KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

Debottlenecking of UGS Lab 3, synergy effects of interconnected storages UGS Lab 3 and reservoir Gajary-baden

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Venue: World Gas Conference 2012

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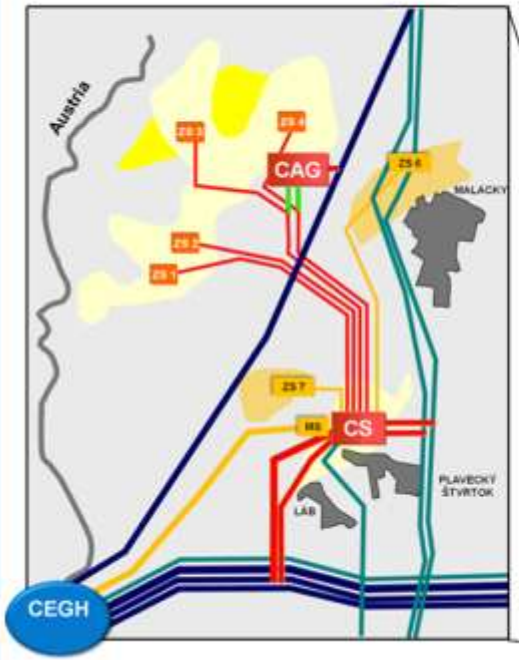
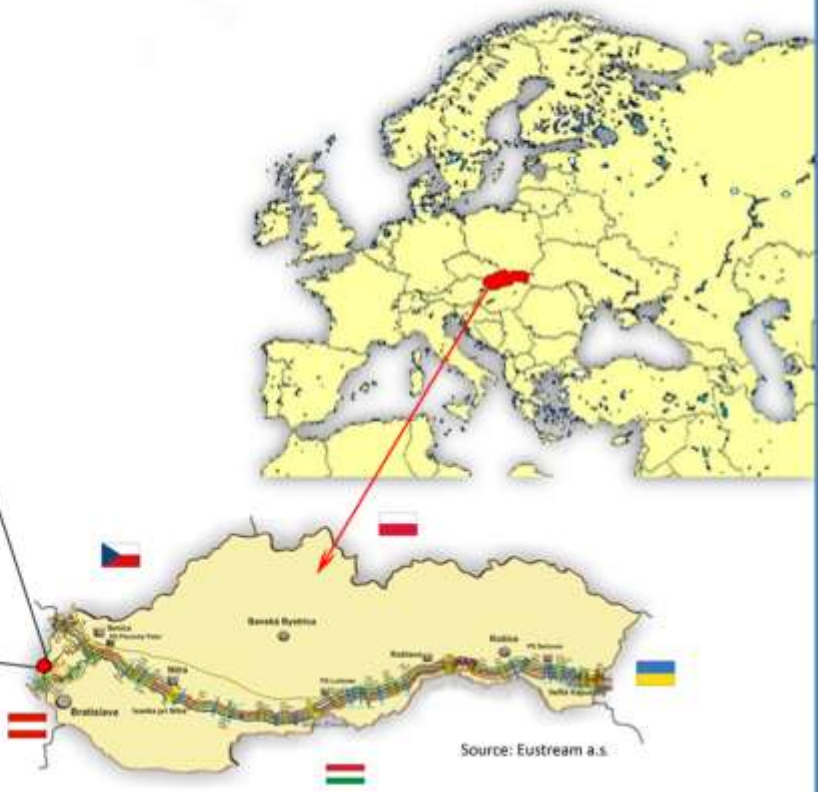
Infrastructure of UGS Lab complex

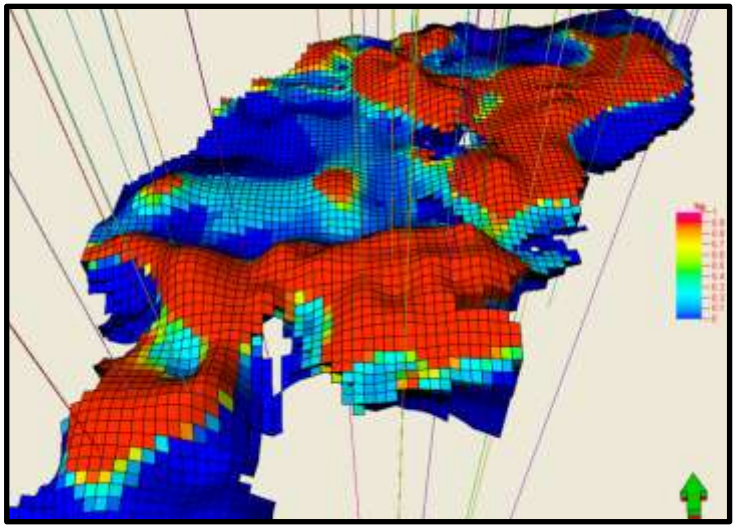




Technical working volume (10^6 Sm^3)	2235.0
Technical injection rate ($10^6 Sm^3$/day)	23.2
Technical withdrawal rate ($10^6 Sm^3$/day)	30.9
Number of reservoir	8

Basic parameters of UGS Lab 3

- **Reservoir parameter**
  - Working gas volume – 1595 MMm3
  - Reservoir pressure – 4.0 – 7.3 MPaa
  - Number of wells W/I - 92
  - Top reservoir depth - 605m
  - UGS cycling - since 1984



- **Infrastructure of surface system**
  - Individual flowlines
  - Number of gathering stations – 4 (four trains of TEG unit)
  - Connecting pipelines
  - Number of turbocompressor unit -5
  - Number of delivery points - 6

Framework of bottleneck analysis

- 1.1 • Definition of basic alternatives which eliminate the bottlenecks
- 1.2 • Selection of method for bottleneck analysis
- 1.3 • Field test - Tuning of model - Performance calculation of basic alternatives
- 1.4 • Definition of criteria for comparison of the basic alternatives
- 1.5 • Recommendation for investment plan

