)	(168.8)	(178.2)	(183.8)	(241.7)	(250.0)	(258.7)	(267.7)	(277.1)	(287.0)	(297.2)	(307.9)	(319.1)	(330.7)	(4,537.4)		
44																																											
45	INCOME BEFORE TAX										0	0	0	0	0	136.6	106.3	130.1	152.3	175.0	196.1	221.7	245.8	270.5	295.7	321.4	347.8	375.2	391.5	408.5	537.1	555.8	574.8	594.9	615.9	637.7	660.5	684.3	708.1	735.0	10,063		
46	ADD: BOOK -- SL DEPRECIATION (CZECH)										0	0	0	0	0	54.7	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	111.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
47	LESS: TAX -- ACCEL DEPRECIATION: (CZECH)										0	0	0	0	0	(107.2)	(200.1)	(185.9)	(171.8)	(157.3)	(143.0)	(128.7)	(114.4)	(100.1)	(85.8)	(71.5)	(57.2)	(42.9)	(28.6)	(14.3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1,608)	
48	TAXABLE INCOME (Tax)										0	0	0	0	0	84.1	19.1	55.2	81.7	128.7	166.1	204.0	242.4	281.4	320.8	360.9	401.8	443.3	473.9	505.1	537.1	555.8	574.8	594.9	615.9	637.7	660.5	684.3	708.1	735.0	10,063		
49																																											
50																																											
51	ADJ FOR LOSSES(+)/LOSSES CARRY FORWARDS(-)										0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
52	ADJUSTED TAXABLE INCOME										0	0	0	0	0	84.1	19.1	55.2	81.7	128.7	166.1	204.0	242.4	281.4	320.8	360.9	401.8	443.3	473.9	505.1	537.1	555.8	574.8	594.9	615.9	637.7	660.5	684.3	708.1	735.0	10,063		
53	INCOME TAXES PAYABLE 45%										0	0	0	0	0	(37.8)	(8.6)	(24.6)	(41.3)	(57.9)	(74.7)	(91.8)	(108.1)	(126.0)	(144.4)	(162.4)	(180.7)	(199.5)	(213.2)	(227.3)	(241.7)	(250.0)	(258.7)	(267.7)	(277.1)	(287.0)	(297.2)	(307.9)	(319.1)	(330.7)	(4,537.5)		
54																																											
55	INCOME TAXES										0	0	0	0	0	(37.8)	(8.6)	(24.6)	(41.3)	(57.9)	(74.7)	(91.8)	(108.1)	(126.0)	(144.4)	(162.4)	(180.7)	(199.5)	(213.2)	(227.3)	(241.7)	(250.0)	(258.7)	(267.7)	(277.1)	(287.0)	(297.2)	(307.9)	(319.1)	(330.7)	(4,537)		
56	BOOK TAXES										0	0	0	0	0	(61.9)	(48.7)	(58.5)	(68.9)	(78.7)	(88.1)	(99.8)	(110.9)	(121.7)	(133.0)	(144.6)	(156.9)	(168.8)	(178.2)	(183.8)	(241.7)	(250.0)	(258.7)	(267.7)	(277.1)	(287.0)	(297.2)	(307.9)	(319.1)	(330.7)	(4,537)		
57	DEFERRED TAXES										0	0	0	0	0	23.6	40.1	33.7	27.3	20.8	14.4	8.0	1.5	(4.9)	(11.3)	(17.6)	(24.2)	(30.6)	(37.1)	(43.5)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(0)	

7.5 INVESTMENT CRITERIA

In addition to overall satisfaction with regard to financeability and security of contract terms, minimum criteria for investment purposes would be greater than 15% on an unleveraged basis (DCF-ROI) and greater than 25% (DCF-ROE) on a leveraged basis.

7.6 PROGRAM OF FUTURE WORK

Pending finalization of commercial agreements, project economics will have to be revised accordingly.

