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Cost estimate of Oil & gas facilities

Welcome to this presentation.

It explains how the investment cost for an Oil & Gas facility is estimated.

After a short introduction, the 3 common methods of cost estimate are shown.

Common ratios, such as $/kg for equipment, pipe etc. are given.

Comments are most welcome (herve.baron@gmail.com), which I will incorporate for the benefit of all.

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Agenda

Introduction

The different estimation methods:

- Capacity factored
- Equipment factored
- Analytical

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Cost estimate of Oil & gas facilities

What will be the overall cost of this facility?

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Cost estimate of Oil & gas facilities

$$\text{Cost} = \sum_{\text{All items}} \text{Quantities} * \text{item costs}$$

How would you determine quantities?

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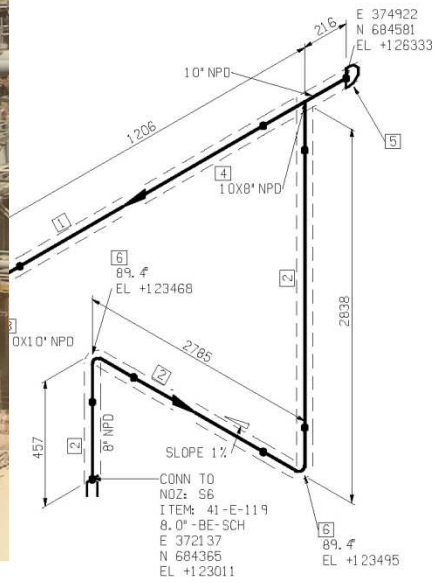
Cost estimate of Oil & gas facilities

Quantities estimates:

- Ratio from past projects
- Material Take-Off



SHOP MATERIAL

PT NO	COMPONENT DESCRIPTION	DIAM. (NS)	IDENT CODE	STOCK CODE	QTY
	PIPE				
1	PIPE, ASME B36.10, , ASME SA106 GR. B, BE, SEAMLESS, IN 10 X S-120	10	C1GABM1	PP2C1FHM1P0000	1956 MM
2	PIPE, ASME B36.10, , ASME SA106 GR. B, BE, SEAMLESS, IN 8 X S-120	8	C6D8E9	PP2C1FHM1P0000	9338 MM
	FITTINGS				
3	EQUAL TEE, ASME B16-9, ASME SA234 GR. WPB, BW, SEAMLESS, IN 10 X S-120	10X10	C1SN23H	DTE2CORAM110000	1
4	REDUCING TEE, ASME B16-9, ASME SA234 GR. WPB, BW, SEAMLESS, IN 10 X S-120 / IN 8 X S-120	10X8	C1SNPE8	DTR2CORAM110000	2
5	CAP, ASME B16-9, ASME SA234 GR. WPB, BW, SEAMLESS, IN 10 X S-120	10	C1UCOJA	DCP2CORAM110000	1
6	90 DEG ELBOW LR, ASME B16-9, ASME SA234 GR. WPB, BW, SEAMLESS, IN 8 X S-120	8	C8GAW1	DE92CORAM110000	4

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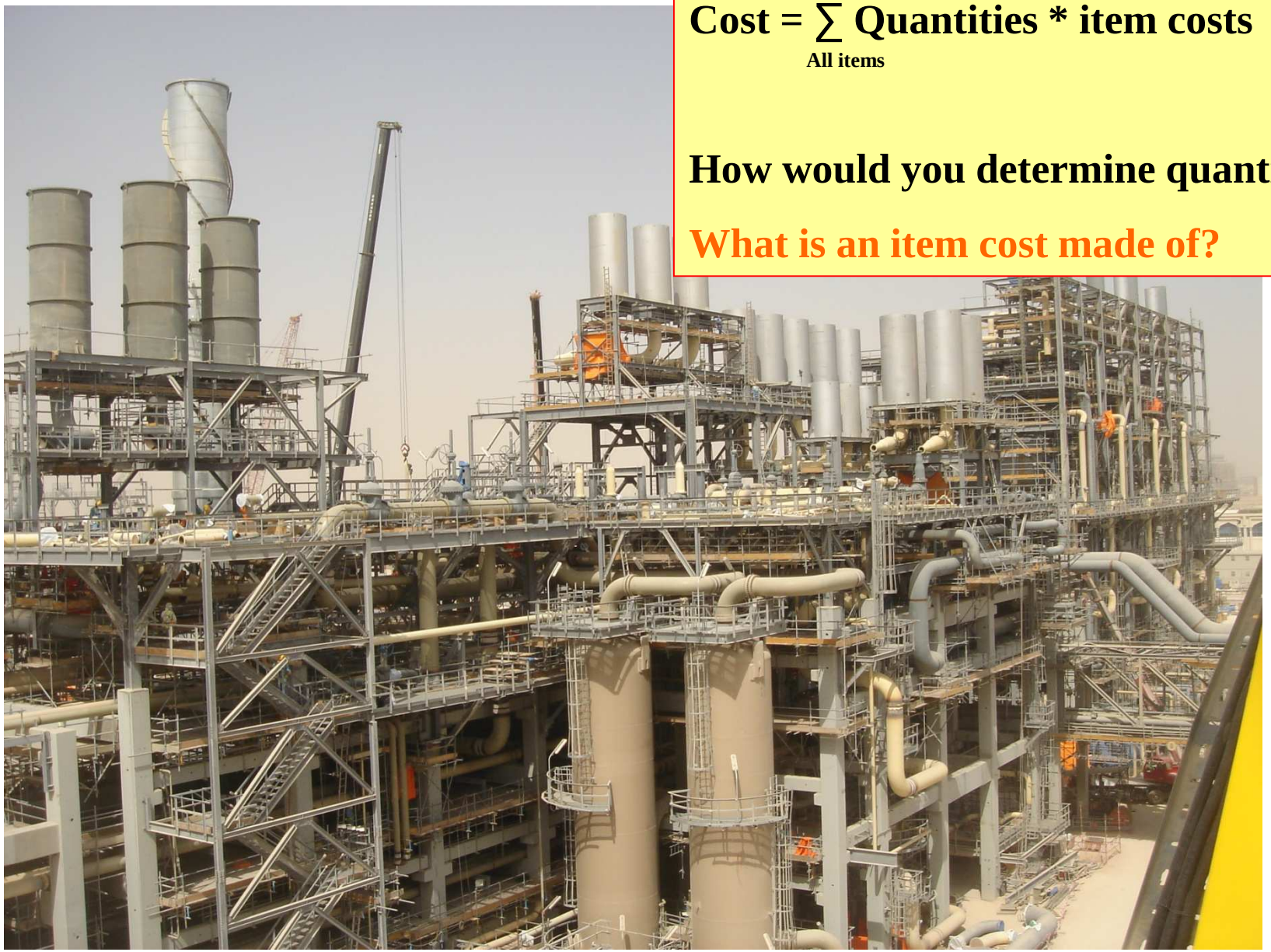
Cost estimate of Oil & gas facilities

$$\text{Cost} = \sum_{\text{All items}} \text{Quantities} * \text{item costs}$$

How would you determine quantities?

What is an item cost made of?



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Cost estimate of Oil & gas facilities

<u>Item cost =</u> Supply cost + installation cost

How would you each one?

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Cost estimate of Oil & gas facilities

Item cost estimates:

Supply + installation

- **In-house data from past projects**
- **Inquiries**

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Cost estimate of Oil & gas facilities

Item cost estimates:

Supply + installation

- **In-house data from past projects**
- **Inquiries**

Sensitivity to:

Raw materials

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Cost estimate of Oil & gas facilities

Item cost estimates:

Supply + installation

- **In-house data from past projects**
- **Inquiries**

Sensitivity to:

Raw materials

- **Steel, alloy steel, copper, cement, iron**

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Cost estimate of Oil & gas facilities

Item cost estimates:

Supply + installation

- **In-house data from past projects**
- **Inquiries**

Sensitivity to:

Raw materials

Construction market

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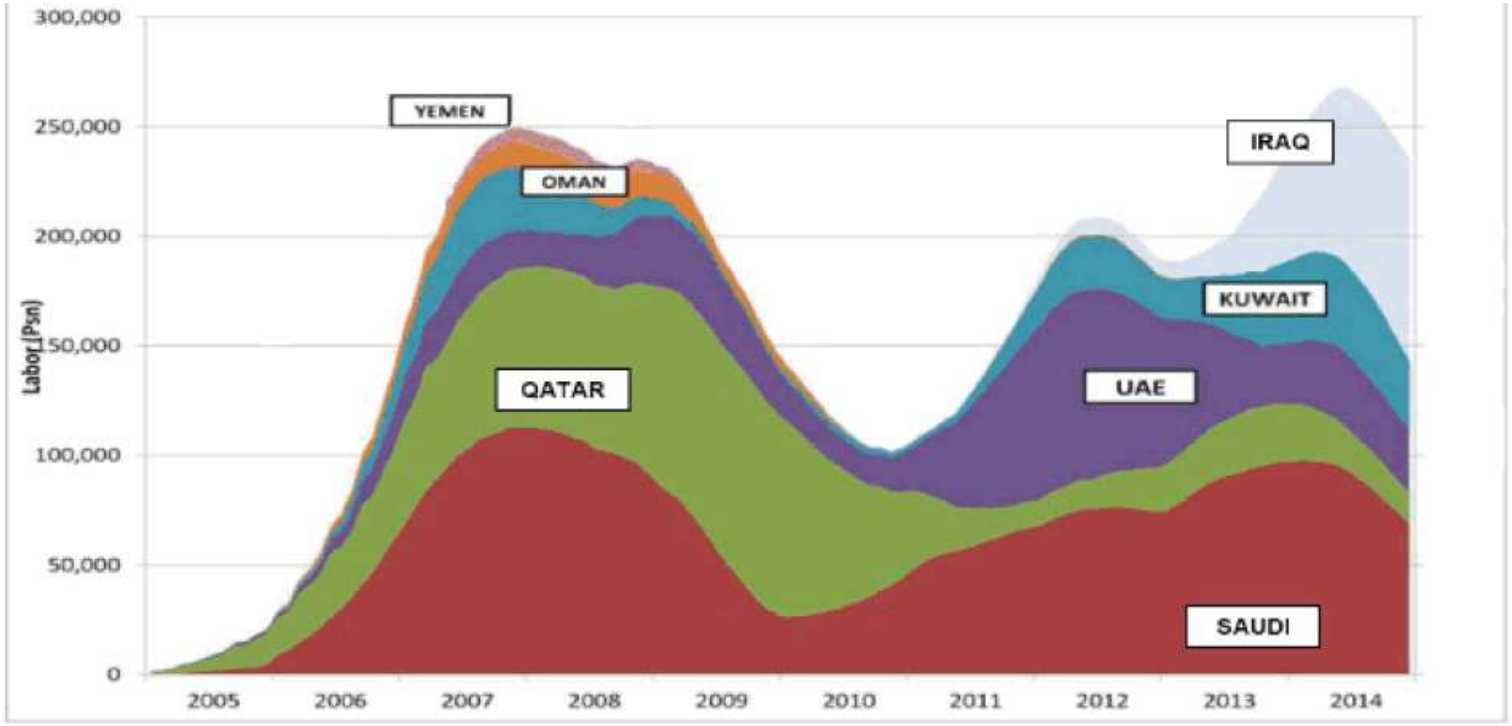
Cost estimate of Oil & gas facilities



Sensitivity to:

Raw materials

Construction market

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Cost estimate of Oil & gas facilities

Purpose of estimate:

- Concept screening
- Study of feasibility
- Decision to invest

Estimate type:

- Capacity factored
- Equipment factored
- Analytical

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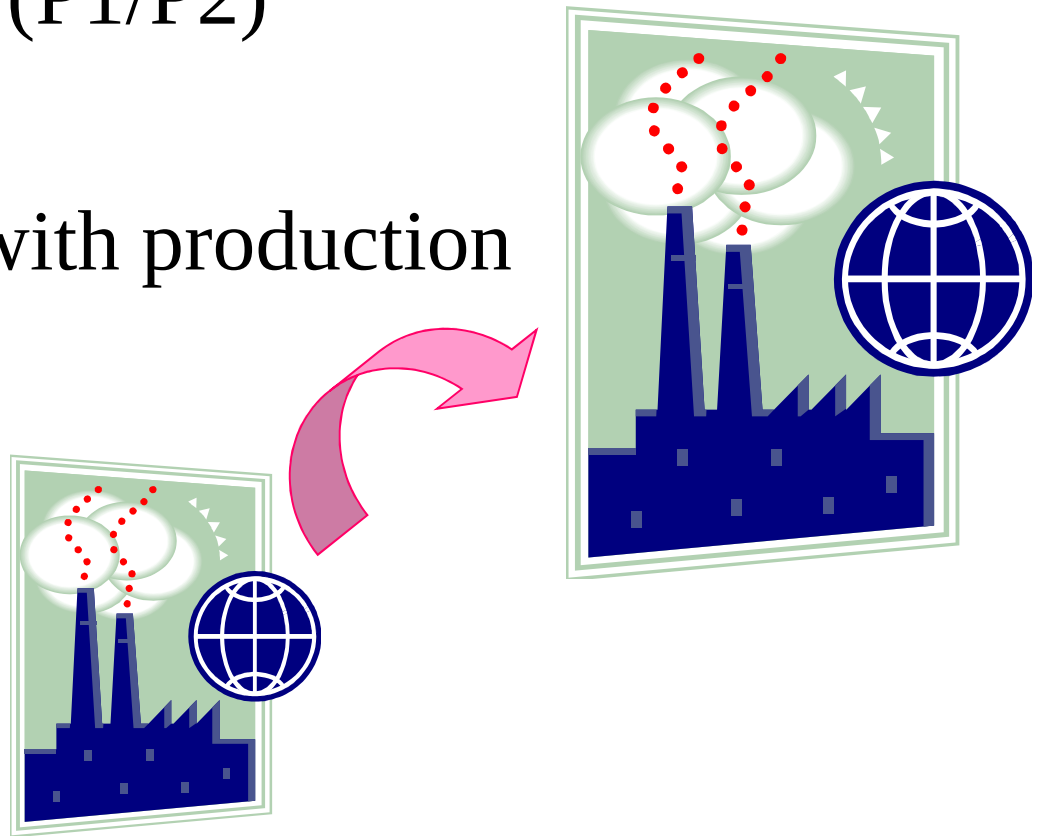
Cost estimate of Oil & gas facilities

- Capacity factored

$$C1/C2 = (P1/P2)^{e}$$

$$e \sim 0.6$$

Ci: Cost of facility with production capacity Pi



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Cost estimate of Oil & gas facilities

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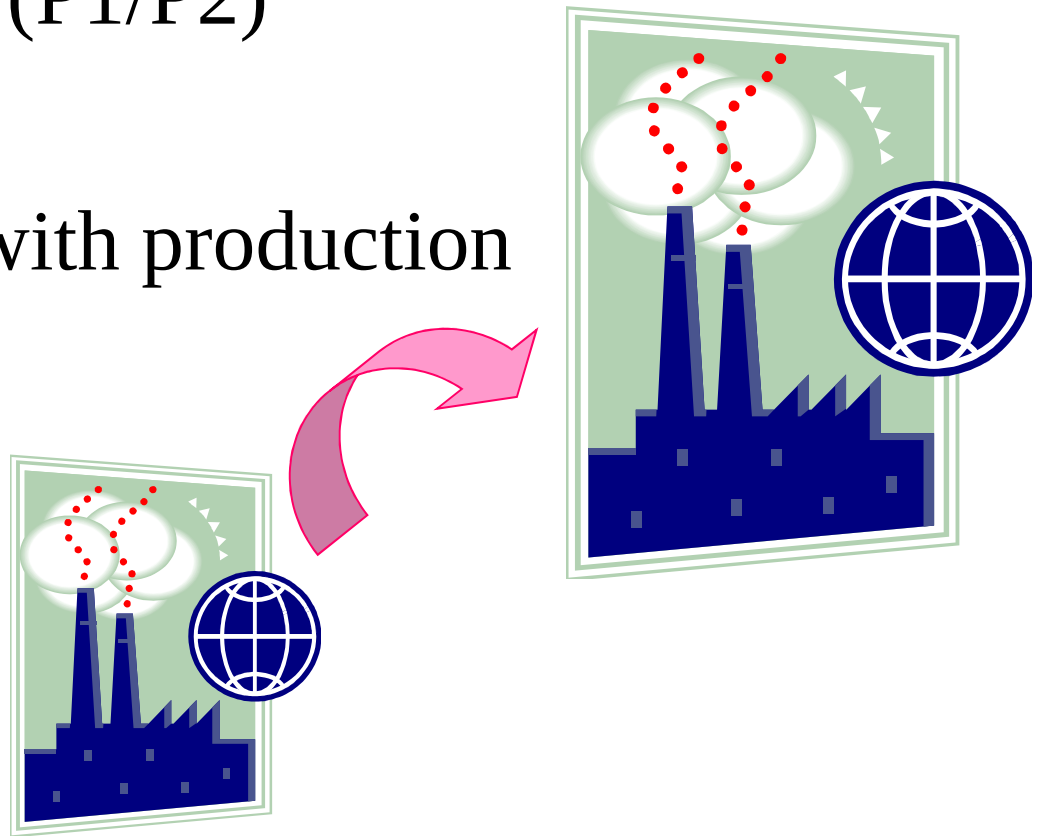

Exercise: what is the increase in cost for +50% capacity increase?