First step of debottlenecking (comparison of basic alternatives)

- 2.1 • Definition of variants (combination of basic alternatives)
- 2.2 • Performance calculation (withdrawal curves)
- 2.3 • Definition of criteria for comparison of the variants
- 2.4 • Recommendation for future debottlenecking (development)

Second step of debottlenecking (comparison of variants)
Variant = combination of basic alternatives

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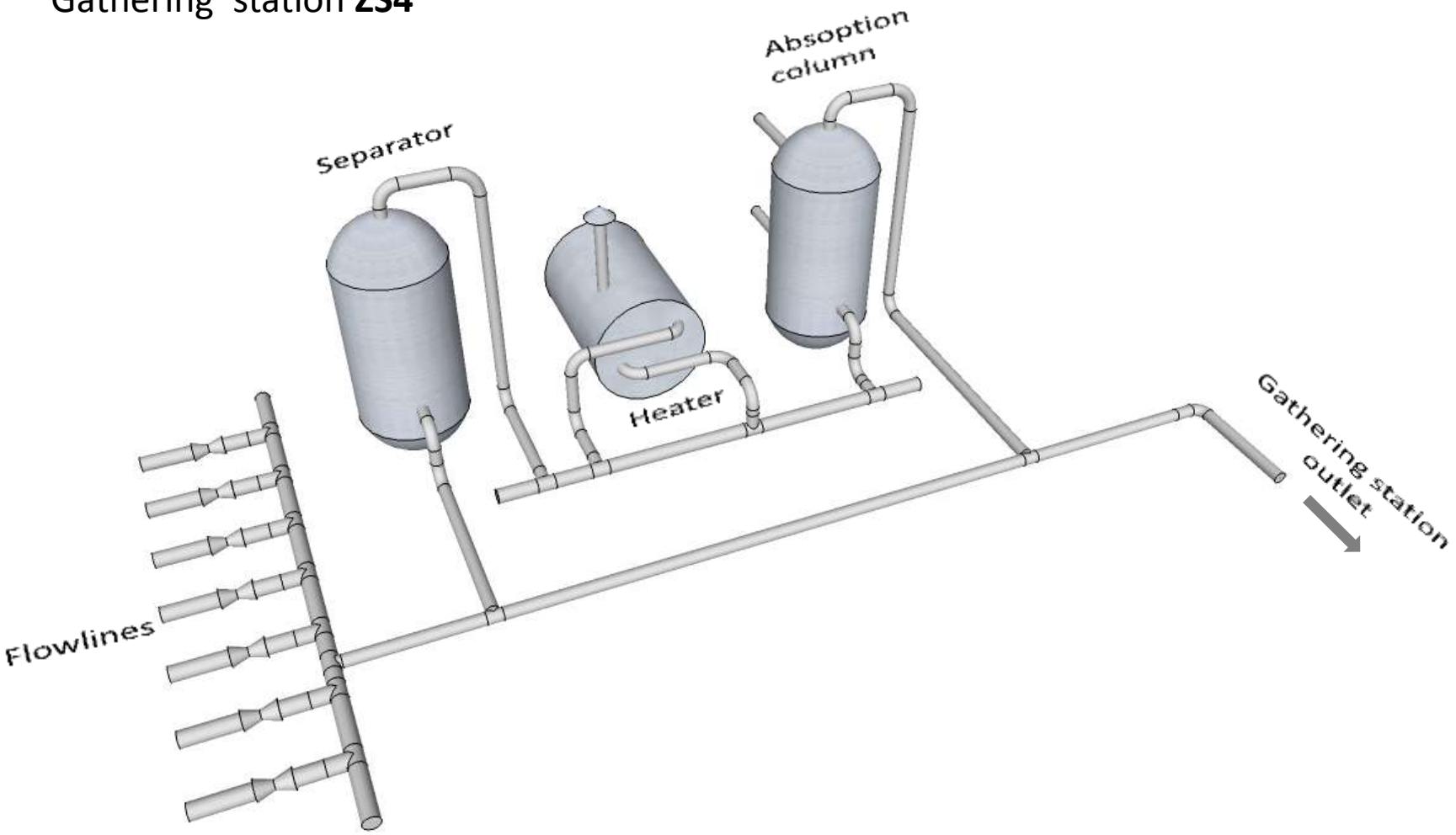
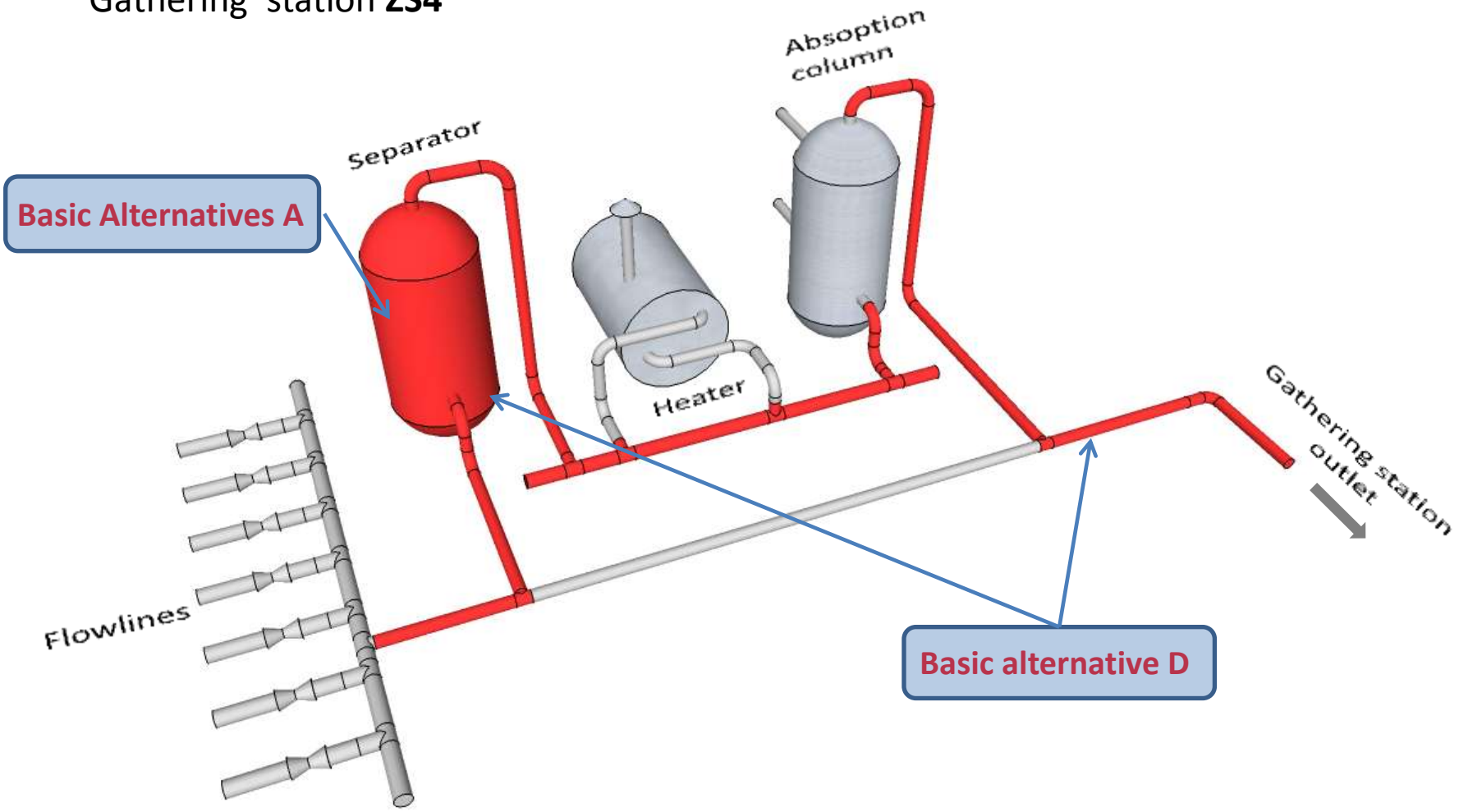
Basic alternatives A, D