**OVERVIEW OF
ALTERNATE CASES**

8. OVERVIEW FOR THE ALTERNATE CASES

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	8.2.3	(Identical to 2.3)
	8.2.4	(Identical to 2.4)
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8.1 Rationale

This chapter describes four possible alternative configurations forming a base for future detailed development

- Downsized cases developed to comply with alternative offtake scenarios
- Steam offtake for CHP constant for all cases (when CHP located gas turbine / HRSG is viewed as being part of SYNCHEM)
- District heat delivery of max 135 MW is optional - Komorany to provide the balance requirement by its own means
- Hierarchy of decision factors
 - Financeability ?
 - German Export ?
 - BEW terms acceptable ?
 - DC transmission line accessible ?
 - Politically acceptable (local / national) ?
 - Capacity availability acceptable ?
 - Profitability ?

NOTE: Cases with no district heat supply have been studied but are not included in this report

8.2 Technical Overview

8.2.0 Definition of Alternate Cases

- * Case 1B is the base case as laid out in the May-93 Feasibility Study and further described in Chapter 2 of this report
- * Case 1A, not included in this chapter, is the original case from 1992 in which SYNCHEM provided the full steam needs for CHP
- * The characteristic of Case 3B, 3E and 2E is that one gas turbine is located inside CHP and fired with fuel gas from SYNCHEM
- * Case 2B is 50% of case 1B except that it delivers the same steam flow to CHP

	1B	3B	Case 3E	2E	2B
Rel. fuel capacity, % (approx.)	100	80	91	60	50
Gas turbines at SYNCHEM site CHP	2x9F	1x9F 1x9E	2x9E 1x9E	1x9E 1x9E	1x9F
Peak boilers at SYNCHEM site Komorany	yes no	no yes	no yes	no yes	no yes
Nº of retrofitted boilers at T700 station	4	4	4	4	4
Nº of retrofitted boilers at Komorany	2	2	2	2	2
Max district heat supply from SYNCHEM processes, MW	182	135	135	135	90
System configuration, figure	8.2.0.1-1	-	8.2.0.1-2	-	8.2.0.1-3

8.2.0.1-1 System Configuration - Case 1B

SYNCHM FEASIBILITY I

8.2.3.1-3 System Configuration - Case 2B

SYNCHM FEASIBILITY I

8.2.1 Project Location & Overall Description

(as 2.1 but with the following differences)

- * Komorany to retrofit certain boiler capacity and deliver district heat together with SYNCHEM
- * SYNCHEM district heat offtake base load to decrease from about 180 to 135 MW (for Case 2B, 90 MW) at minimum ambient temperature
- * For three of the alternative cases CHP to host one gas turbine (type GE frame 9E) and HRSG fueled by fuel gas from SYNCHEM also resulting in decreased steam delivery from the SYNCHEM IGCC plant to CHP

8.2.2 CHP Activities in Litvinov

(identical to section 2.2)

8.2.3. Komorany Activities in Litvinov/Most

(identical to section 2.3)

8.2.4. DUK Activities in the Most Area

(identical to section 2.4)

8.2.5. CEZ / SEZ Power System

(identical to section 2.5)

8.2.6. Existing Steam and Electricity Generation at CHP

(identical to section 2.6)

8.2.7 Chemopetrol Requirements

8.2.7.1 Expected Future Demand

	Winter max	Winter average	Summer average	Total per year
El power cons	184 MW	178 MW	170 MW	1525 GWh
Steam 31 bara, 450 °C	52 t/h	45 t/h	32 t/h	335,000t
19 bara, 300 °C	327 t/h	290 t/h	215 t/h	2,208,000t
3.5 bara, 180°C	334 t/h	286 t/h	170 t/h	1,995,600t
Max demand	713 t/h			

8.2.7.2 Expected Delivery from Revamped T700 (50%) with T200 Shutdown

	Winter max	Winter average	Summer average	Total per year
El power cons	54 MW	48 MW	33 MW	357 GWh
Steam 31 bara, 450 °C	nil	nil	nil	nil
19 bara, 300 °C	77 t/h	78 t/h	105 t/h	802,000 t
3.5 bara, 180°C	266 t/h	230 t/h	117 t/h	1,520,000 t
Max delivery	343 t/h			

Note Revamped T700 (50%) comprises :

- 4 new boilers rated for 135 t/h steam @94 bara,@540°C
- One line Flue Gas Desulphurization & Baghouse
- New Stack
- New Honeywell TCD 3000 control system
- 4 refurbished extraction condensing turbines and generators