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Cost estimate of Oil & gas facilities

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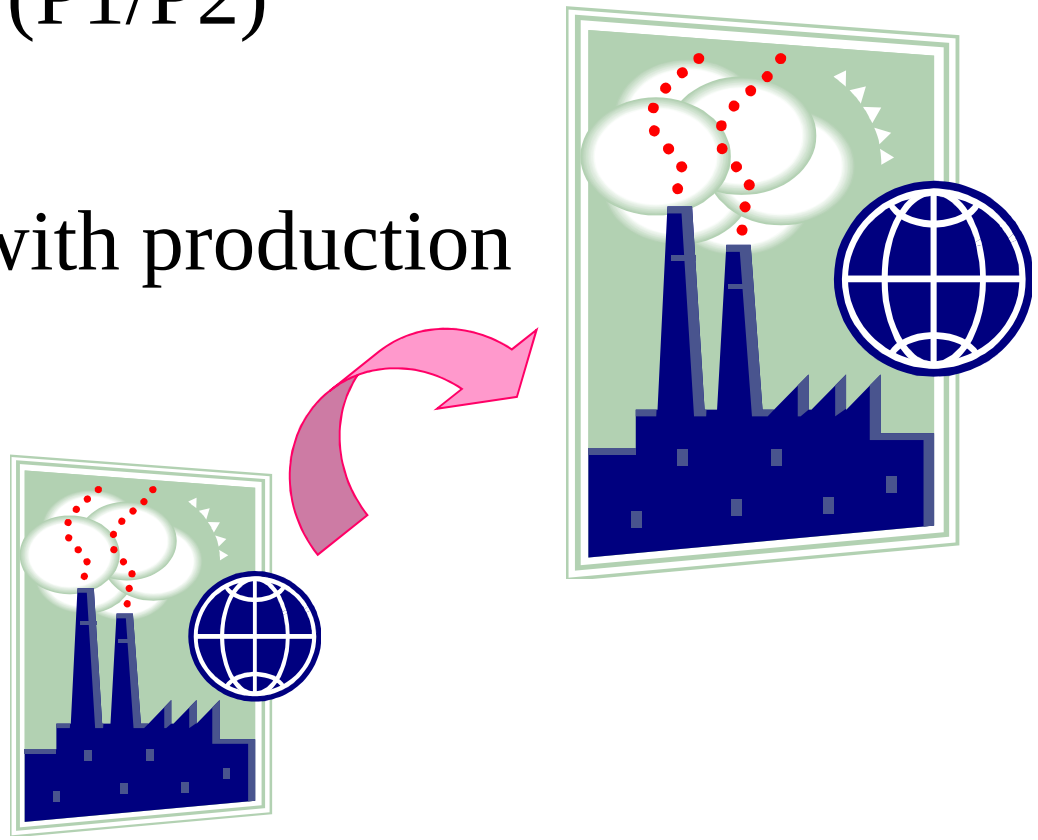

Exercise: what is the increase in cost for +50% capacity increase?

In your opinion, what is the limit of such estimate?

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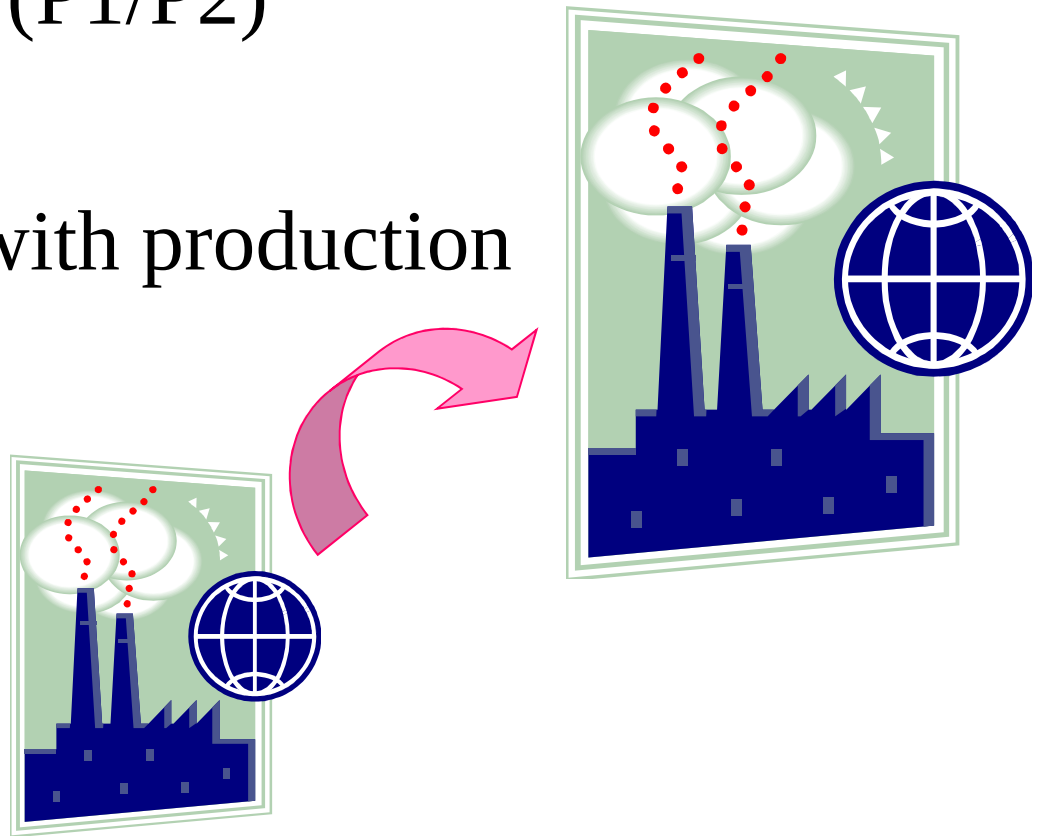

Exercise: what is the increase in cost for +50% capacity increase?

In your opinion, what is the limit of such estimate? It takes into account neither *market conditions* nor *plant location* (labour cost)

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Cost estimate of Oil & gas facilities

- Equipment factored

  C = f M

  C: total installed cost of facility

  M: cost of main equipment

  f: factor

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Cost estimate of Oil & gas facilities

- Equipment factored

  C = f M

  C: total installed cost of facility

  M: cost of main equipment

  f: factor

Item	Cost
Main equipment	100
Secondary equipment & materials	73
Erection Main equipment	7
Construction Piping, E&I	90
Construction: Civil, steel structure, painting, insulation	69
Services (Engineering, Project Management)	104
TOTAL	**443**

Note: Typical figures for Petrochemical Plant

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Cost estimate of Oil & gas facilities

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What's the main equipment?

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How is the cost of main equipment evaluated?

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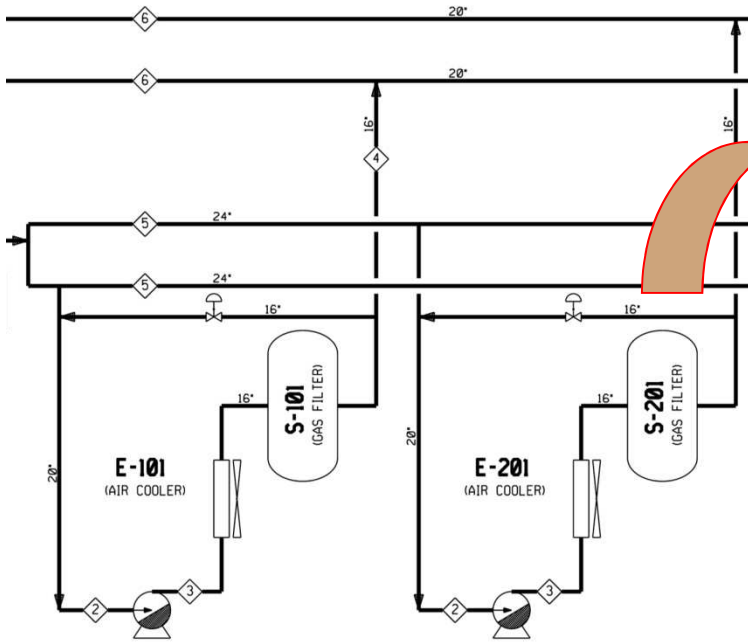
Cost estimate of Oil & gas facilities

Process design

PFDs

H&M balance

STREAM NUMBER	1	2	3	4	5	6	7	8
PRESSURE (MPa-abs)	8.78	6.52	25.1	25.06	8.52	25.06	24.95	24.95
TEMPERATURE (°C)	27.25	26.4	130	50.0	26.4	50.0	49.6	49.0
TOTAL FLOWRATE (Kg/h)	1388816	345204	345204	345204	690408	690408	1388816	690408
PHASE	gas	gas	gas	gas	gas	gas	gas	gas
FLOWRATE (Sm³/h) (NOTE 4)	2007000	501750	501750	501750	1003500	1003500	2007000	1003500
ACTUAL FLOWRATE (m³/h)	28457	5262	2816	2816	10525	4893	8210	4105
VELOCITY (m/s)	5.4	9.4	7.9	5.7	12.7	7.9	10.2	5.1
VISCOSITY (cP)	0.0136	0.0134	0.0201	0.0219	0.0134	0.0219	0.0216	0.0219
DENSITY (Kg/m³)	87.5	65.6	122.6	168.7	65.6	168.7	168.2	168.2
MOLECULAR WEIGHT	16.52	16.52	16.52	16.52	16.52	16.52	16.52	16.52
COMPOSITION (% mol.)								
METHANE (C1)	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378
ETHANE (C2)	0.880	0.880	0.880	0.880	0.880	0.880	0.880	0.880
								0.140
								0.015
								0.026
								0.0383
								0.8617
								0.930
								0.410
								nil
								0.0056
								0.00036
								0.00027



DESIGNATION	QTY	SECT.	INTER. DIAM. I.D. mm	HEIGHT T.L. to T.L. mm	DESIGN TEMP. °C	DESIGN PRESS. bar g.	MATERIALS +corr. allow. (mm)
Debutanizer	1	T	4800	14125	98	24	KCS +6 (A)
Deethanizer	1	T	2200	2520	89	24.5	KCS +6 (B)
Absorber	1		1600	28400	94	14.7	KCS +6 (C)
LPG Amine Absorber	1		2300	17000	80 / -29	32.5	KCS +6 (D)
Fuel Gas Amine Absorber	1		1200	14900	85	10.2	KCS +6 (E)

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Cost estimate of Oil & gas facilities

- Equipment factored

  C = f M

  f: factor

  f depends on

  – type of facility (petrochemical, refining, LNG, off-shore)
  – Size

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Cost estimate of Oil & gas facilities

- Equipment factored

  C = f M

  f: factor

  f depends on

  – type of facility (petrochemical, refining, LNG, off-shore)

  – Size

Item	cost	
	large facility	small facility
Main equipment	100	100
Main equipment erection	10	15
Piping	100	120
Electrical	15	25
Instrumentation	75	120
Civil	20	25
Steel structure	20	25
Painting, insulation	10	20
Engineering	70	150
Construction facilities	20	20
TOTAL	**440**	**620**

Typical figures for a chemical plant

In your opinion, how can we refine the estimate?

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Cost estimate of Oil & gas facilities

- Equipment factored

  $C = \sum fi\ Mi$

  Mi Cost of all type i Main equipment

  fi: factor

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Cost estimate of Oil & gas facilities

- Equipment factored

  $C = \sum fi\ Mi$

  Mi Cost of all type i Main equipment

  fi: factor

Why do you think justifies such an approach?

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Cost estimate of Oil & gas facilities

- Equipment factored

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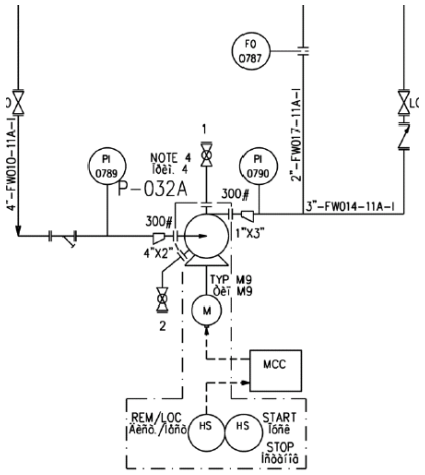
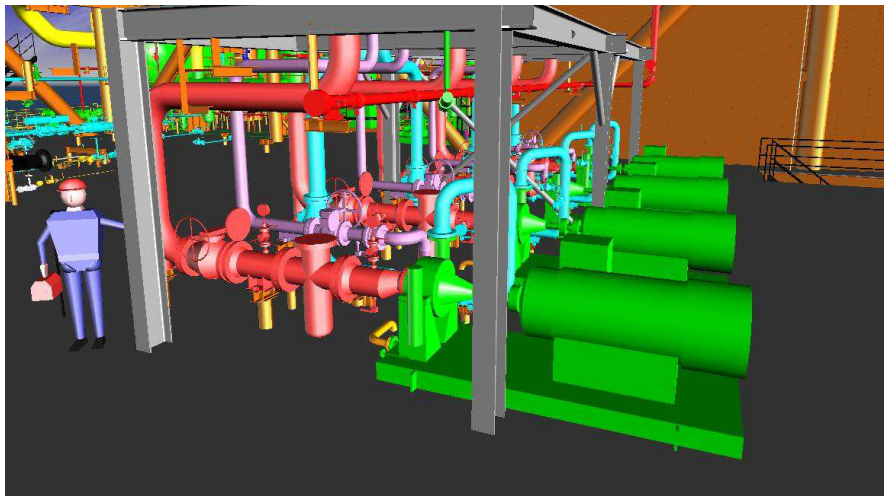
Why do you think justifies such an approach?