Gathering station **ZS4**



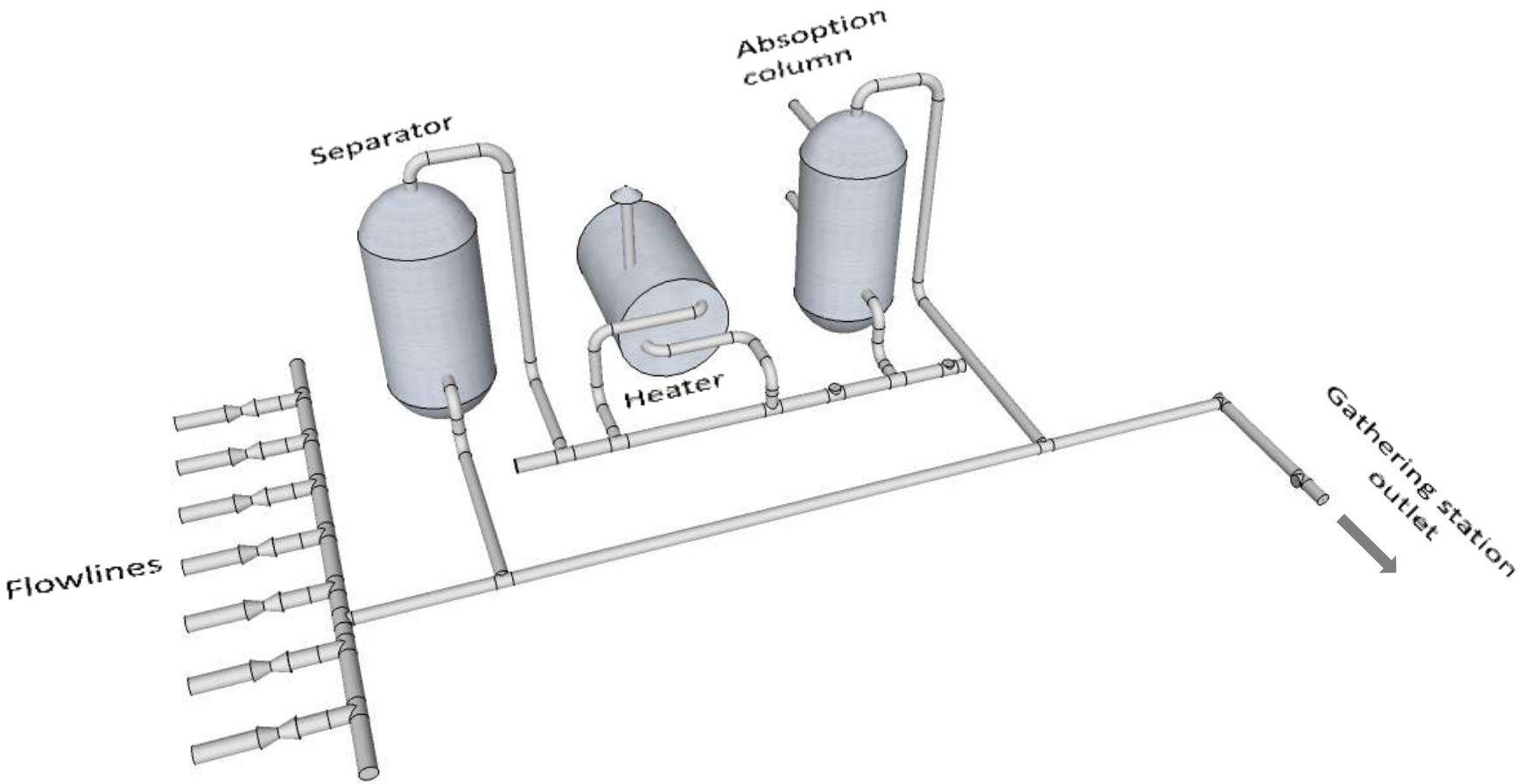
Basic alternatives A, D

Gathering station **ZS4**