8.2.7.3 CHP Requirements to be supplied by the SYNCHEM IGCC plant

Case 1B, 2B

	Winter max	Winter average	Summer average	Total per year
El power cons	130 MW	130 MW	137 MW	1168 GWh
Steam 31 bara, 450 °C	52 t/h	45 t/h	32 t/h	335,000 t
19 bara, 300 °C	250 t/h	212 t/h	110 t/h	1,406,000 t
3.5 bara, 180°C	68 t/h	56 t/h	53 t/h	465,600 t
Max demand	370 t/h			

Case 3B, 3E & 2E

- The figures below are the net CHP needs from the SYNCHEM IGCC plant when one gas turbine type GE frame 9E together with a HRSG is located within CHP and fired with fuel gas from the SYNCHEM IGCC plant
- Steam from the HRSG is fed to existing steam turbines within T700

	Winter max	Winter average	Summer average
31 bara, 450 °C	52 t/h	45 t/h	32 t/h
19 bara, 300 °C	130 t/h	92 t/h	0
3.5 bara, 180°C	0	0	0

(cont'd)

8.2.7.3 CHP Requirements to be supplied by the SYNCHEM IGCC plant (cont'd)**Case 3B, 3E & 2E**

- Fuel gas from SYNCHEM to CHP (at +1°C)

Composition :

CO, vol %	25.6
H ₂ , -"	26.5
CO ₂ , -"	11.5
H ₂ O, -"	35.0
CH ₄ , -"	0.07
Ar, -"	0.08
N ₂ , -"	0.5
H ₂ S, COS, ppm	35
Flow, kmol/h	11 329.5
Temp, °C	198
Pressure, bar	22

- No power export is required from the SYNCHEM IGCC plant to CHP but CHP will have a net power export from the combined T700 (50%) and the 9E installation of approx. 55 MW as a yearly average

8.2.8 Existing Heat and Electricity Generation at Komorany

(identical to section 2.8)

8.2.9 Komorany Requirements

8.2.9.1 Expected Future District Heating Demand

	1998	Design basis after 1998
Production :	4600 TJ/year	4800 TJ/year

8.2.9.2 Hot Water Demand

8.2.9.3 Proposed Production Principle in Future

- Komorany to retrofit certain boiler capacity and deliver district heat together with SYNCHEM
- SYNCHEM to supply the District Heating System with base load capacity and Komorany to provide the remaining middle and peak load capacities
- The Komorany unit to produce power both in back pressure mode and condensing mode together with district heat
- District heating network to be rebuilt such that both the suppliers of heat can deliver heat to all three consumers (cities of Most and Litvinov and industries)

Case 3B, 3E and 2E - Heat Load Diagram with Heat Sources

Note Case 1B, including the full heat demand as described in section 2, can also be redesigned according to the load diagram above

(cont'd)

8.2.9.3 Proposed Production Principle in Future (cont'd)

Case 2B - Heat Load Diagram with Heat Sources

8.2.10 IGCC Plant Description

8.2.10.1 Background

Note The work carried out for the Base Case (Case 1B, see section 2) is a detailed feasibility study while the work done for case 3B, 3E, 2B and 2E is a tentative feasibility exercise

- The insights gained from Case 1B is used in the tentative calculations for the other four cases
- Two major process differences are incorporated in the four cases 3B, 3E, 2E and 2B

One : LTGC, saturation and expansion is designed with LP saturation meaning that expansion takes place before saturation

Two : The sulphur removal and recovery units includes a physical absorption process with tail gas recycle from the sulphur recovery tail gas treatment unit

- From system solution point of view the gas turbine / HRSG installation within CHP with regard to cases 3B, 3E and 2E are parts of the ISBL plant
- Other OSBL parts of the project are handled as described in 2.9.1

8.2.10.2 Principle Structure

- Major interconnections between SYNCHEM / CHP / Komorany and the National power grid are shown in figure 8.2.0.1 - 1 to 3
- * Comparative table of principle structure :