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Cost estimate of Oil & gas facilities

- Equipment factored

$$C = \sum f_i M_i$$

Mi Cost of all type I Main equipment

fi: factor

Item	cost	
	column	pumps
Main equipment	100	100
Main equipment erection	20	15
Piping	110	260
Electrical	20	110
Instrumentation	100	70
Civil	20	35
Steel structure	20	35
Painting, insulation	10	10
TOTAL	**400**	**635**

In your opinion, what is the limit of such estimate?

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Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous

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Cost estimate of Oil & gas facilities

- Analytical
  - Establish the bill of quantities (**BOQ**) in each trade: equipment, civil, piping, structural steel etc.
  - BOQ = Material Take-Off (what is measured from available drawings at this stage) + allowances for design development + allowances for what is not yet on drawings + contingencies
  - Apply ratios to get supply + installation cost
  - Installation cost = qty * manhours/ton ratio * labour cost
  - Labour cost is all in, i.e., includes construction equipment (crane, scaffolding)
  - The ratio is based on standard manhours, i.e., home country,
  - Localization factor (productivity) to be applied, i.e., actual installation manhours = ratio * productivity
  - Example: piping installation cost, ratio: 250 std h / ton
    - Western Europe, labour cost $100/hr yields $20k/ton
    - Middle East, labour cost $18/hr, productivity 2.5 yeilds $16k/ton

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Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
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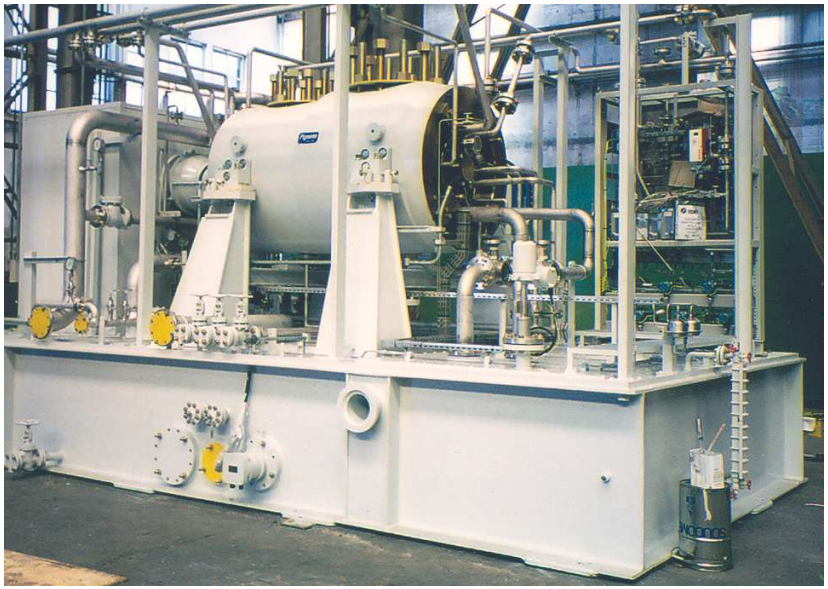
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply

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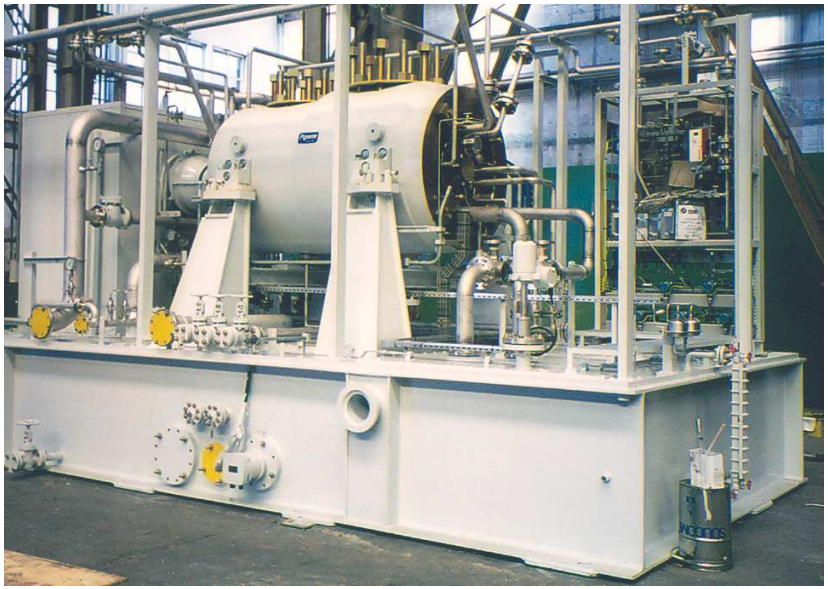
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply: eqt list (dimensions) => weight

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Cost estimate of Oil & gas facilities

Process design

PFDs

H&M balance

STREAM NUMBER	1	2	3	4	5	6	7	8
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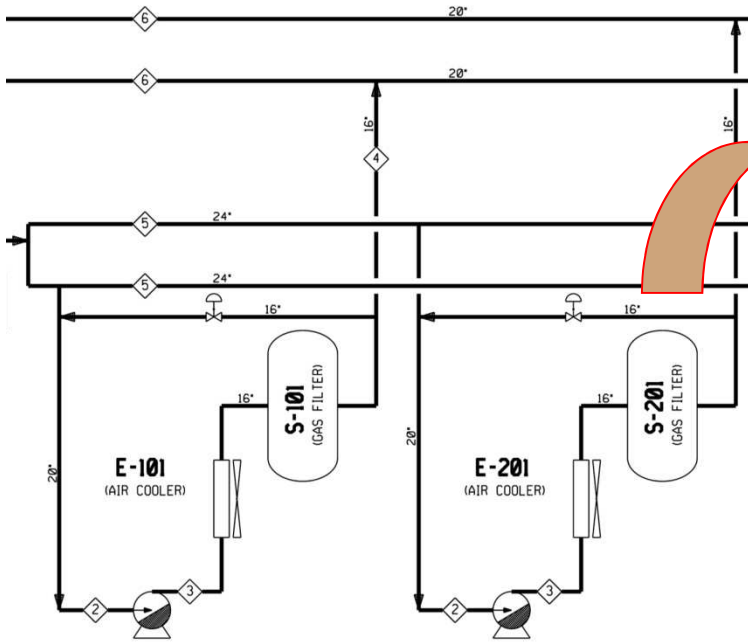

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Cost estimate of Oil & gas facilities

- Main equipment supply + install
  - Supply: eqt list (dimensions) => weight
  - Rate?

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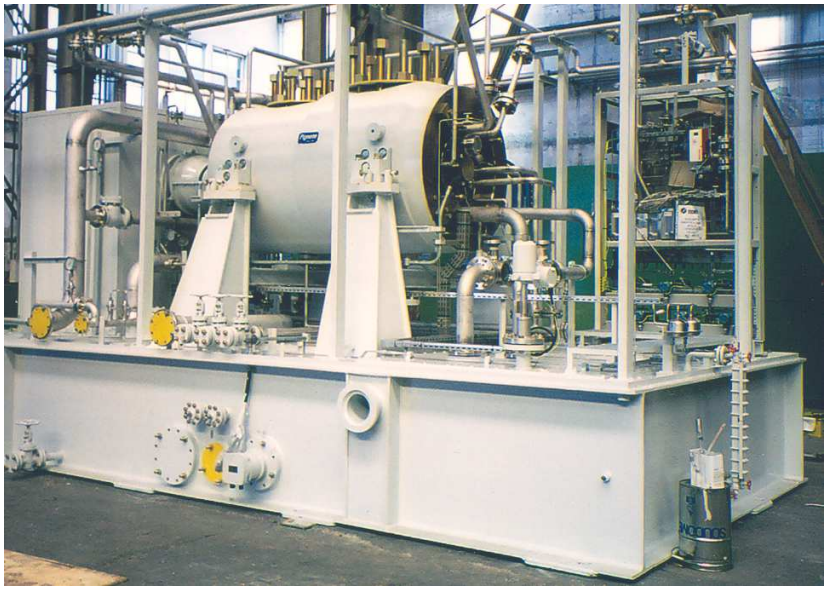
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply: eqt list (dimensions) => weight
  - Rate:

    USD 4/kg for CS – depends on eqt size: 4 (large) – 10 (small)

    USD12/kg for SS

    USD 300-500 /m2 for Shell&Tube / Air-coolers

    USD 1000/kW for pumps

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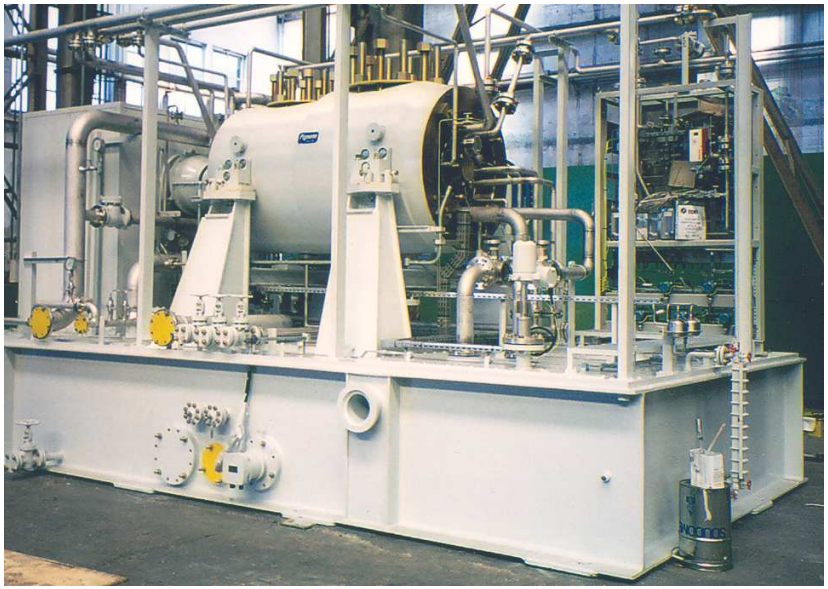
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply: eqt list, dimensions/capacity/weight
  - Installation

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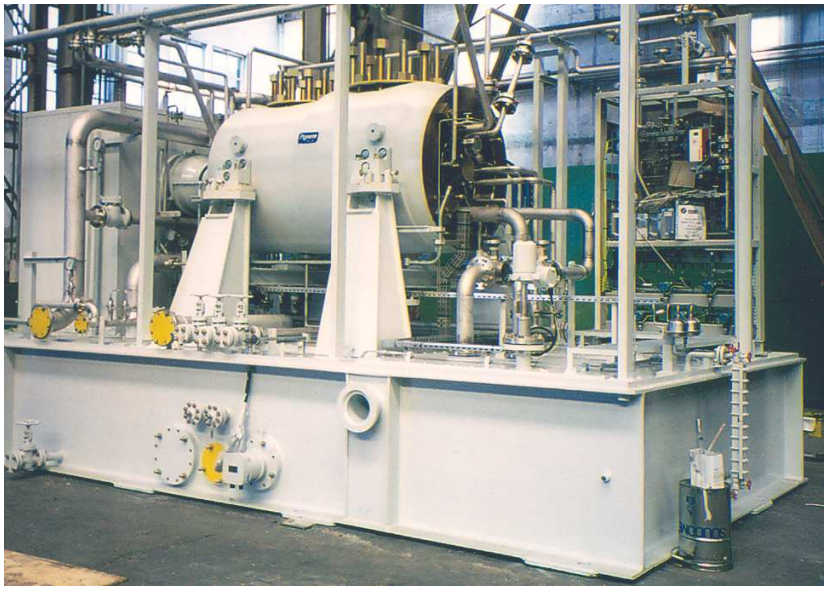
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply: eqt list, dimensions/capacity/weight
  - Installation ratios: % supply cost, typ. 8%

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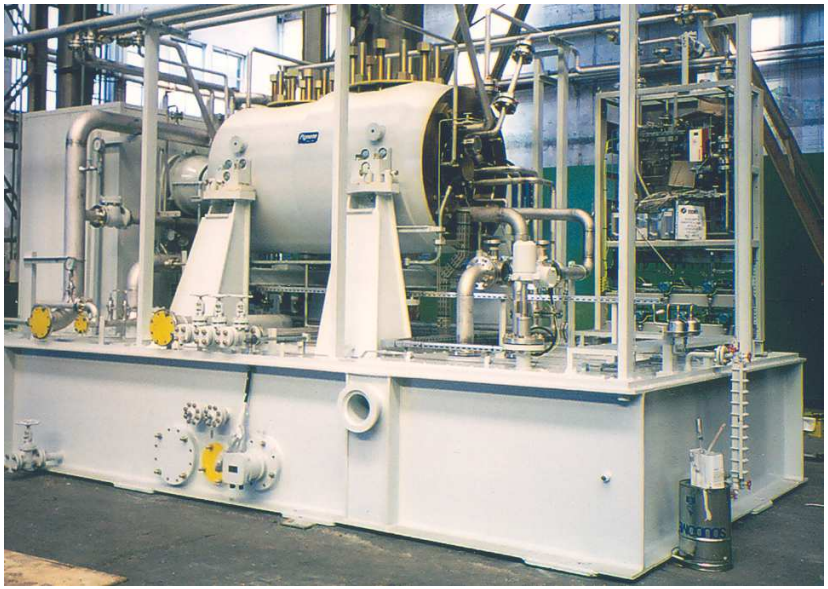
Cost estimate of Oil & gas facilities



- Main equipment supply + install
  - Supply: eqt list, dimensions/capacity/weight
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    30 std manhours/ton (includes labour and equipment)

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Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous

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Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio (eqt weight), typ. 40%

Piping supply + install

- Qty: ratio f (eqt number)