Basic alternatives B, C

Gathering station **ZS1**



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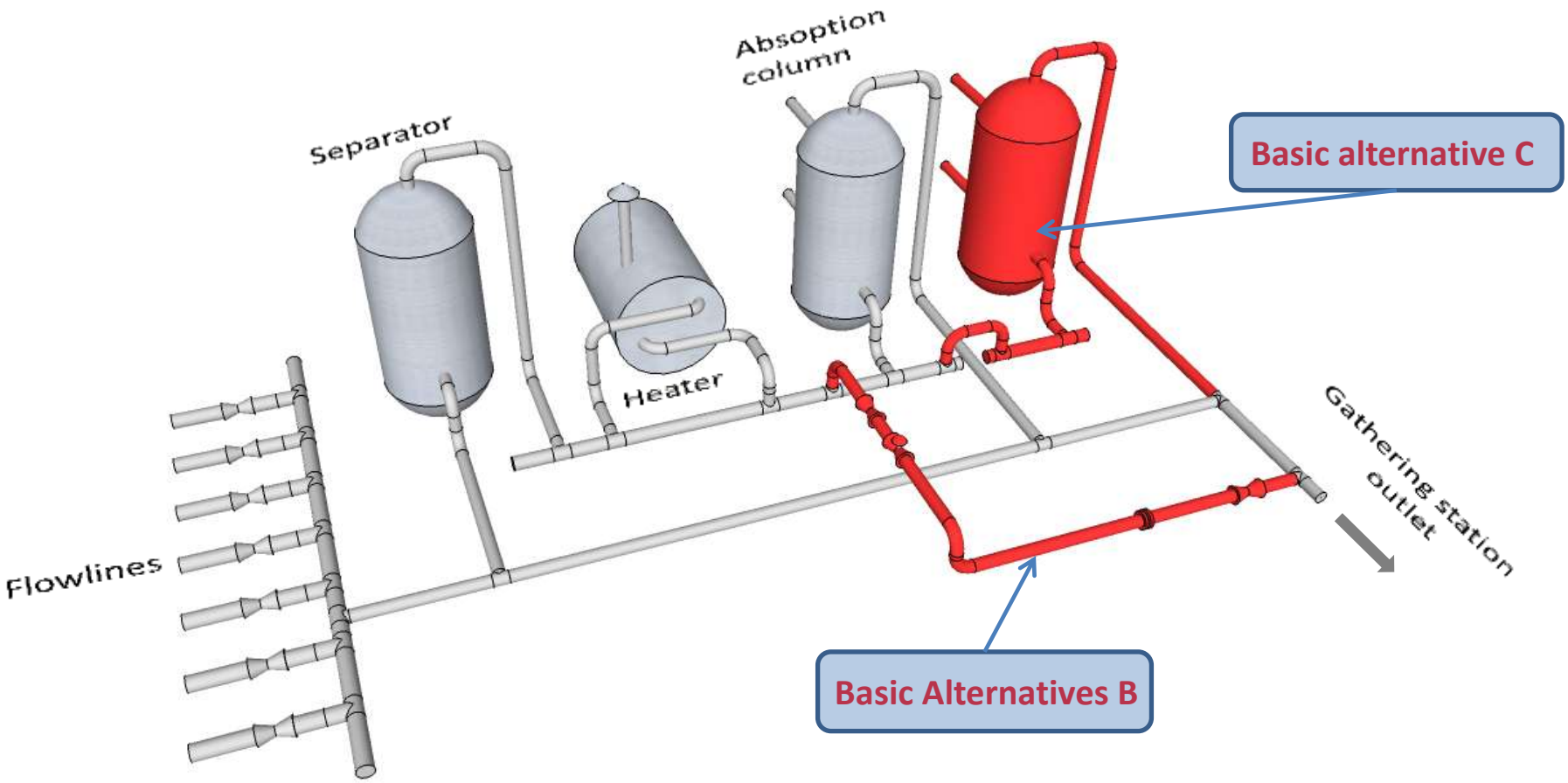
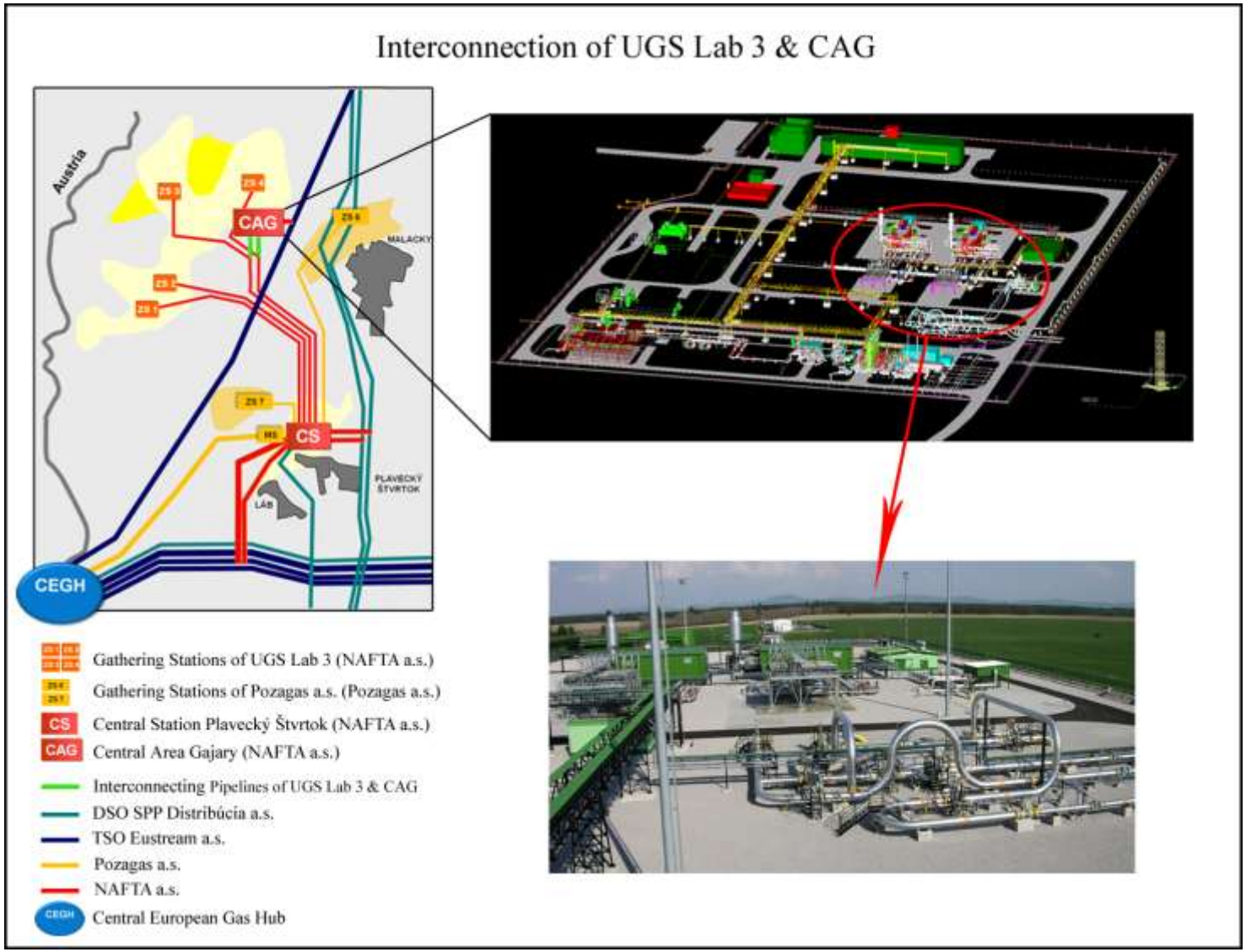
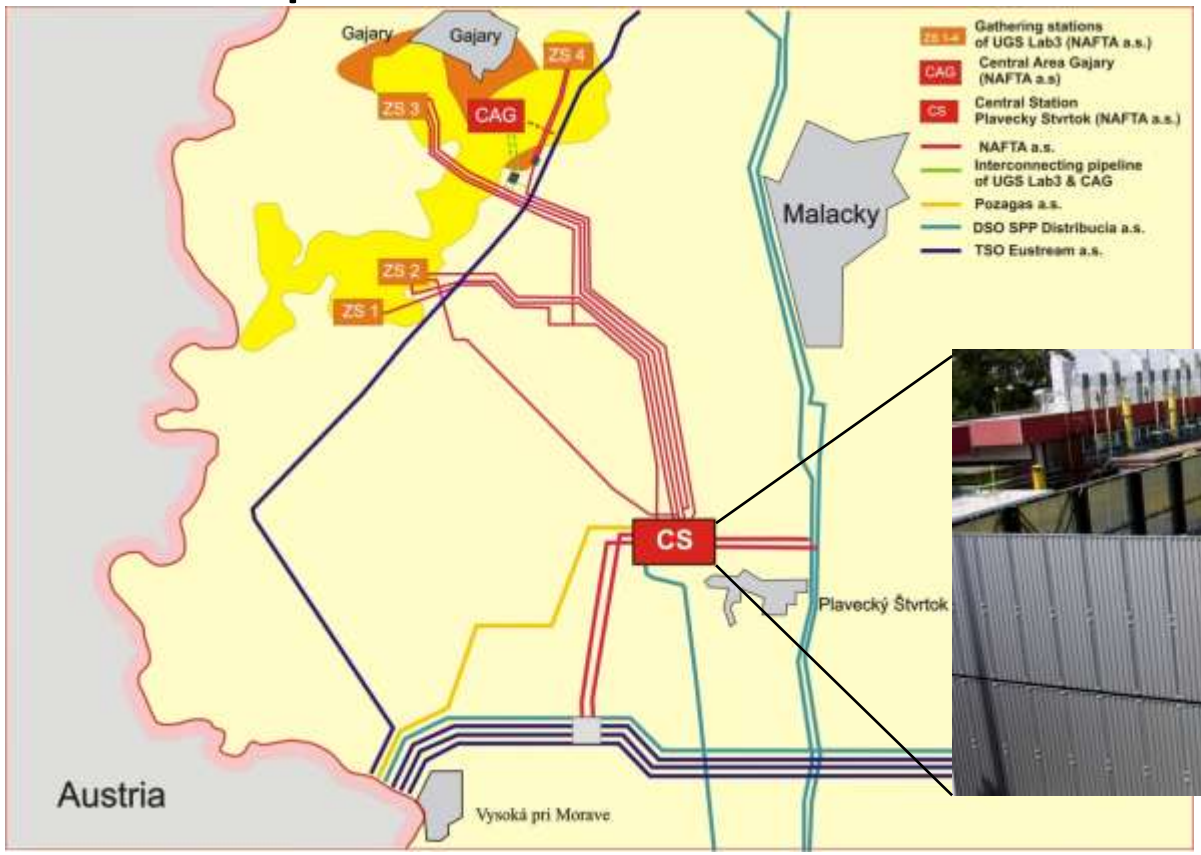