	Case				
	1B	3B	3E	2E	2B
Relative fuel gas prod, %	100	80	90	60	50
I G C C paralell trains					
- ASU					
air compressors	3x33.3%	2x50%	3x33.3%	2x50%	2x50%
cold boxes	3x33.3%	2x50%	3x33.3%	2x50%	2x50%
O2 compressors	4x25%	4x25%	4x25%	2x50%	2x50%
- TGP gasification trains	4x25%	4x25%	4x25%	2x50%	2x50%
- LTGC, saturation & expansion	2x50%	2x50%	2x50%	1x100%	1x100%
- Sulphur removal, recovery & TGT	2x50%	2x50%	2x50%	1x100%	1x100
- C C Units					
within SYNCHEM	2x9F	1x9F	2x9E	1x9E	1x9F
within CHP	-	1x9E	1x9E	1x9E	
Number of boilers at CHP T700	4	4	4	4	4
Number of coal fired boilers at Komorany	2	2	2	2	2

8.2.10.3 Key Data

- * Data such as coal, HVR, flux and oxygen consumption is calculated as being directly proportional to the fuel gas requirement
- * Cooling duty for the LTGC (from TGP unit to AGR unit) is calculated as proportional to the fuel gas flow but the utilization of the recovered heat is different from case to case
- * Fuel gas is preheated to 187°C for the 9F Gas Turbine and to 200°C for the 9E Gas Turbine
- * Fuel gas to gas turbines is saturated to 35 %(w)
- * The 9F Gas Turbine has performance data corresponding to the 1B Case
- * The 9E Gas Turbine performance is calculated using the GT PRO Computer Software
- HRSG steam system calculations are internal Nykomb calculations
- Steam turbine performance for CHP located turbines is provided by CHP
- * The 9F Gas Turbine utilizes steam injection at high ambient temperature to keep constant power output
- * The 9E Gas Turbine is calculated to lose 6% output and consume 6% less fuel gas when ambient temperature increases from +1 to +15°C

(cont'd)

8.2.10.3 Key Data (cont'd)

At +1°C ambient temperature

* Fuel flow to combustion turbine		
to 1 x 9F, MW(LHV)		722.6
to 1 x 9E, MW (LHV)		431.4
• 1x9E flue gas flow		
CHP located, kg/s		500.3
SYNCHEM located, kg/s		501.6
* 9E flue gas temp		
CHP located, °C		526
SYNCHEM located, °C		550
* 1 x 9E HRSG supplementary firing		
CHP located, MW (LHV)		none
SYNCHEM located, MW (LHV)		13.2
* 1 x 9E heat duty down to 120°C (water side)		
CHP located, MW		224
SYNCHEM located, MW		237
• LTGC steam production		
Case 1B	23 bar, t/h	382.8
	8 bar, -" -	216.4
Case 3B	23 bar, -" -	388.0
	8 bar, -" -	122.0
Case 3E	23 bar, -" -	436.8
	8 bar, -" -	164.8
Case 2B	23 bar, -" -	250.0
	8 bar, -" -	76.8
Case 2E	23 bar, -" -	287.4
	8 bar, -" -	109.4

Figure 8.5-1 Syngas to Fuels and Chemicals

8.2.11 Gasification Test Results

(Identical to section 2.11)

8.2.12 CHP Steam Security

- * Cases with two parallel trains and / or with one gas turbine located within CHP (1B, 3B, 3E, 2E) , have in principle the same back-up system as described in section 2.12
- * Case 2B will have a somewhat lowered steam security as the normal SYNCHEM steam supply will be provided from one train instead of two
 - 4 x 12.5% requirement from T700 boilers
 - 1 x 50% requirement from a single train SYNCHEM
 - 2 x 12.5% requirement from two back-up boilers

8.2.13 Komorany Heat Security

- * SYNCHEM process plant and Komorany coal fired and oil fired boilers provides heat capacity according to the following

- * For Cases 3B, 3E and 2E

Note Case 1B, including the full heat demand as described in chapter 2,, can also be redesigned according to figures below.