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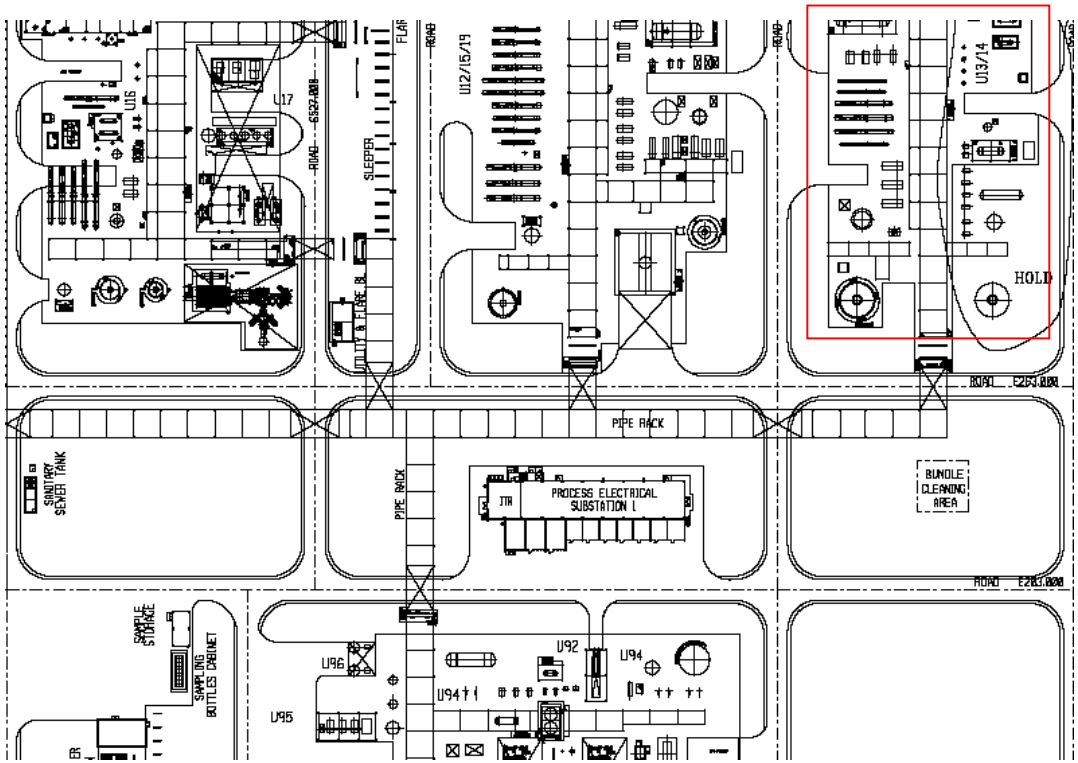
Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio f (eqt number)



Item	qty
Equipment	10
Isometric / eqt	6
average length (m) / iso	10
average line diameter (inch)	12
material of construction	CS
total length (m)	**600**

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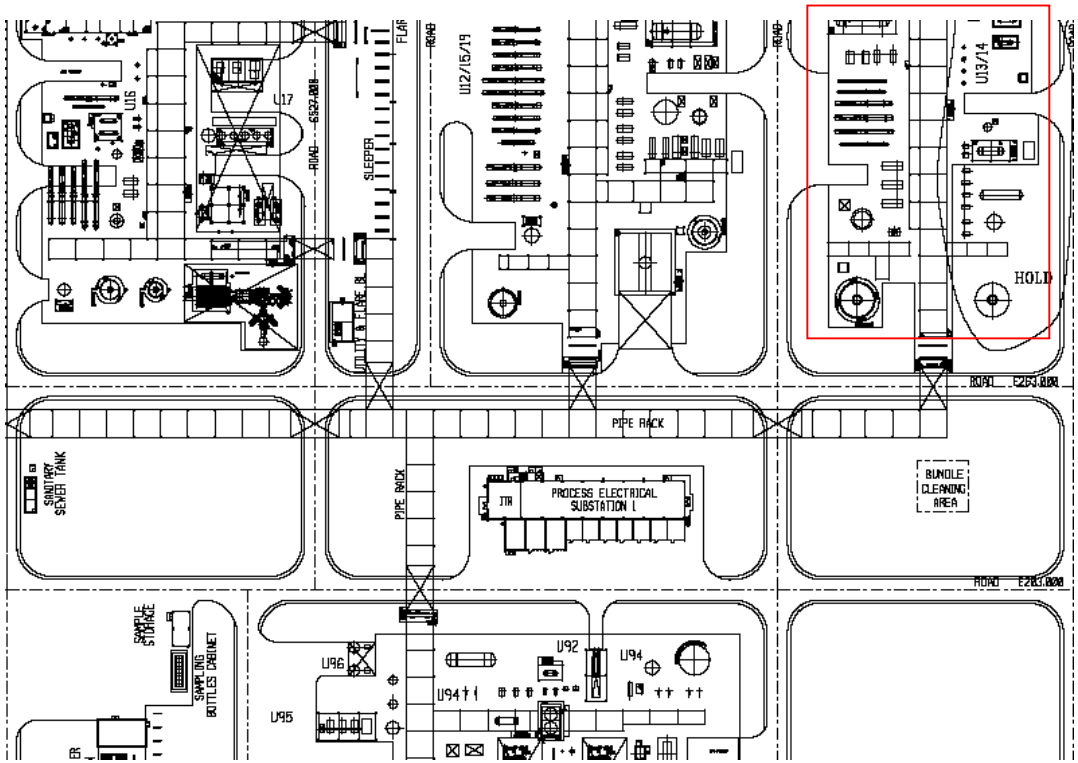
Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio f (eqt number)

  Remark: Unit vs Interconnection



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Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio (eqt number, eqt weight)

  MTO

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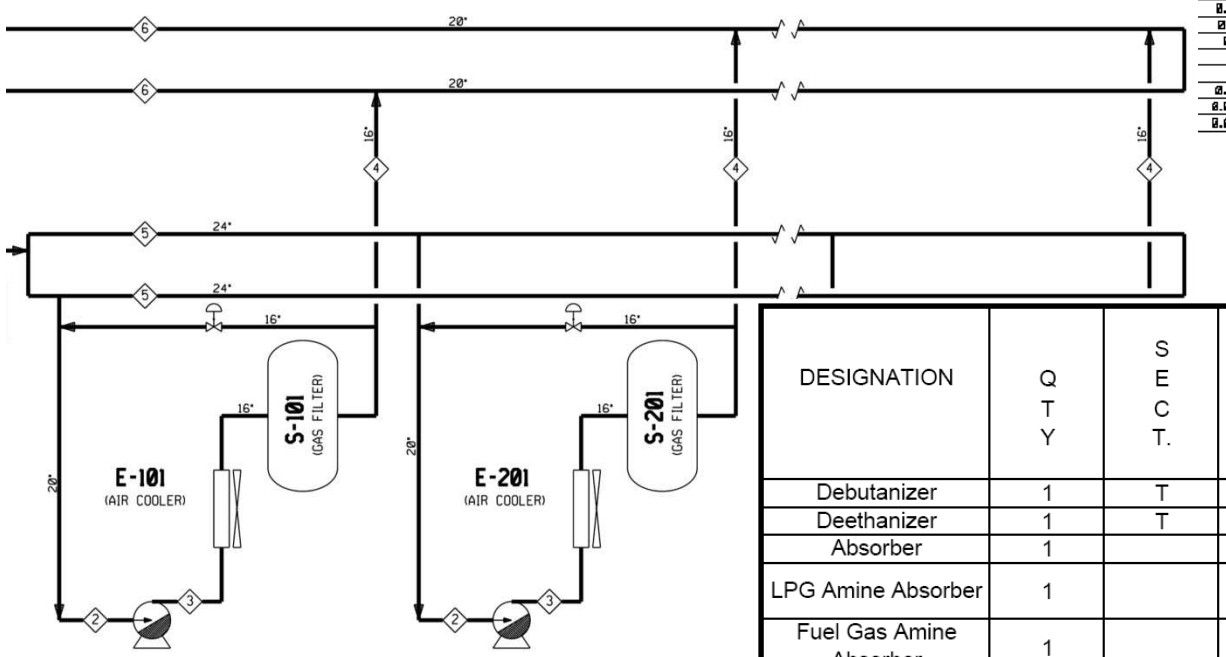
FLOWRATE (Sm³/h) (NOTE 4)	2007000	501750	501750	501750	1003500	1003500	2007000	1003500
ACTUAL FLOWRATE (m³/h)	28457	5262	2816	2816	10525	4893	8210	4105
VELOCITY (m/s)	5.4	9.4	7.9	5.7	12.7	7.9	10.2	5.1
VISCOSITY (cP)	0.0136	0.0134	0.0201	0.0219	0.0134	0.0219	0.0216	0.0219
DENSITY (Kg/m³)	87.5	65.6	122.6	168.7	65.6	168.7	168.2	168.2
MOLECULAR WEIGHT	16.52	16.52	16.52	16.52	16.52	16.52	16.52	16.52
COMPOSITION (% mol.)								
METHANE (C1)	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378	97.49378
ETHANE (C2)	0.880	0.880	0.880	0.880	0.880	0.880	0.880	0.880
								0.140
								0.015
								0.026
								0.0383
								0.8617
								0.938
								0.418
								nil
								0.0056
								0.00036
								0.00027



DESIGNATION	QTY	SECT.	INTER. DIAM. I.D. mm	HEIGHT T.L. to T.L. mm	DESIGN TEMP. °C	DESIGN PRESS. bar g.	MATERIALS +corr. allow. (mm)
Debutanizer	1	T	4800	14125	98	24	KCS +6 (A)
Deethanizer	1	T	2200	2520	89	24.5	KCS +6 (B)
Absorber	1		1600	28400	94	14.7	KCS +6 (C)
LPG Amine Absorber	1		2300	17000	80 / -29	32.5	KCS +6 (D)
Fuel Gas Amine Absorber	1		1200	14900	85	10.2	KCS +6 (E)

HERVE BARON

Cost estimate of Oil & gas facilities

Process design

PFDs

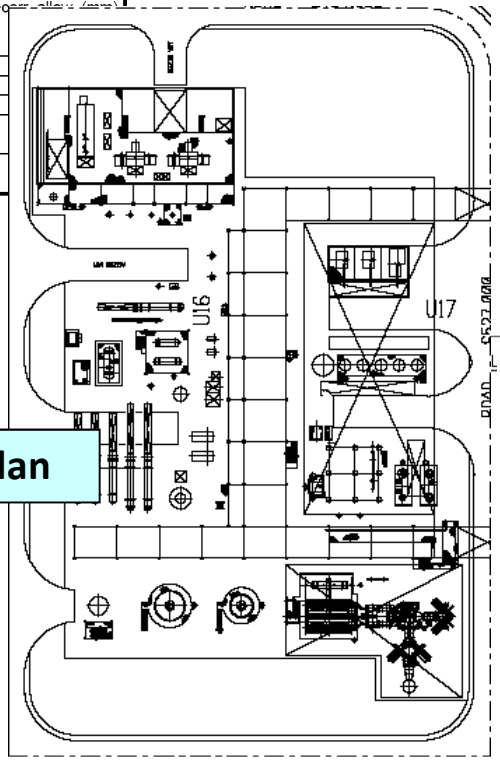
H&M balance

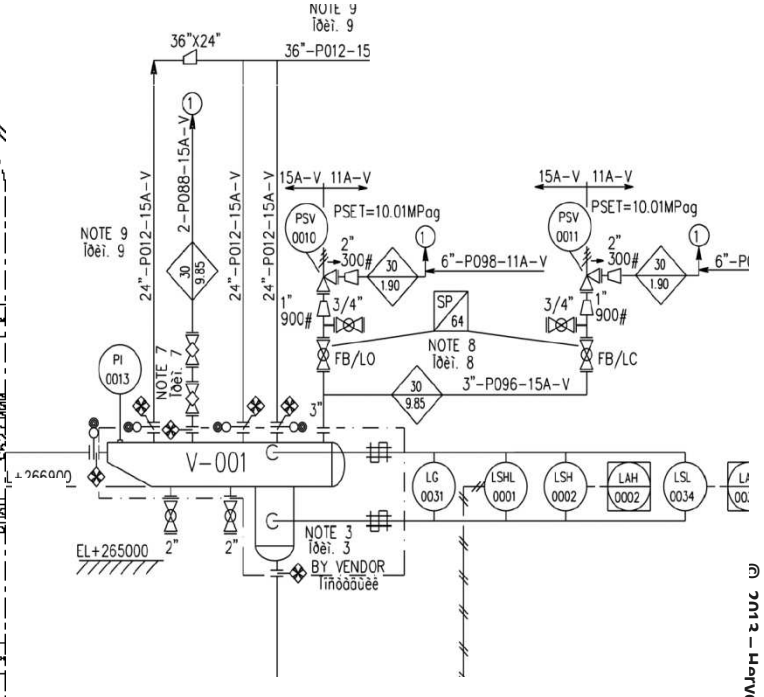
P&IDs

DESIGNATION	QTY	SECT.	INTER. DIAM. I.D. mm	HEIGHT T.L. to T.L. mm	DESIGN TEMP. °C	DESIGN PRESS. bar g.	MATERIALS
Debutanizer	1	T	4800	14125	98	24	
Deethanizer	1	T	2200	2520	89	24.5	
Absorber	1		1600	28400	94	14.7	
LPG Amine Absorber	1		2300	17000	80 / -29	32.5	
Fuel Gas Amine Absorber	1		1200	14900	85	10.2	

Equipment list

Plot Plan





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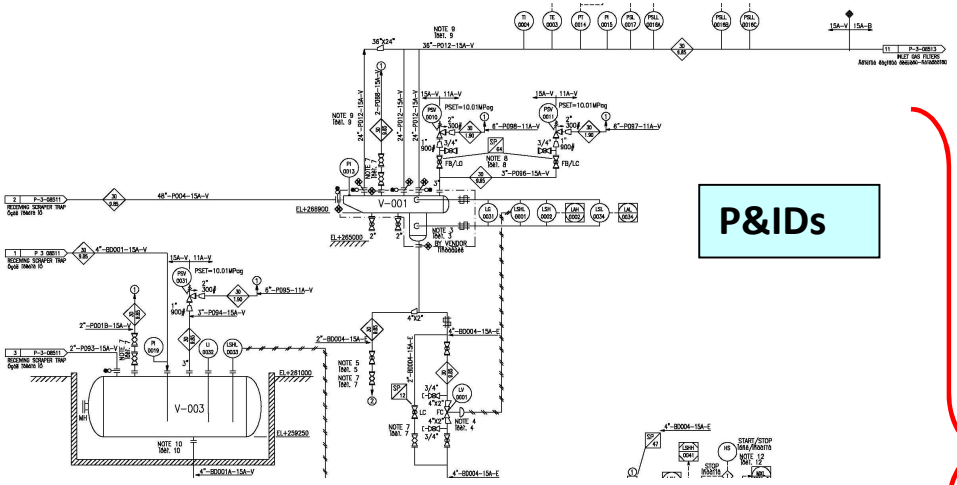
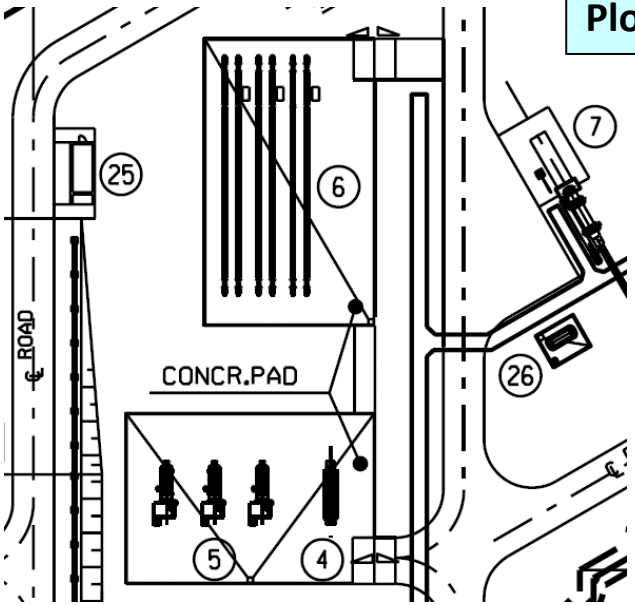
Cost estimate of Oil & gas facilities