Basic alternatives „E“



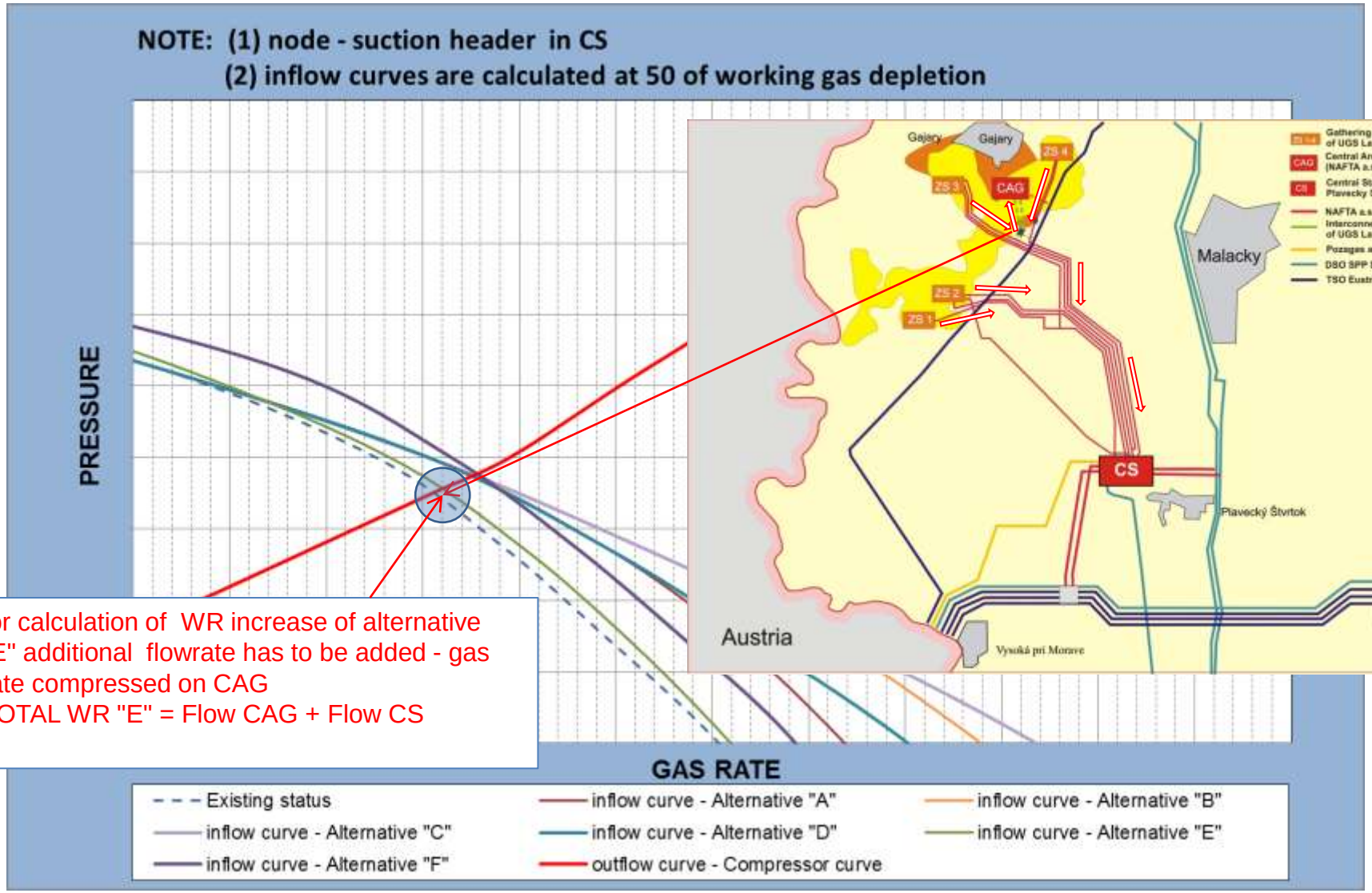
Method of bottleneck analysis

- Total production = Nodal analysis was used for first comparison of basic alternatives
- Division point (node) into upstream ans downstream part - **suction header of compressors**



Suction header of compressors

Nodal analysis of basic alternatives



for calculation of WR increase of alternative "E" additional flowrate has to be added - gas rate compressed on CAG
TOTAL WR "E" = Flow CAG + Flow CS

Criteria of economical evaluation

CRITERIA	WEIGHTING
Increase of withdrawal rate	60%
Investment costs (CAPEX)	15%
Capex per unit of withdrawal rate increase	15%
Complexity of preparation and realization of construction investment	10%

Number of points for criteria = Weighting x Order

Total number of points ranges the basic alternatives

Criteria of economical evaluation and Result of Nodal analysis

BASIC ALTERNATIVES		CRITERIA OF ECONOMICAL EVALUATION								RESULT	
		INCREASE OF WR		CAPEX		CAPEX PER UNIT OF WR INCREASE		COMPLEXITY OF PREPARATION AND REALIZATION OF CONSTRUCTION INVESTMENT			
Lettering	Description of alternatives	Order	Weighting 60%	Order	Weighting 15%	Order	Weighting 15%	Order	Weighting 10%	Total points according to weighting	Total order
A	Replacement of inlet separator on gathering station ZS 4	4	2.4	2	0.30	3	0.45	2	0.20	3.35	**3**
B	Bypass of dehydration unit on gathering station ZS1	3	1.8	1	0.15	2	0.30	1	0.10	2.35	**2**
C	Completion of dehydration unit on gathering station ZS1	3	1.8	4	0.60	5	0.75	4	0.40	3.55	4
D	Change of pipes on gathering station na ZS4 and replacement of inlet separator on ZS4	4	2.4	3	0.45	4	0.60	3	0.30	3.75	6
E	Interconection with CAG	1	0.6	5	0.75	1	0.15	5	0.50	2.00	**1**
F	Change of flowlines and tubings for selected wells	2	1.2	6	0.90	6	0.90	6	0.60	3.60	5