- 2 x 15% from SYNCHEM train #1 and #2
- 2 x 12.5% from Komorany coal fired boilers #1 and #2
- 3 x 15% from three Komorany LS fuel oil fired boilers (approx. figures)

- * For Case 2B

- 1 x 20% from SYNCHEM train #1 and #2
- 2 x 17% from Komorany coal fired boilers #1 and #2
- 3 x 15% from three Komorany LS fuel oil fired boilers (approx. figures)

8.2.14 Plant Emissions

- * For SO₂, CO₂ and slag emissions, figures given in section 2.13 can be used multiplied with the following factors

<u>Case</u>	<u>Factor</u>
3B	0.799
3E	0.913
2E	0.605
2B	0.50

- * For NO_x and CO the following apply

<u>Case</u>	<u>Factor</u>
3B	} factors above can be used as approximations
3E	
2E	
2B	0.5

8.2.15 Electrical High Voltage Interconnection

Note Figures below reflect the situation for Case 2B and is in principle the same for Case 2E. Case 3B and 3E shall be compared with Case 1B for which the high voltage interconnection is described in chapter 2.15

8.2.15.1 Power Balance

	MW
Total generation	409
Plant auxillary loads	70
Net SYNCHEM export	339
Supply to Chemopetrol	135
Balance export	204

8.2.15.2 Maximum / individual Generator Load

Gas Turbine	1 x 275
Steam Turbine	1 x 138
Expansion Turbine	1 x 15

8.2.15.3 Interconnections

- SYNCHEM generators feed into new 110kV bus
- New 110 kV lines to Chotejovice (possibly not required)
- New 110 kV connections to Chemopetrol & SEZ
- See Figure 8.2.15.3-1

8.2.15.4 Scope of Facilities & Works

- 110 kV substation
- 110/15 kV transformers (3x)
- 110/35 kV transformers
- 35 kV substations
- 110 kV cable connections

- 110 kV cables / lines (rated length 70 km)
- 6.3 kV substation
- 110/6.3 kV transformers
- 6.3 kV cable connections
- 6.3 kV cables

- 110 kV substation extension Chotejovice (if required)
- production devices
- controls / dispatching

Figure 8.2.15.3-1
Power Interconnections (Case 2B)

8.2.16 Hot Water Pipeline System Interconnections

- See figure 8.2.16-1
- SYNCHEM and Komorany both deliver heat to the district heating network
- SYNCHEM and Komorany acts in paralell thus both supplying hot water at required temperatures
- SYNCHEM hot water production is maximum 135 MW
- New pipeline from SYNCHEM to Komorany with diameter 500 mm and 40 bar design pressure
- To protect the existing pipeline towards Litvinov against too high operating pressure, the line to be equipped with pressure reduction control at the SYNCHEM connection point
- With changes as per above, the pipeline system will be suitable to receive heat from both SYNCHEM and Komorany without any limitations (except capacity with respect to SYNCHEM)

Figure 8.2.16-1
Hot Water Pipeline System Interconnections
 SYNCHEM and Komorany in parallel heat production

8.2.17 Steam System Interconnection

- Case 2B is equal to Case 1B and is described in 2.17
- * Case 3B, 3E and 2E have a 9E gas turbine with HRSG located within CHP resulting in less need for steam from SYNCHEM to CHP
- * For Cases 3B, 3E and 2E no DN 800 / PN 40 pipeline required for transfer of 3.5 bar steam from SYNCHEM to CHP. Compare section 2.17.3

8.2.18 Fuel and Services Interconnections and Availability

- * Items under this heading are pro-rated against the capacity of Case 1B

8.2.19 Site Preparation

- Site preparation activities are only slightly effected by changes in the configuration and size of SYNCHEM

8.2.20 Preliminary Plot Layout

(not included for Alternate Cases)

8.2.21 Capital Cost Estimate

- * The ISBL investment cost are based on the US Gulf cost calculation for case 1B using factoring methods
- * Investment figures as used in this section for all cases include a Czech factor of 0.8 in relation to the US Gulf Coast estimate
- * IDC is included
- * OSBL costs are calculated by CHP, Komorany and Czech consultants
- * The SYNCHEM investment figure includes the 9E + HRSG installation within CHP
- * CHP investments as per table below
- * Komorany Heat and Power Plant investments are not included