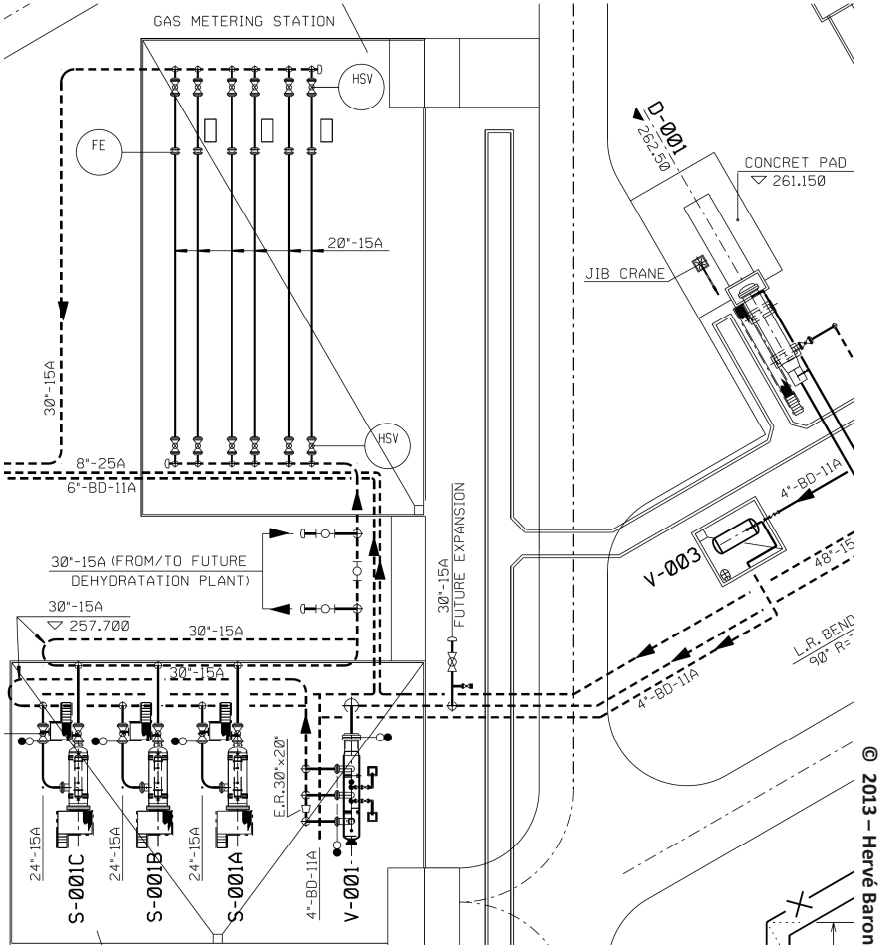


P&IDs

Plot Plan



Piping Layout



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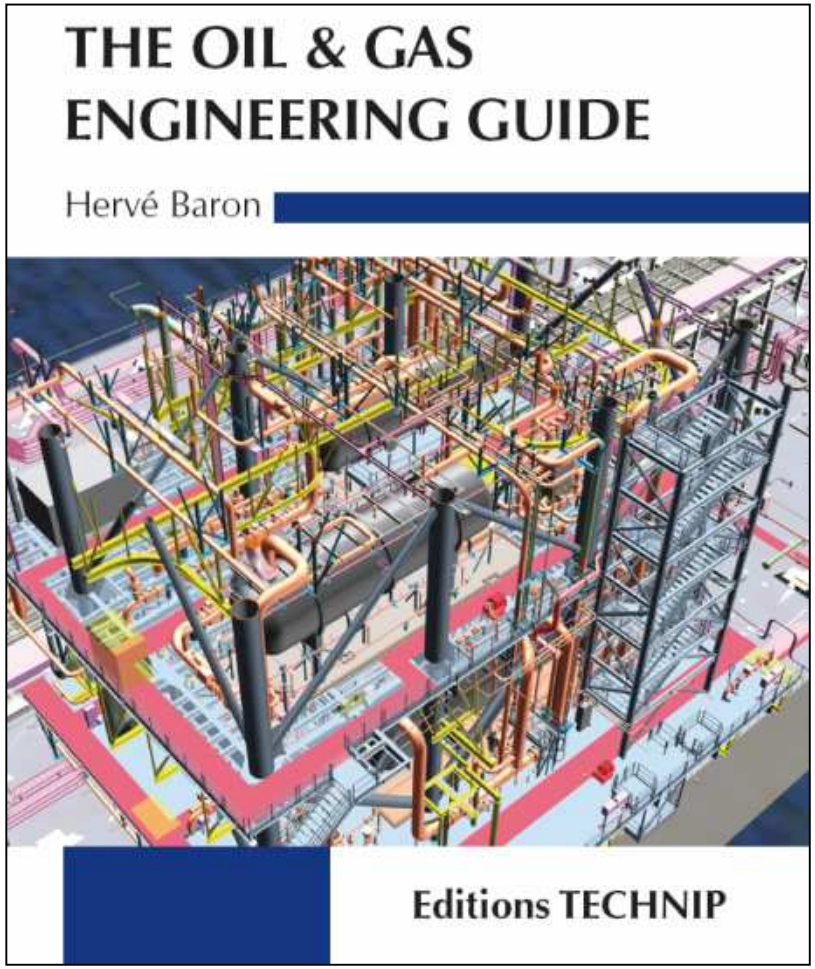
Cost estimate of Oil & gas facilities

For more information on Engineering, look up in:



A unique synthesis for the busy Project professional

200 pages, 250 illustrations

Piping supply + install

- Qty: MTO

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout
  - ➢ Both Process & Utility lines
  - ➢ Both Above Ground & Underground lines, Fire water

HERVE BARON

Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout
  - ➢ Both Process & Utility lines
  - ➢ Both Above Ground & Underground lines, Fire water

  Allowances added for:

HERVE BARON

Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout
  - ➢ Both Process & Utility lines
  - ➢ Both Above Ground & Underground lines

  Allowances added for:

  - what is not taken-off, e.g., small diameter and design development (P&ID completion) to obtain *quantities to erect*

HERVE BARON

Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout
  - ➢ Both Process & Utility lines
  - ➢ Both Above Ground & Underground lines

Allowances added for:

- what is not taken-off, e.g., small diameter and design development (P&ID completion) to obtain *quantities to erect*

Discipline	Category	%
Piping	All piping except valves	10
	Manual valves	5
	Motorised valves	0

Piping supply + install

- Qty: MTO
  - » Item count: P&IDs
  - » Lengths: Piping Layout
  - ➢ Both Process & Utility lines
  - ➢ Both Above Ground & Underground lines

Allowances added for:

- what is not taken-off, e.g., small diameter and design development (P&ID completion) to obtain *quantities to erect*

Discipline	Category	%
Piping	All piping except valves	10
	Manual valves	5
	Motorised valves	0

- cut and losses to obtain *quantities to be supplied*

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Cost estimate of Oil & ga

Piping supply + install

- Qty: ratio (eqt number, eqt weight)

  MTO

- Rate Supply

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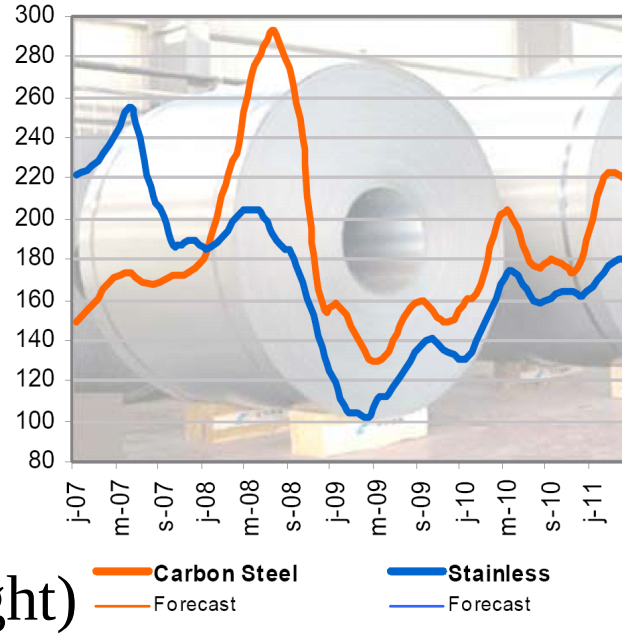
Cost estimate of Oil & gas facilities



Piping supply + install

- Qty: ratio (eqt number, eqt weight)
  MTO
- Rate Supply $ /kg, typ. USD 3 /kg for CS

HERVE BARON

Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio (eqt number, eqt weight)

  MTO

- Rate Supply $ /kg, typ. USD 3 /kg for CS

  Install

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Cost estimate of Oil & gas facilities

Piping supply + install

- Qty: ratio (eqt number, eqt weight)

  MTO

- Rate
  - Supply: $ /kg, typ. USD 3 /kg for CS
  - Install: std mhrs/ton, typ. 200-250 in unit,

    100 on interconnecting pipe-racks, applied to the total piping weight, including fittings & valves.

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Cost estimate of Oil & gas facilities

Electrical supply + install

- Price ratio % Main equipment, typ. 15-20%

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Cost estimate of Oil & gas facilities

Electrical supply + install

- Price ratio % Main equipment, typ. 15-20%
- Quantities: Consumers list
- Rate (supply+install): generation) USD 50k / consumer (w/o
  USD 520 / installed kW

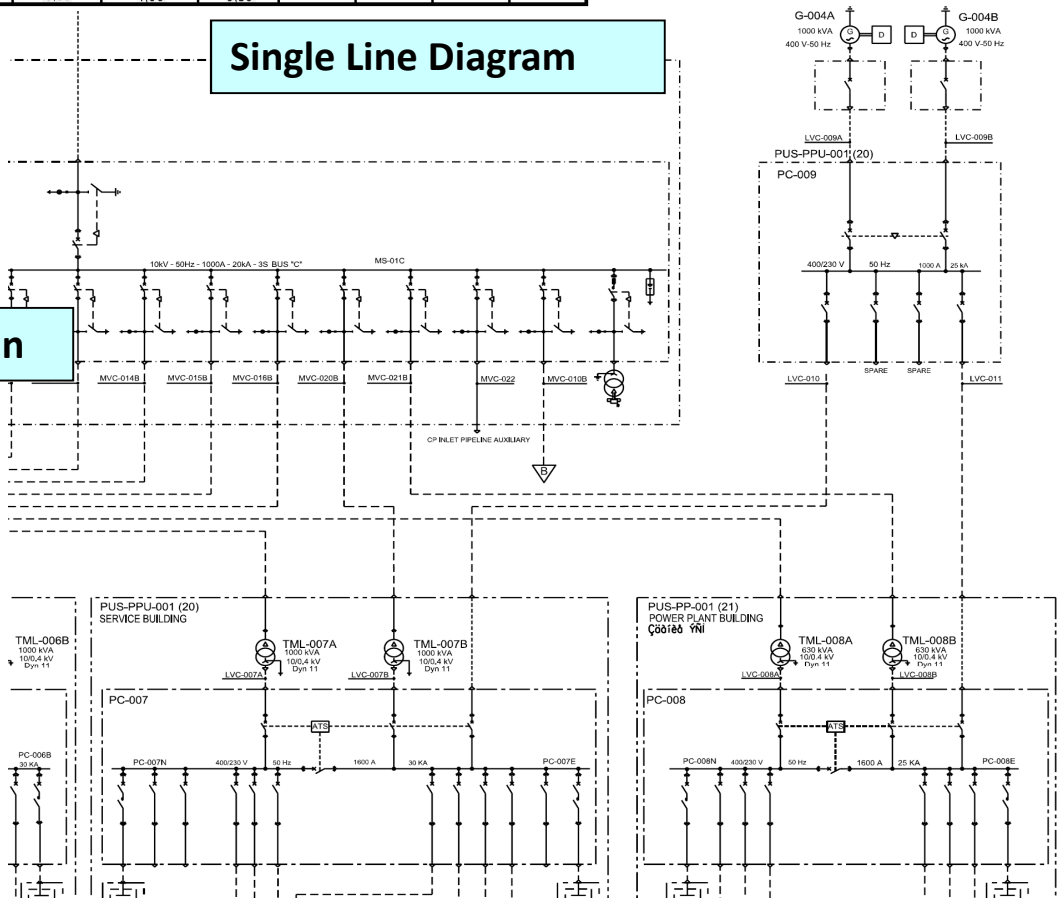
HERVE BARON

Cost estimate of Oil & gas facilities

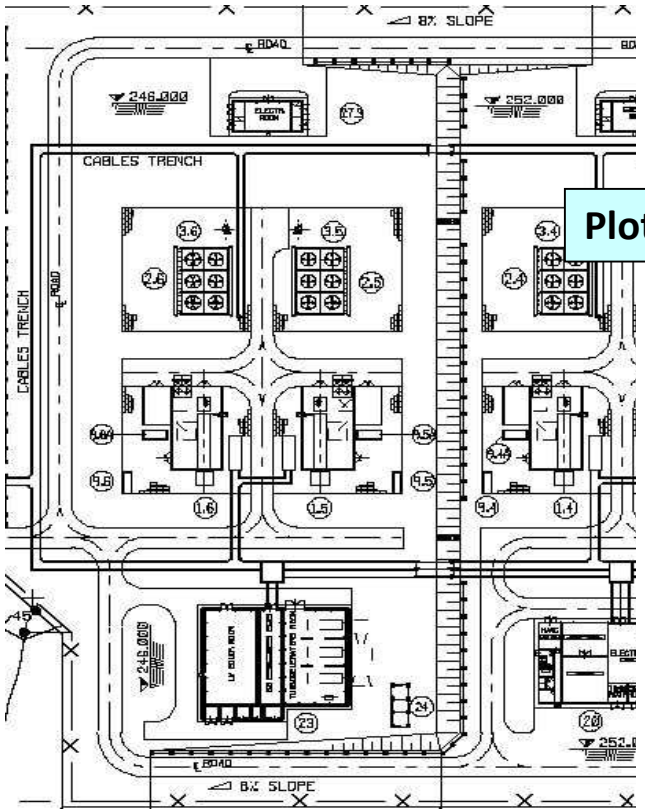
MV SWITCHGEAR MS-001A/B/C (V=10kV)														
Equipment No.	Description	Vital	Essential	Normal	Restarting	Duty Type	ABSORBED LOAD (A)	TRANSF. RATING (B)	LOAD FACTOR = A / B*100 (C)	EFFICIENCY AT LOAD FACTOR C (D)	POWER FACTOR AT LOAD FACTOR C	kW = A / D CONSUMED LOAD Continuous (E)		Intermittent (F)	
							kVA - *kW*	kVA	%	In decimal	cos fi	kW	kvar	kW	kvar
TML-001A	AIR COOLER TRANSFORMER 001A			X		C	726	1000	73		0,82	625	298	35	26
TML-001B	AIR COOLER TRANSFORMER 001B			X		S		1000							
TML-002A	AIR COOLER TRANSFORMER 002A			X		C	675	1000	67		0,81	600	287		
TML-002B	AIR COOLER TRANSFORMER 002B			X		S		1000							
TML-007A	PROD. POWER UNIT TRANSF. 007A			X		C	809	1000	81		0,83	529	357	225	173
TML-007B	PROD. POWER UNIT TRANSF. 007B			X		S		1000							
TML-008A	POWR. PLANT UNIT TRANSF. 008A			X		C	703	630	112		0,80	596	345	17	12
TML-008B	POWR. PLANT UNIT TRANSF. 008B			X		S		630							
	Feeder for external P/L load			X		C	*70*			1,00	0,80	70	53		
TML-010A	Supply to Fire building			X		C	230	400,00	0,58	1,00	0,90	230,00	111,39		
TML-010B	Supply to Fi							400,00	0,58	1,00	0,90				