Criteria of economical evaluation and Result of Nodal analysis

BASIC ALTERNATIVES		CRITERIA OF ECONOMICAL EVALUATION								RESULT	
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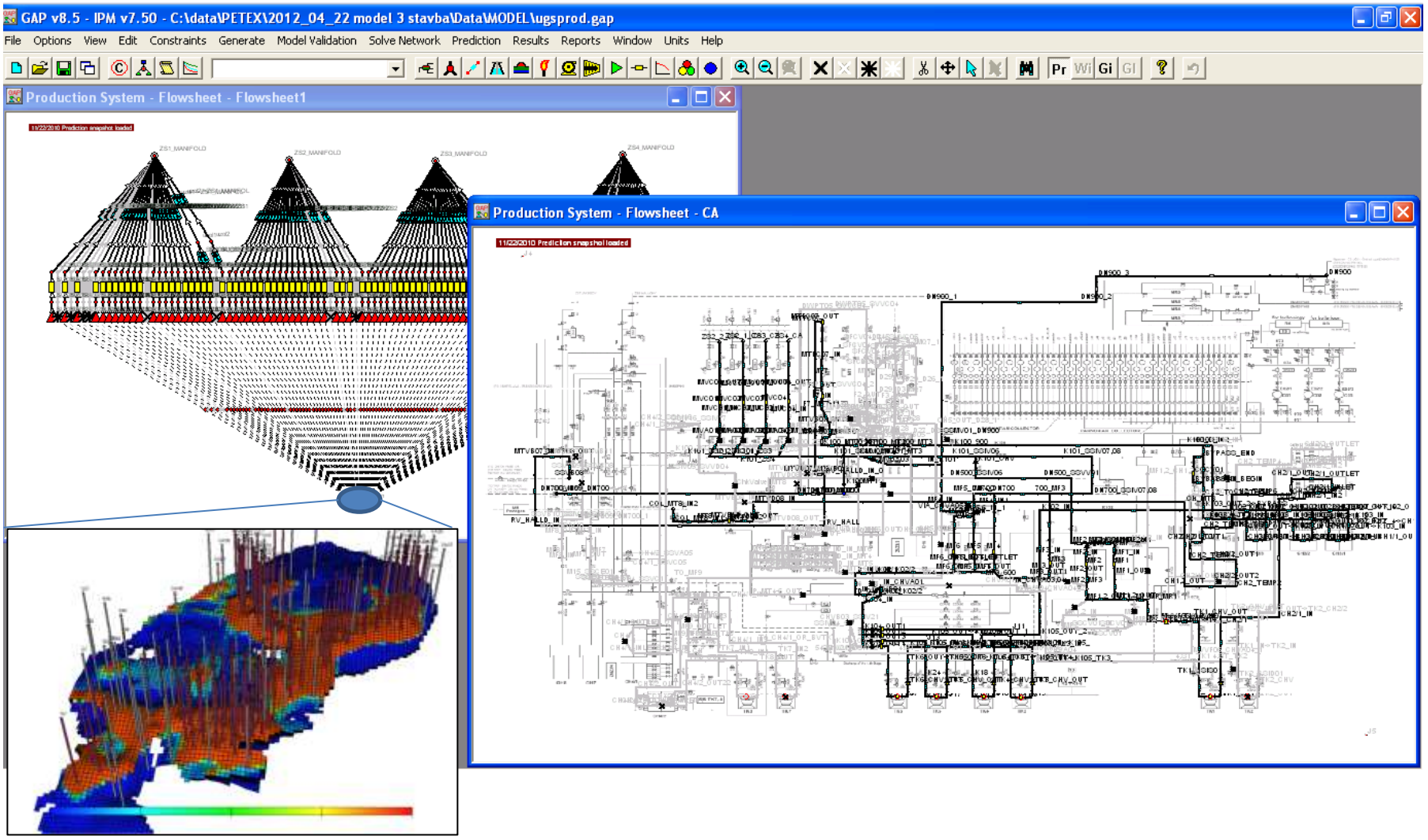
Second step of debottlenecking (comparison of variants)
Variant = combination of basic alternatives