<u>Case</u>	<u>SYNCHEM*</u> <u>MMCEK</u>	<u>CHP</u> <u>MMCEK</u>
1B	28,800	5,100
3B	23,200	5,100
3E	25,400	5,100
2E	17,400	5,100
2B	16,500	5,100

*) ISBL and OSBL incl. contingency and IDC

8.2.22 EPC Arrangements

Identical to section 2.22

8.2.23 Programme of Future Work

Identical to section 2.23

8.3 Plant Utilization

8.3.0 General

- * The following diagrams show the yearly feedstock consumptions as well as expected utilization time for the various process and power production trains
- * The left part of each diagram shows the gas production train capacities
- * The right part of each diagram shows the gas turbine consumption rate (related to coal and HVR consumption)
- * 100% corresponds to
 - 269.424 t/h of coal (as received)
 - 80.820 t/h of HVRwhich is equal to 100% utilization of case 1B at -9°C ambient temp.
- * Other cases refer to the flow rates of Case 1B
- * At times when gas and power production is down because of planned or forced outages, back-up units for steam and hot water will secure agreed energy flows to CHP and Komorany

8.3.1 Case 1B Plant Utilization Diagram

Example :

Coal feed consumption

$$269.424 \times 7700 = 2074 \text{ kton/year}$$

$$0.5 \times 269.424 \times (400+400) = 108 \text{ "-}$$

$$2182 \text{ kton/year}$$

1) 100% equals full feedrate for case 1B at -9°C ambient temp

8.3.2 Case 3B Plant Utilization Diagram

Example :

Coal feed consumption

$$\begin{aligned}
 & \frac{0.7986 + 0.788}{2} \times 269.424 \times 7700 = 1647 \text{ kton/year} \\
 & 0.399 \times 269.424 \times 400 = 43 \\
 & 0.288 \times 269.424 \times 400 = 31 \text{ "-} \\
 & \hline
 & 1721 \text{ kton/year}
 \end{aligned}$$

- 1) 100% equals full feedrate for Case 1B at -9°C ambient temp
- 2) one gas train in full operation
- 3) one gas train at 72% load

8.3.3 Case 3E Plant Utilization Diagram

Example :

Coal feed consumption

$$\begin{aligned}
 &\frac{0.913 + 0.858}{2} \times 269.424 \times 7700 = 1837 \text{ kton/year} \\
 &0.429 \times 269.424 \times 400 = 46 \\
 &0.286 \times 269.424 \times 400 = 31 \text{ "-} \\
 &\hline
 &1914 \text{ kton/year}
 \end{aligned}$$

- 1) 100% equals full feedrate for case 1B at -9°C ambient temp
- 2) one gas train in full operation
- 3) one gas train at 63% load

8.3.4 Case 2E Plant Utilization Diagram

Example :

Coal feed consumption

$$\frac{0.605 + 0.569}{2} \times 269.424 \times 8100 = 1281 \text{ kton/year}$$

1) 100% equals full feedrate for case 1B at -9°C ambient temp

8.3.5 Case 2B Plant Utilization Diagram

Example :

Coal feed consumption

$$0.5 \times 269.424 \times 8100 = 1091 \text{ kton/year}$$

1) 100% equals full feedrate for case 1B at -9°C ambient temp

8.4 Economic Overview

Energy balances based on plant utilization as according to 8.3

	<u>1B</u>	<u>3B</u>	<u>3E</u>	<u>2E</u>	<u>2B</u>
<u>Case characteristics</u>					
SYNCHEM - gas turbines	2x9F	1x9F + + 1x9E	3x9E	2x9E	1x9F
- rel. gas capacity	100%	80%	90%	60%	50%
T700 boilers retrofitted	4	4	4	4	4
Heat supply, at min temp, MW	190	135	135	135	90
<u>Economics</u>					
Investment, incl IDC	33 900	28 300	30 500	22 500	21 600
whereof SYNCHEM	(28 800)	(23 200)	(25 400)	(17 400)	(16 500)
Power to grid - GWh/year	4 450	3 150	3 620	1 750	1 370
- MW, at min temp ¹⁾	510	370	440	200	150
Fuel consumption, GWh/year	20 800	17 090	18 630	13 600	12 050
whereof T700 3 085 GWh					
Profitability index	100%	95%	95%	90%	85%

¹⁾ Peak capacity (summer) 60-70 MW higher.