Consumers list

Single Line Diagram



Plot Plan



HERVE BARON

Cost estimate of Oil & gas facilities

Consumers list

MV SWITCHGEAR MS-001A/B/C (V=10kV)

Equipment No.	Description	Vital	Essential	Normal	Restarting	Duty Type	ABSORBED LOAD (A)	TRANSF. RATING (B)	LOAD FACTOR = A / B*100 (C)	EFFICIENCY AT LOAD FACTOR C (D)	POWER FACTOR AT LOAD FACTOR C	kW = A / D CONSUMED LOAD Continuous (E)		Intermittent (F)	
							kVA - kW	kVA	%	In decimal	cos fi	kW	kvar	kW	kvar
TML-001A	AIR COOLER TRANSFORMER 001A			X		C	726	1000	73		0,82	625	298	35	26
TML-001B	AIR COOLER TRANSFORMER 001B			X		S		1000							
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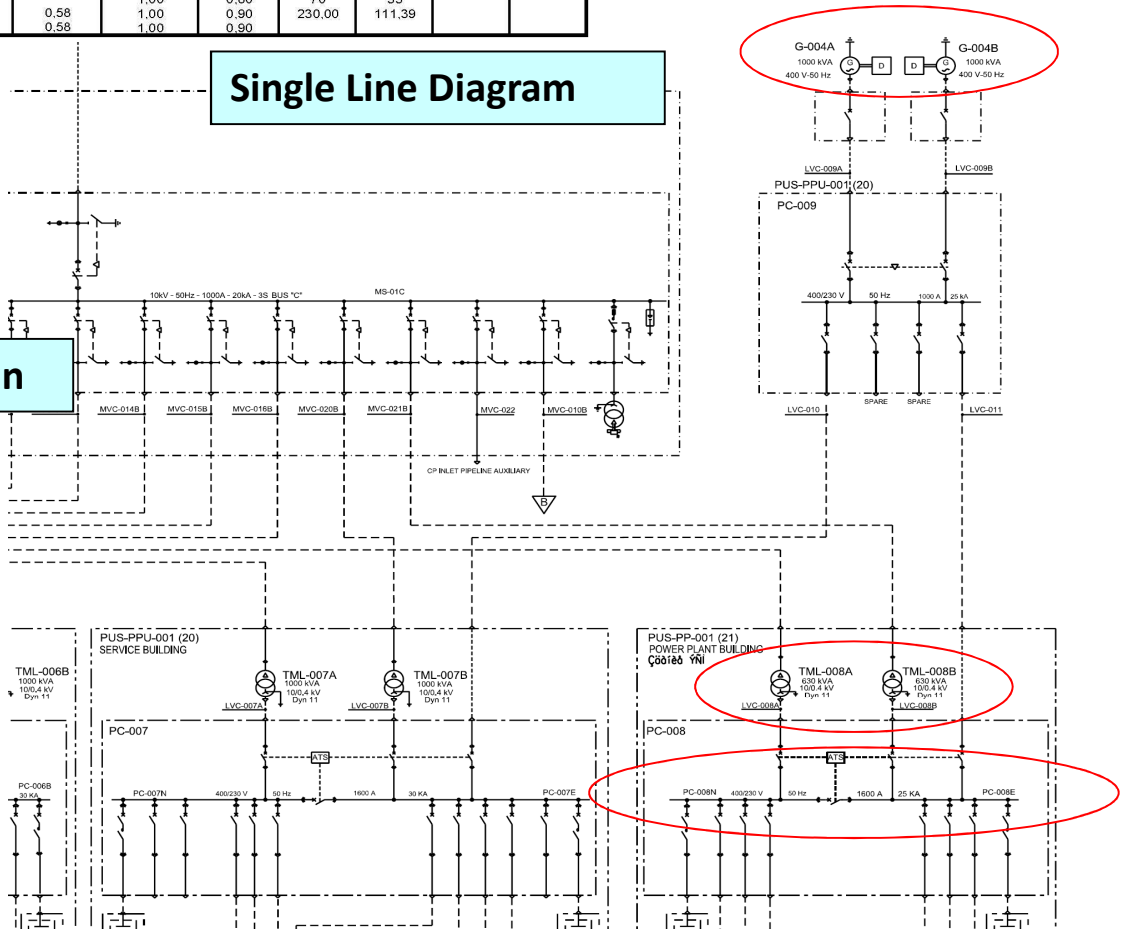
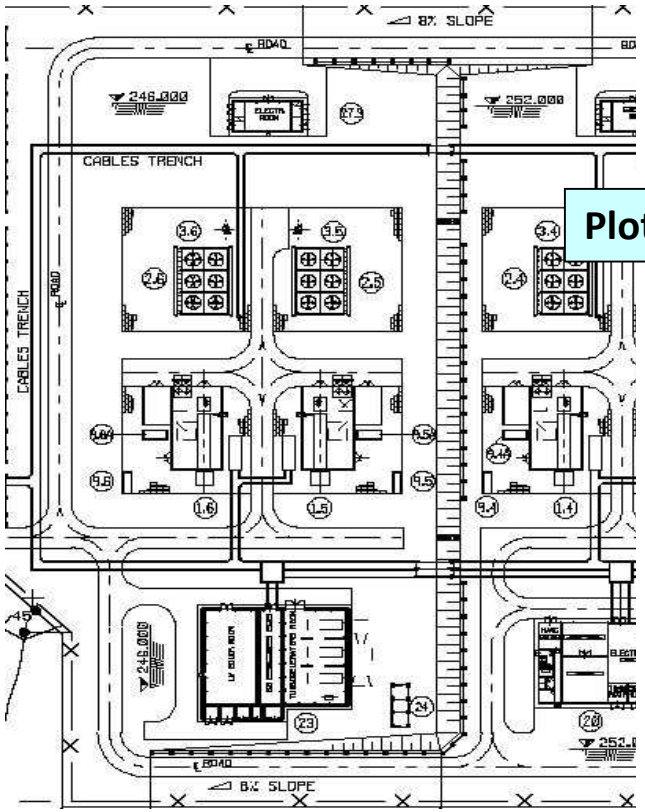
TML-008B	POWR. PLANT UNIT TRANSF. 008B			X		S		630							
	Feeder for external P/L load			X		C	70			1,00	0,80	70	53		
TML-010A	Supply to Fire building			X		C	230	400,00	0,58	1,00	0,90	230,00	111,39		
TML-010B	Supply to Fi							400,00	0,58	1,00	0,90				

Single Line Diagram



Plot Plan



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Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%

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Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties

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Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties nb equiv. loops (CV, 0.5 ON/OFF, Analyser)

HERVE BARON

Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties nb equiv. loops (CV, 0.5 ON/OFF, Analyser)
- Rate

HERVE BARON

Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties nb equiv. loops (CV, 0.5 ON/OFF, Analyser)
- Rate supply: $ /equivalent control loops, typ. 90k
  install: hrs / equivalent control loops, typ. 750

HERVE BARON

Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties Instrument list

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Cost estimate of Oil & gas facilities

Instrumentation & Control system supply + install

- Price ratio % Main equipment, range: 40-120%
- Qties Instrument list
- Rate Supply+install: $ / I/O, typ. 1000

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Cost estimate of Oil & gas facilities

Civil Works

- Price Ratio % Main equipment cost, typ. 15-20%

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Cost estimate of Oil & gas facilities

Civil Works

- Price Ratio % Main equipment cost, typ. 15-20%
- Qty

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Cost estimate of Oil & gas facilities

Civil Works

- Price Ratio % Main equipment cost, typ. 15-20%
- Qty Dimensions/Weight of equipment & structure => size of foundations (m3)

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Cost estimate of Oil & gas facilities

Civil Works

- Price Ratio % Main equipment cost, typ. 15-20%
- Qty Dimensions/Weight of equipment & structure => size of foundations (m3)
- Rate

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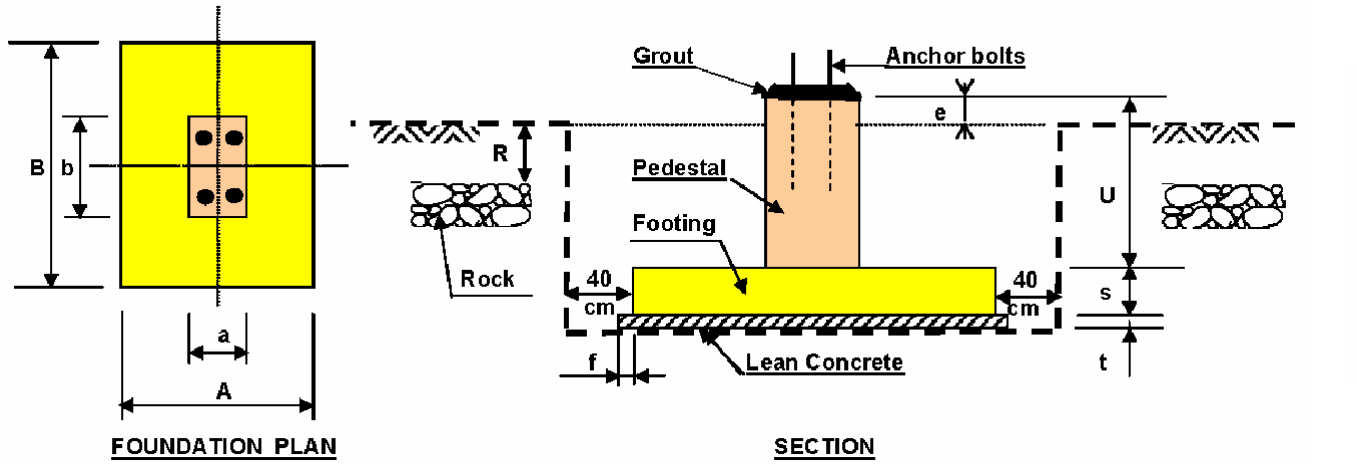
Cost estimate of Oil & gas facilities

Civil Works

- Price Ratio % Main equipment cost, typ. 15-20%
- Qty Dimensions/Weight of equipment & structure => size of foundations (m3)
- Rate all-in (materials & labour) rate $/m3, typ. 1000

HERVE BARON

Cost estimate of Oil & gas facilities



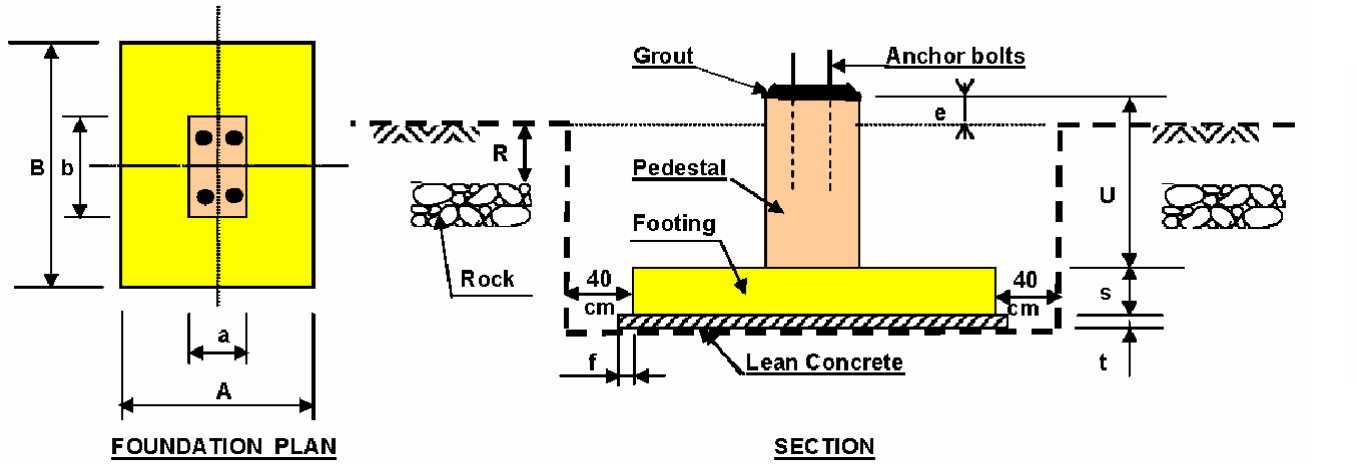
Civil Works

- Price Ratio — % Main equipment cost, typ. 15-20%
- Qty — MTO: excavation, formwork, rebar, etc.

Steel Pipe Racks Foundations	TOTAL CONCRETE	Section excavations by machine in earth	Backfill	Steel Reinforcement		Anchor Bolts 4 ϕ 33 / unit	Non-shrink Grout 25 mm thick	Lean Concrete "1"	Foundation concrete	Surface treatment of foundation
	VOLUME by dimens.	Down to 2 m depth	From Excavation	Rebars for footings	Rebars for pedestals					
	(m^3)	(m^3)	(m^3)	(kg)	(kg)	(kg)	(m^2)	(m^2)	(m^3)	(m^2)
105-PR-03	130	445	296	9 504	1 078	818	11	225	130	445

HERVE BARON

Cost estimate of Oil & gas facilities



Civil Works

- Price Ratio — % Main equipment cost, typ. 15-20%
- Qty — MTO: excavation, formwork, rebar, etc.
- Rate — Mhrs/operation + labour cost

Steel Pipe Racks Foundations	TOTAL CONCRETE	Section excavations by machine in earth	Backfill	Steel Reinforcement		Anchor Bolts 4 ϕ 33 / unit	Non-shrink Grout 25 mm thick	Lean Concrete "1"	Foundation concrete	Surface treatment of foundation
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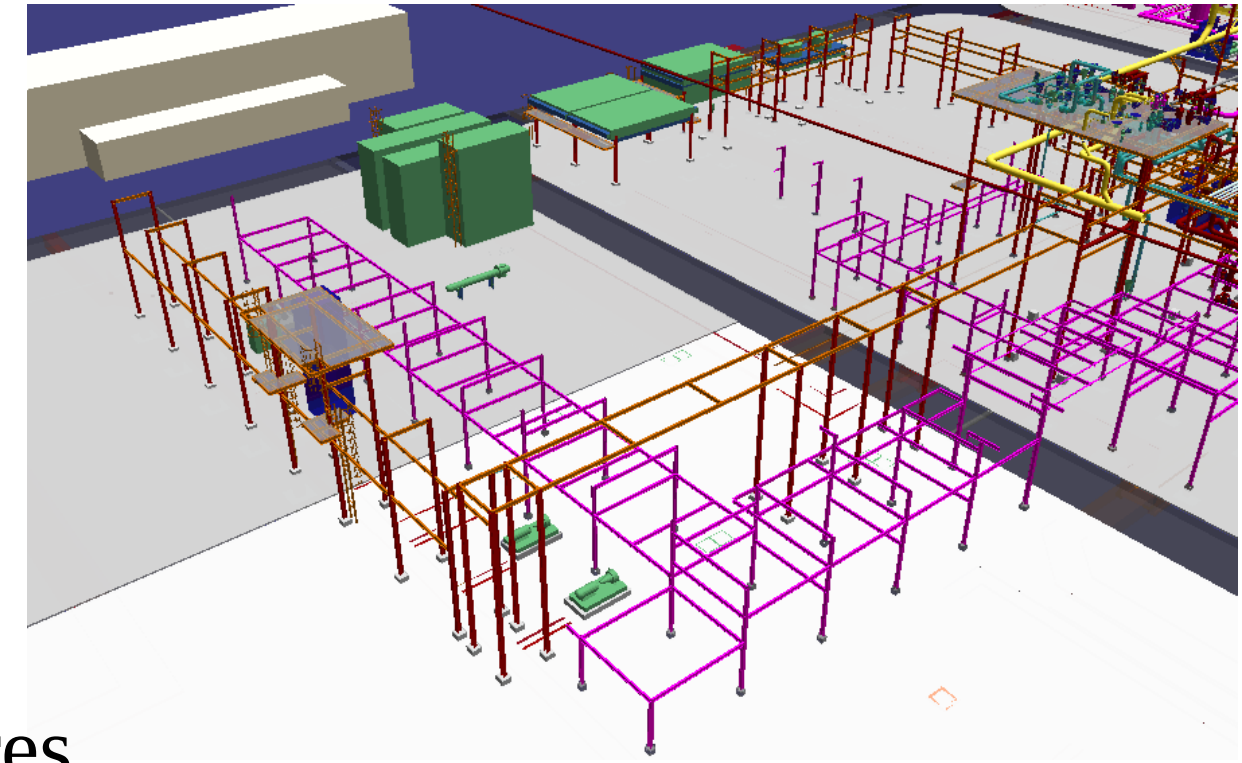
HERVE BARON