Definition of variants

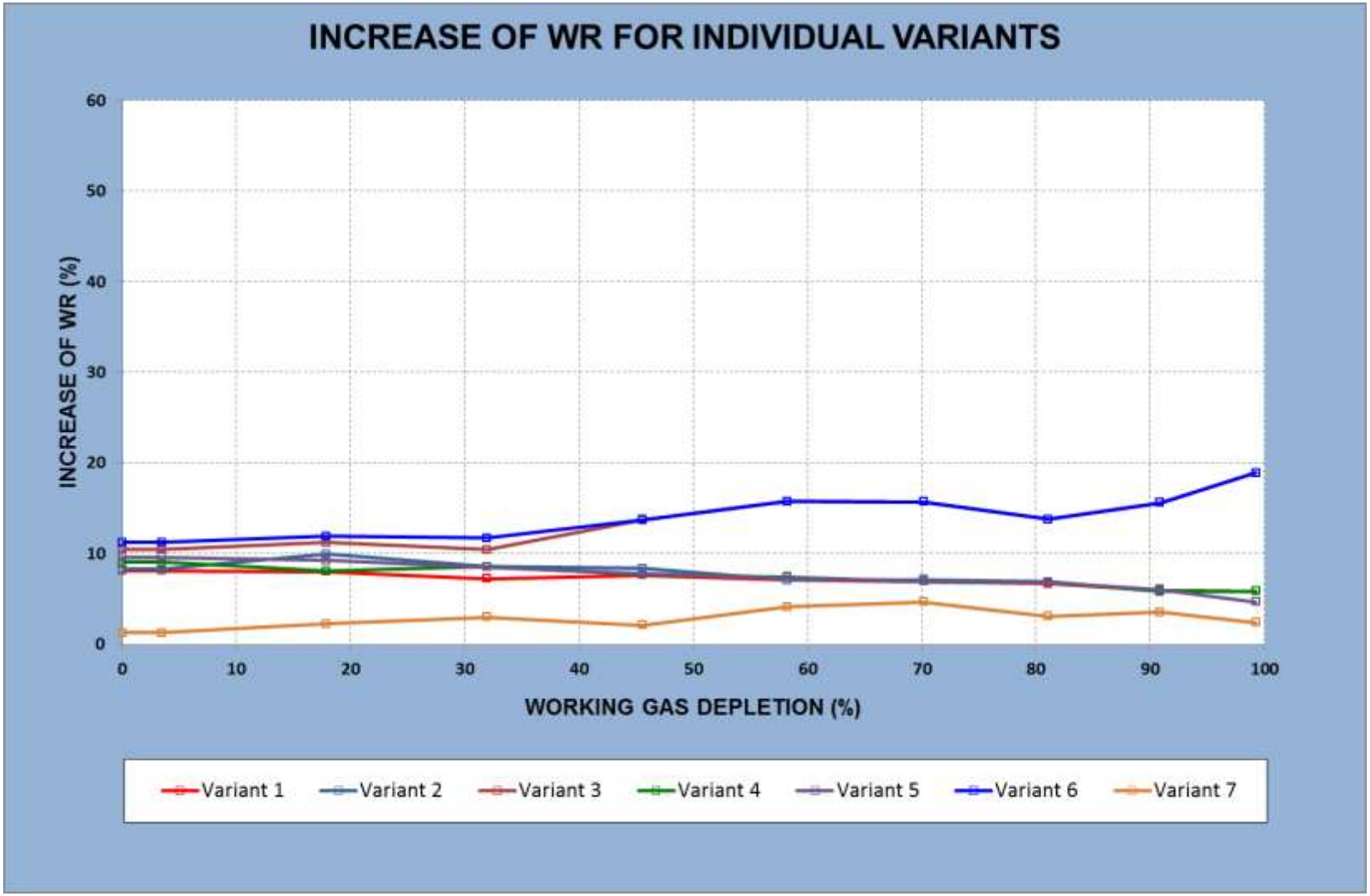
BASIC ALTERNATIVES	DESCRIPTION OF ALTERNATIVES	VARIANT 1	VARIANT 2	VARIANT 3	VARIANT 4	VARIANT 5	VARIANT 6	VARIANT 7
A (reference case)	Repalcement of inlet separator on gathering station ZS 4	x	x	x	x	x	x	x
B	Bypass of dehydration unit on gathering station ZS1					x		
C	Completion of dehydration unit on gathering station ZS1				x		x	
D	Change of pipes on gathering station ZS4		x				x	
E	Interconection with CAG	x	x	x	x	x	x	
F	Change of flowlines and tubings for selected wells			x			x	x

Calculation of withdrawal curves

Integrated reservoir and surface model



Calculation of withdrawal curves



Criteria of economical evaluation and recommedation for development

	CRITERIA OF ECONOMICAL EVALUATION													
	INCREASE OF WR			CAPEX		CAPEX PER UNIT OF WR INCREASE		COMPLEXITY OF PREPARATION AND REALIZATION OF CONSTRUCTION INVESTMENT		DELIVERABILTY			RESULT	
VARIANTS	(%)	Order	Weighting 40%	Order	Weighting 15%	Order	Weighting 20%	Order	Weighting 10%	Increase of deliverabilty (days)	Order	Weighting 15%	Total points according to weighting	Total order
Variant 1	6.0	2	0.8	1	0.15	2	0.40	1	0.10	4	3	0.45	1.90	1
Variant 2	6.0	2	0.8	3	0.45	3	0.60	2	0.20	4	3	0.45	2.50	3
Variant 3	15.6	1	0.4	6	0.90	1	0.20	5	0.50	6	2	0.30	2.30	2
Variant 4	6.0	2	0.8	4	0.60	5	1.00	4	0.40	4	3	0.45	3.25	6
Variant 5	6.0	2	0.8	3	0.45	3	0.60	3	0.30	4	3	0.45	2.60	4
Variant 6	15.6	1	0.4	6	0.90	4	0.80	6	0.60	6	2	0.30	3.00	5
Variant 7	2.3	3	1.2	2	0.30	6	1.20	7	0.70	8	1	0.15	3.55	7

Criteria of economical evaluation and recommedation for development

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Variant 2	6.0	2	0.8	3	0.45	3	0.60	2	0.20	4	3	0.45	2.50	3
Variant 3	15.6	1	0.4	6	0.90	1	0.20	5	0.50	6	2	0.30	2.30	2
Variant 4	6.0	2	0.8	4	0.60	5	1.00	4	0.40	4	3	0.45	3.25	6
Variant 5	6.0	2	0.8	3	0.45	3	0.60	3	0.30	4	3	0.45	2.60	4
Variant 6	15.6	1	0.4	6	0.90	4	0.80	6	0.60	6	2	0.30	3.00	5
Variant 7	2.3	3	1.2	2	0.30	6	1.20	7	0.70	8	1	0.15	3.55	7

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Variant 6	15.6	1	0.4	6	0.90	4	0.80	6	0.60	6	2	0.30	3.00	5
Variant 7	2.3	3	1.2	2	0.30	6	1.20	7	0.70	8	1	0.15	3.55	7

	BASIC ALTERNATIVES		
	"A" (reference case) Repalcement of inlet separator on gathering station ZS 4	"E" Interconection with CAG	"F" Change of flowlines and tubings for selected wells
Variant 1	x	x	
Variant 3	x	x	x

Conclusion

- Realized investment
  - Inlet separator on gathering station ZS4

  - Interconnection of UGS Lab 3 with CAG

- Further development of UGS Lab complex (increase of WR and IR) will keep the procedure:

  Analysis ➡ Calculation&evaluation ➡ Verification ➡ Construction ➡ Sell

Conclusion

Thank you for your attention

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