8.5 OPTION : Coproduction of Chemicals

8.5.0 General

- * Gasification technology is unique as compared to alternative power technologies in that it also enables the coproduction of chemicals and storable liquid fuels
- * Synthesis gas from the gasification unit can after conditioning be converted to (see figure 8.5-1)
 - hydrogen
 - various chemicals
 - fuel grade methanol

8.5.1 Hydrogen

- * Pure hydrogen can be extracted from the synthesis gas via use of gas shift / PSA technologies or via membrane / PSA technologies
- Purity of hydrogen to be determined by the quality demand of the receiving process

8.5.2 Various Chemicals

- * Air Products and Chemicals, a SYNCHEM principal, has been working for 12 years to develop efficient processes for direct production of chemicals from a gasification syngas, without a need for intermediate processing of the gas. Such chemicals are :
 - methanol •
 - oxo alcohols •
 - formic acid
 - acetic acid*
 - ethylene glycoll
 - vinyl acetate •
 - acetaldehyde
 - adipic acid
 - sebacic acid
 - synthetic crude oil • (via Fisher-Tropsch synthesis)

NOTE: Chemicals noted with an (*) have specifically been studied and, in certain cases, demonstrated in the "Liquid Phase Reaction Technology" development program together with U.S. Department of Energy.

8.5.3 Fuel Grade Methanol (*)

- * The technology for methanol production utilizing liquid phase synthesis is currently being commercially demonstrated in the U.S. under a Department of Energy program
- * Methanol coproduced with power could serve either as a chemical building block for CHP or as a stored fuel for power production during peak demand periods

8.5.4 Further work

- * Production of methanol for energy storage will be analyzed by the SYNCHEM partners as means to better match power production with the needs of the Czech power grid

Figure 8.5-1 Syngas to Fuels and Chemicals

**SCHEDULE AND
BUDGET**

9. SCHEDULE AND BUDGET

Table of Contents

- * **Tasks**
- * **SYNCHEM - Time Table Interim Phase and Development Phase**
- * **SYNCHEM - Budget Interim Period, Mid October 1993 - February 1994**
- * **SYNCHEM - Budget Development Phase**

Tasks

- * Continued work to be considered for 1998 commercial operations
- * Before initiation of Final Preparatory work, Development Phase, leading to start of construction, the following issues to be concluded over a three month period.

Interim Phase Tasks:

- Select configuration for downsize case
- Finalize basis for design
- Develop downsize case economics
- Finalize Term sheets
- Issue Financial Prospectus
- Finalize and initiate discussions on Czech Government Guarantees
- Secure US and Czech Government Support/Endorsement
- Initiate permitting process
- Development Phase Agreement

- * Development Phase - 12 months duration

Development Phase tasks:

- Establish Owners Organization
- Final permitting
- Financing
- Front end engineering and design
- Bidding
- Main Contractor Consortium Agreement

**SYNCHEM - Budget Interim Phase
Mid October 1993 - February 1994**

	HRS	Thousand USD
Overall management	400	70
Engineering	650	80
Commercial	650	90
Financing	200	35
Economic modelling	100	10
Czech translation		20
Liason		10
Office	<hr/>	<u>10</u>
	2000	<u>325</u>

Travel, subsistence and other expenses are not included.

SYNCHEM - Budget Development Phase

Thousand USD

Overall management

Permitting 2,500

Engineering

- Feed packages	3,325
- Technical evaluation of bids	200
- Optimize Configuration - Assume	<u>100</u>
	3,625

Commercial

- Offtake/Supply/License/O&H Agreement	
- Commerical evaluation of bids and Main Contractor Agreement	400

Economics 200

External Financing and legal services 2,500

Total 9,625

Comments:

- Gasification and Process Design Packages are included and estimated to be obtained for USD 2,500,000.
- No costs for engineering and preparation of bids for the ASU unit and the Combined Cycle unit.
- License Fees are not included.
- Bids from selected contractors free of charge.
- Travel, subsistence and other expenses are not included.