Cost estimate of Oil & gas facilities



Steel structures

- Price Ratio % Main equipment cost, typ. 10-30%

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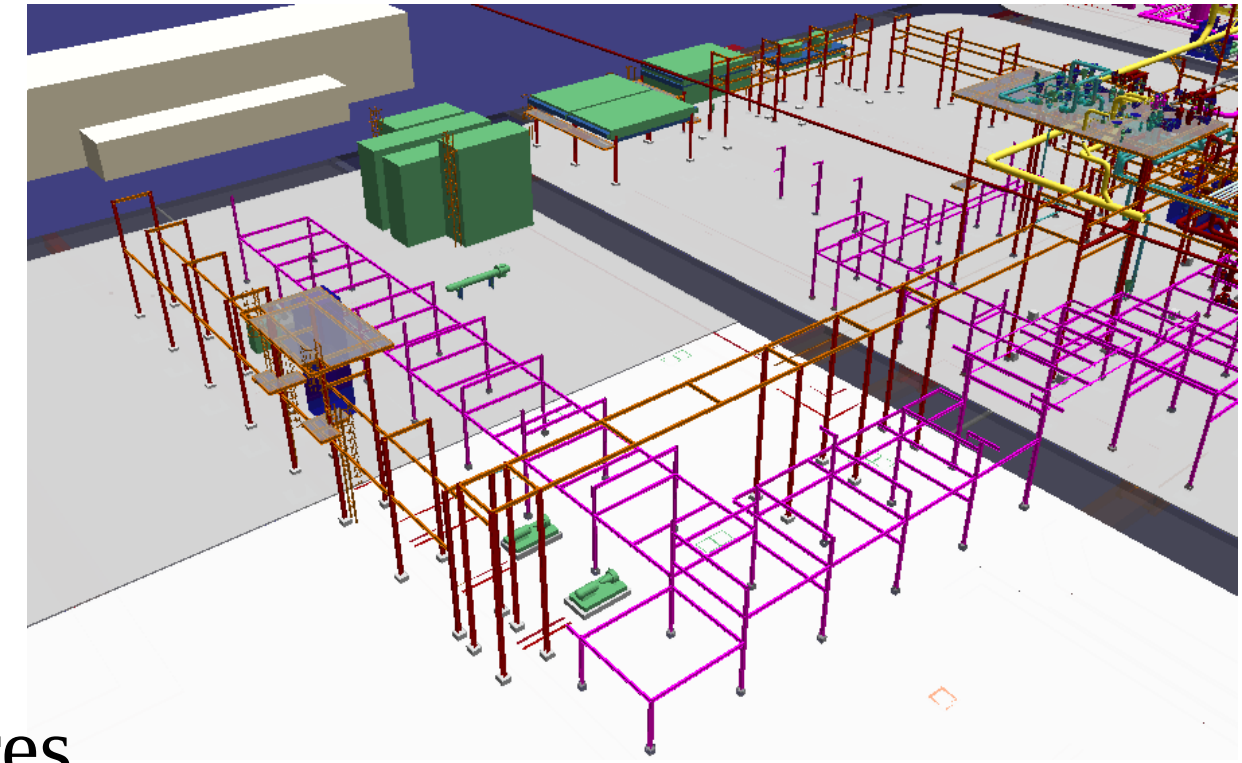
Cost estimate of Oil & gas facilities



Steel structures

- Price Ratio % Main equipment cost, typ. 10-30%
- Qty Ratio

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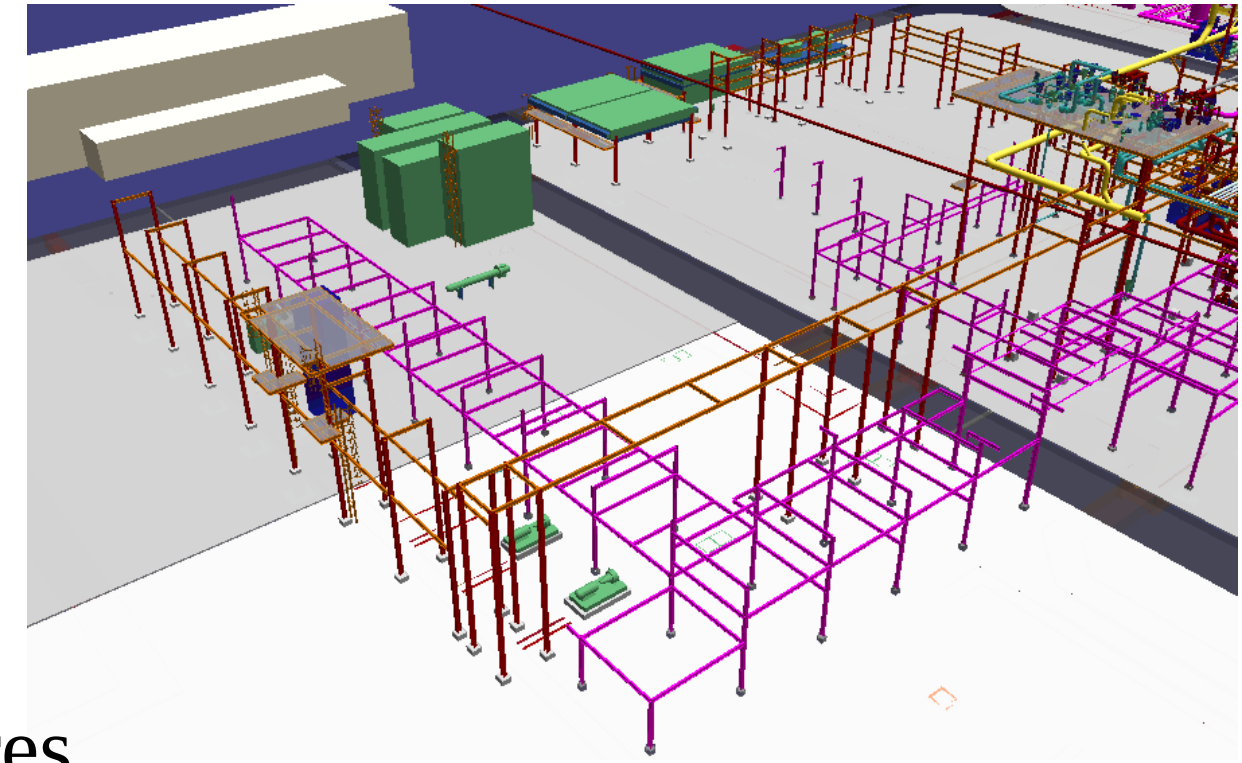
Cost estimate of Oil & gas facilities



Steel structures

- Price Ratio
- Qty Ratio

% Main equipment cost, typ. 10-30%

pipe-racks: 90% of piping weight

platforms: 10% of equipment weight

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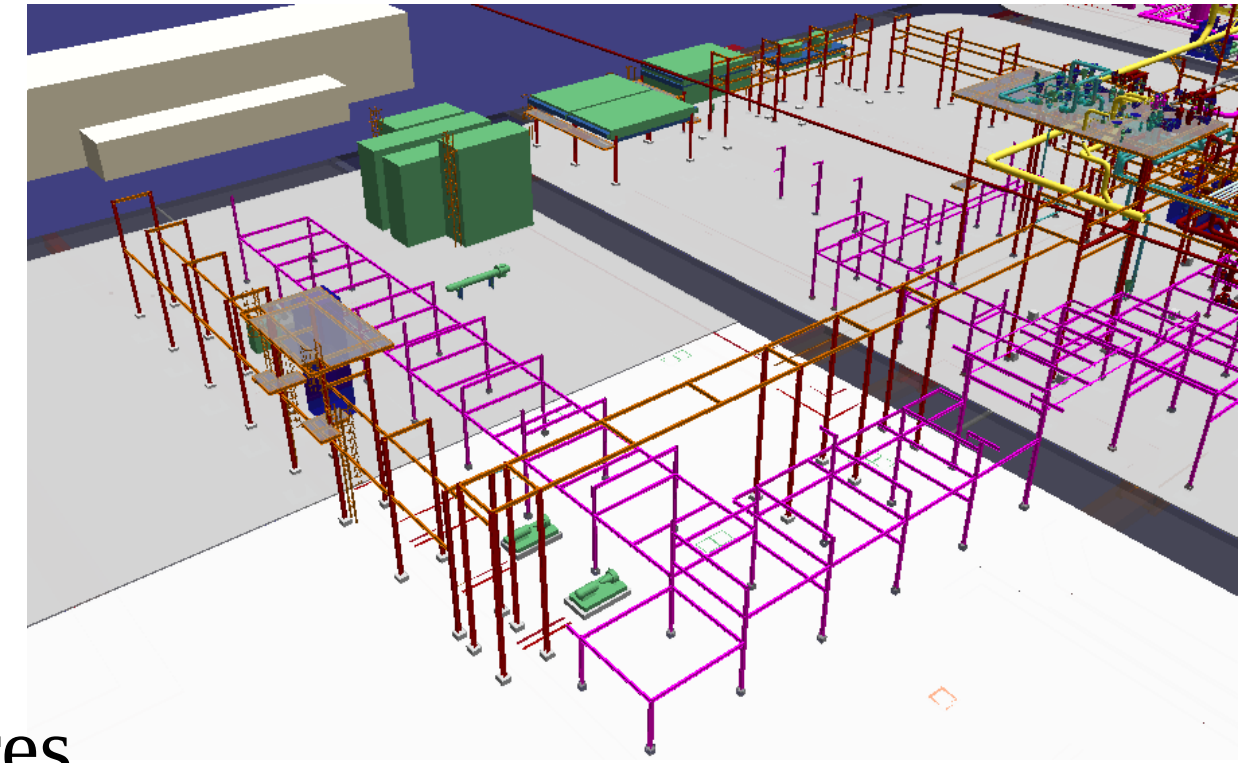
Cost estimate of Oil & gas facilities

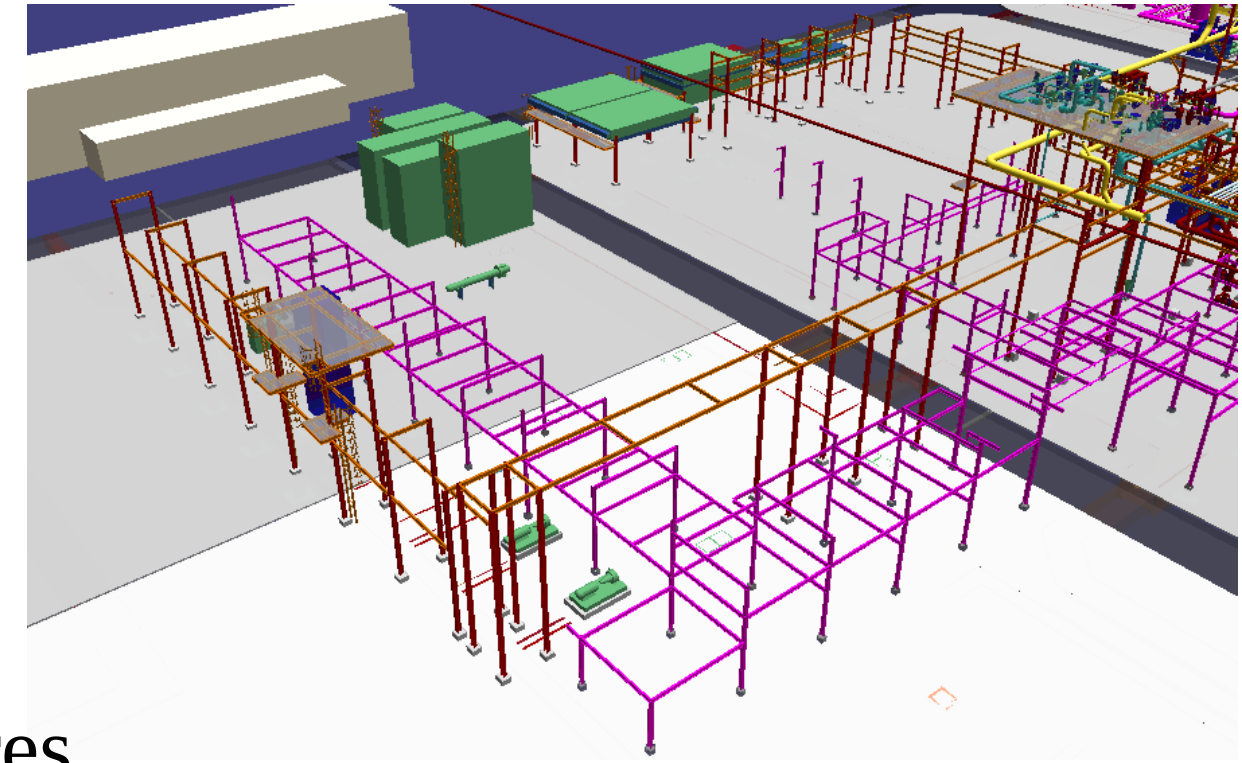


Steel structures

- Price Ratio — % Main equipment cost, typ. 10-30%
- Qty Ratio — pipe-racks: 90% of piping weight
  platforms: 10% of equipment weight
- Rate

HERVE BARON

Cost estimate of Oil & gas facilities



Steel structures

- Price Ratio — % Main equipment cost, typ. 10-30%
- Qty Ratio — pipe-racks: 90% of piping weight
  platforms: 10% of equipment weight
- Rate — Supply USD 2/kg
  Erection 20 std manhours/t

HERVE BARON

Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation

HERVE BARON

Cost estimate of Oil & gas facilities

- Painting, Insulation
  - Price ratio % eqt, piping, str cost, typ. 5% each

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Cost estimate of Oil & gas facilities

- Painting, Insulation
  - Price ratio % eqt, piping, str cost, typ. 5% each
  - Qty MTO

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Cost estimate of Oil & gas facilities

- Painting, Insulation
  - Price ratio — % eqt, piping, str cost, typ. 5% each
  - Qty — MTO
  - Rate — supply + install h / m2
    typ. 0,5 for painting 1,5 for (hot) insul.

HERVE BARON

Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous

HERVE BARON

Cost estimate of Oil & gas facilities

- Temporary Construction facilities
  - Ratio % total cost, typ. 5% for new site
  - Detailed

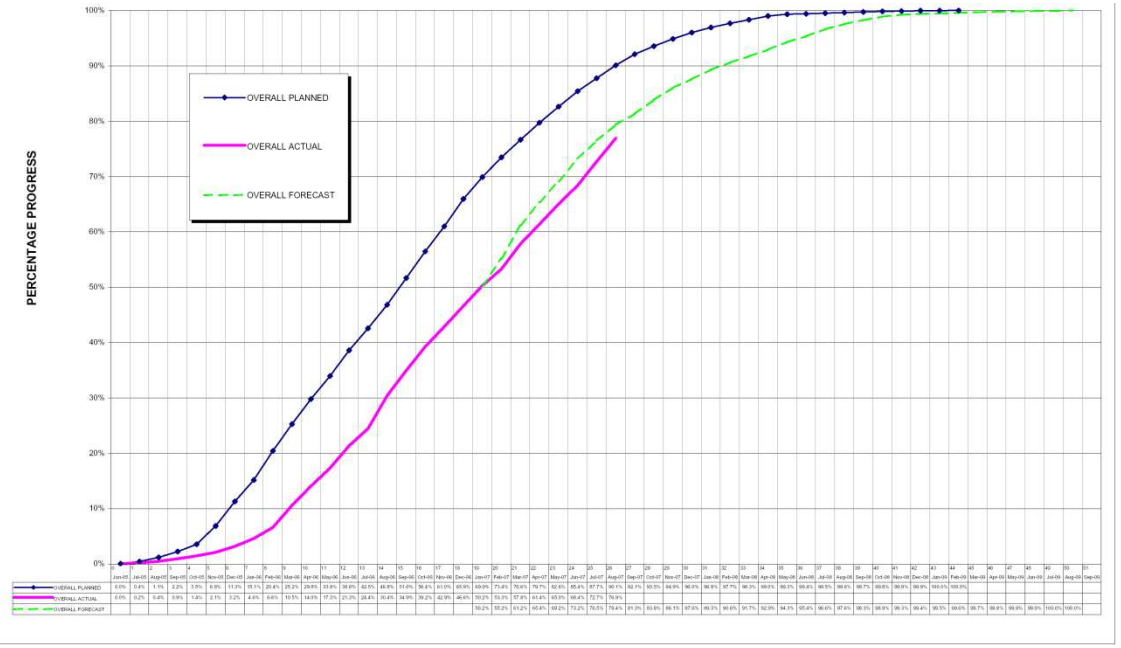
HERVE BARON

Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous

HERVE BARON

Cost estimate of Oil & gas facilities



- Engineering & Project Management = all Project services
  - Price ratio % total cost, typ. 15%

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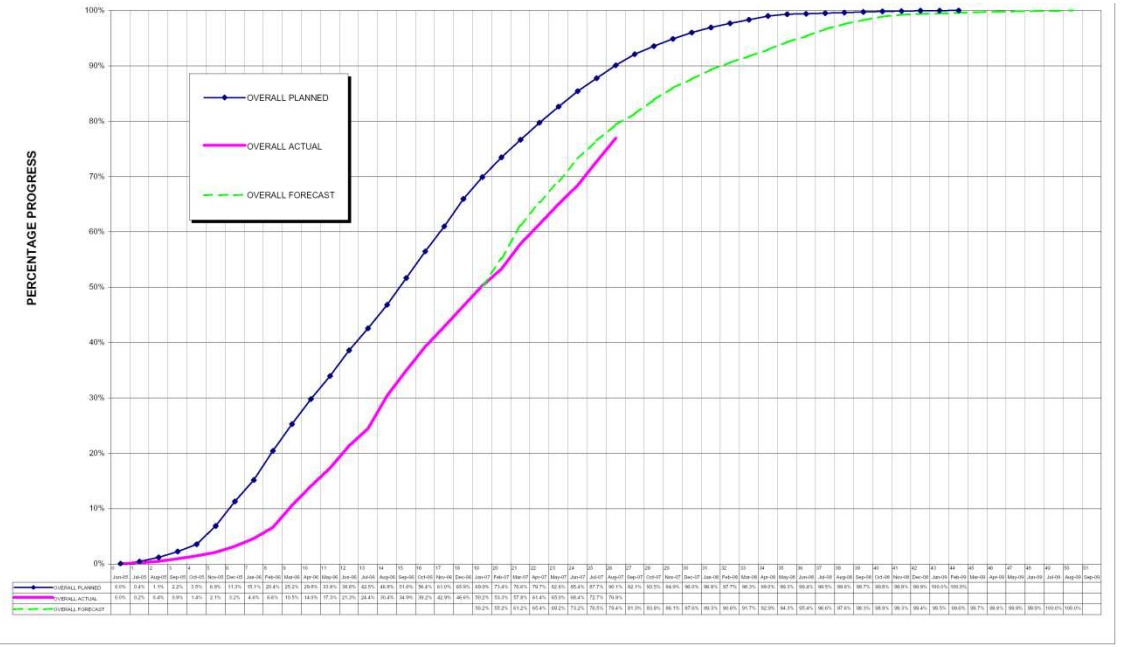
Cost estimate of Oil & gas facilities



- Engineering & Project Management = all Project services
  - Price ratio % total cost, typ. 15%
  - Qty ratio

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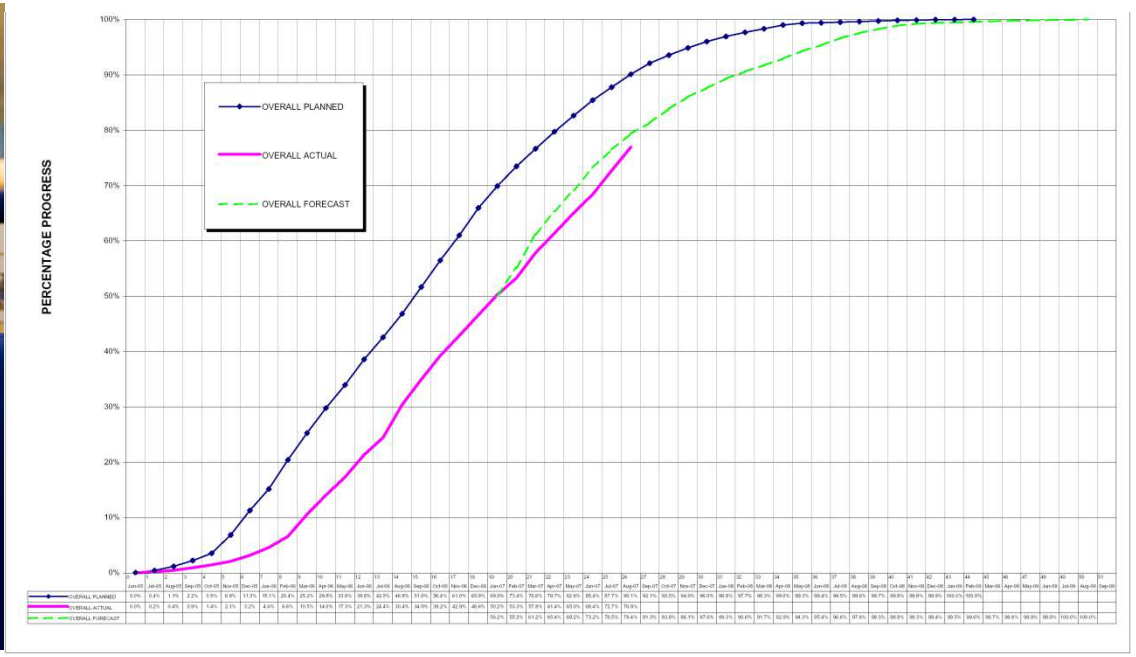
Cost estimate of Oil & gas facilities



- Engineering & Project Management = all Project services
  - Price ratio % total cost, typ. 15%
  - Qty ratio hrs / eqt item, typ. 1800 for Refining, 2500 for gas, 4000 for LNG

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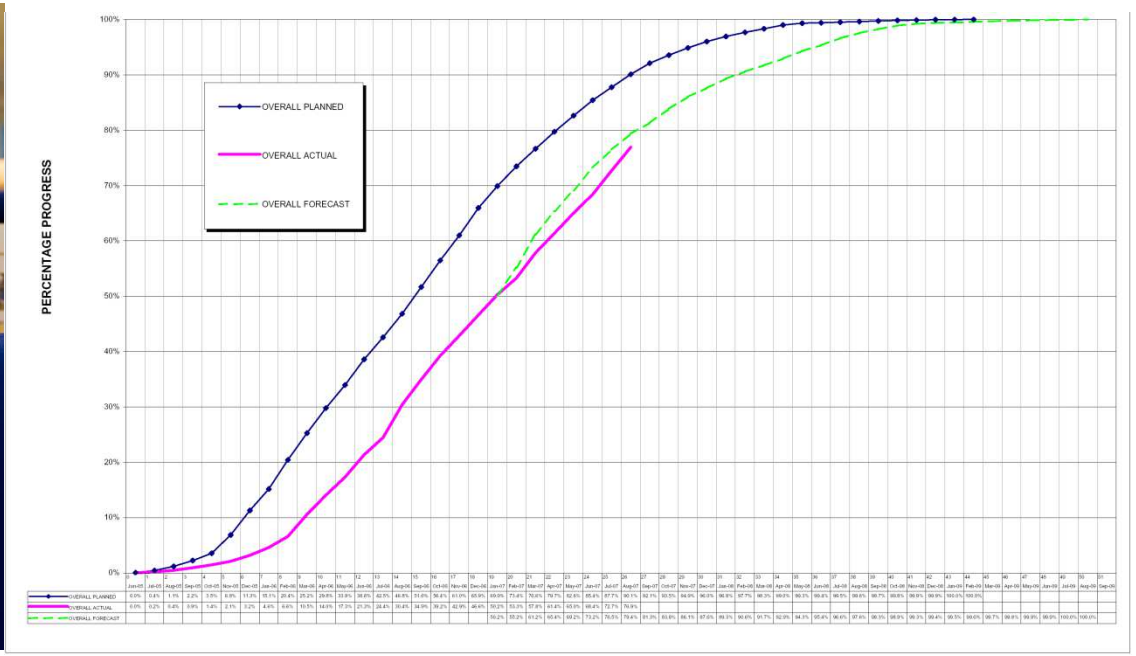
Cost estimate of Oil & gas facilities



- Engineering & Project Management = all Project services
  - Price ratio % total cost, typ. 15%
  - Qty

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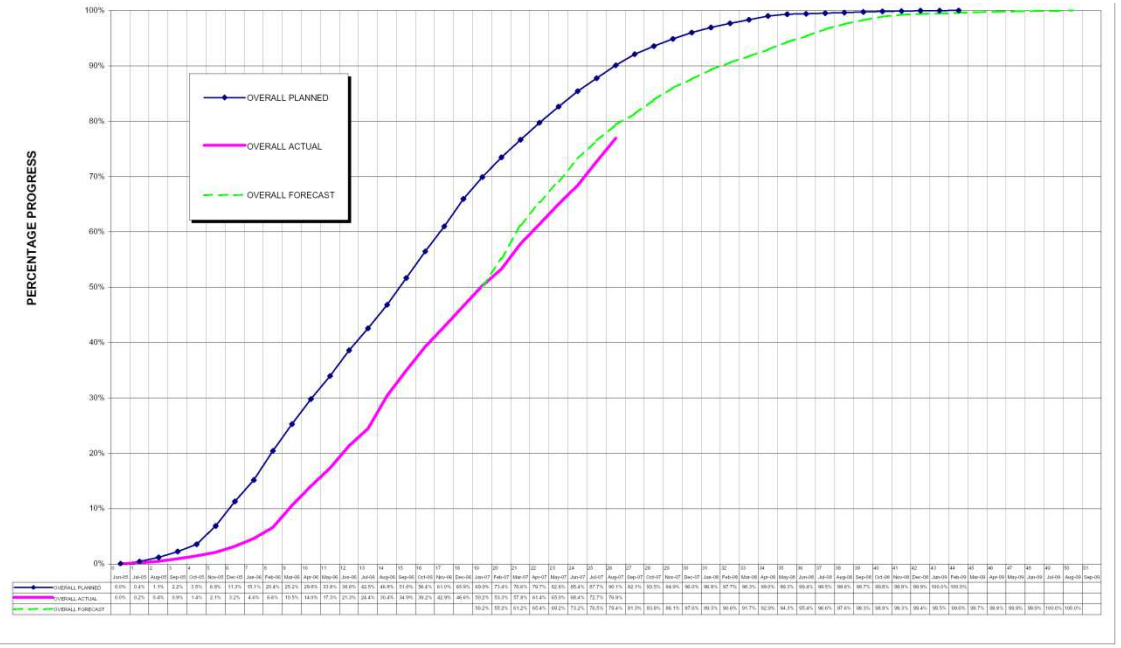
Cost estimate of Oil & gas facilities



- Engineering & Project Management = all Project services
  - Price ratio — % total cost, typ. 15%
  - Qty — home office: tasks list + std manhours
    field supervision: ratio to labour, typ. 1/7

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Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous
  - Contractor's cost

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Cost estimate of Oil & gas facilities

- Miscellaneous
  - Earthworks: always specific
  - Special foundations
  - Infrastructures: roads, buildings
  - Spare parts, typ. 5% main equipment cost
  - First fill (catalyst, lubes, chemicals)

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Cost estimate of Oil & gas facilities

- Analytical
  - Main equipment supply + install
  - Piping supply + install
  - Electrical supply + install
  - Instrumentation & Control system supply + install
  - Civil Works
  - Steel structures
  - Painting, Insulation
  - Temporary construction facilities
  - Engineering & Project Management
  - Miscellaneous
  - Contractor's cost

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Cost estimate of Oil & gas facilities

- Contractor's cost
  - profit,
  - risks,
  - sales cost,

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Cost estimate of Oil & gas facilities

- Contractor's cost
  - profit, typ. 7%
  - risks,
  - sales cost,

  typ. 10-15%

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Cost estimate of Oil & gas facilities

- Main equipment supply + install
- Piping supply + install
- Electrical supply + install
- Instrumentation & Control system supply + install
- Civil Works
- Steel structures
- Painting, Insulation
- Temporary construction facilities
- Engineering & Project Management
- Miscellaneous: catalysts etc.
- Contractor's cost

Typical breakdown of overall facility cost	
Project Services	15
Equipment & materials supply	40
Construction	30
Contractor'sn profit, risks, sales cost etc.	15
TOTAL	100

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Cost estimate of Oil & gas facilities

Main features:

- Different level of Cost estimate accuracy
  - Feasibility study +/-30% accuracy
  - Final Investment Decision (FID) +/- 10%

Which of the methods we have seen would you use for each case?

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Cost estimate of Oil & gas facilities

Main concepts:

- Different level of Cost estimate accuracy
- Factored / Detailed
- Qty estimate: allowances for design development
- Rates:
  - In-house historical data – similar Plant
  - Cost estimate: Contingencies for cost escalation
  - Inquiries + provisions for cost adders (supplies), additional works/re-works (construction)
- Direct costs / Indirect costs

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Cost estimate of Oil & gas facilities

Historical evolution:

+ Increased instrumentation & control costs

- Engineering low cost centers

- Low cost sourcing – 20% cheaper

- Increase in productivity (3D model)

+ Additional requirements: safety, environment

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Cost estimate of Oil & gas facilities

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