



# المؤتمر الدولي العلمي الحادي عشر للهندسة الكيميائية الخضراء حول "أثر تحولات الطاقة على حماية البيئة في ظل تحقيق أهداف التنمية المستدامة"

01 - 03 يوليو 2024

القاهرة – جمهورية مصر العربية

**FLARE RECOVERY MULTI APPROACHES – PETROJET**

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## INTRODUCTION



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IT ALL STARTS WITH ...



المنظمة العربية للتنمية الإدارية  
جامعة الدول العربية



**A FLARE!**

What Comes to **our minds** , when we first see a ....

The art and science of asking questions is the source of all knowledge.

- Thomas Berger



**A FLARE !?**



**CAIRO – 24 July 2017: Media reports circulated photos of a gas flame was reportedly seen for the first time coming from the Zohr gas field in the Mediterranean. EGYPT TODAY**

**Minister of Petroleum and Mineral Resources Eng. Tarek El Molla** stated the project's plan aims to produce about :

- **1 BCFD** in the first stage by the end of **2017**,
- While it will reach about **2.7 BCFD** by the end of **2019**.



Although EGYPT is not an importer of energy .  
, it approximately flares .



**5 %**  
**EGYPT'S**  
**Energy Needs**

**\$250 million,**  
*(World Bank)*

**5.66 (MSCM/D) ↓ of Natural Gas**  
**20 Gas (As planning countries) . [GGFR]**

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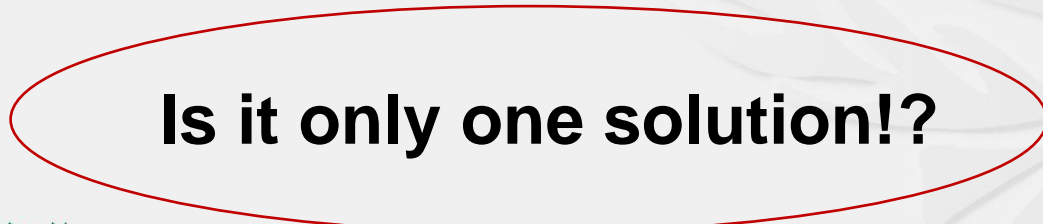
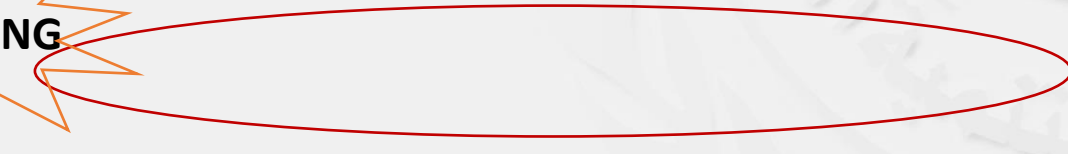
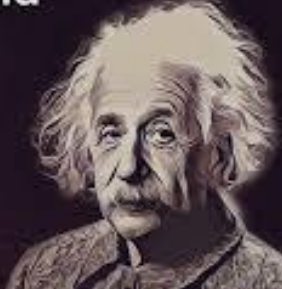
What is the Flare !?



Why Do We Flare !? !?



If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions.  
- Albert Einstein



Is it only one solution!?





# GAS FLARING DEFINITION & PURPOSE



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SCHE

Flares are primarily used for burning off flammable gas released by pressure relief valves during any over-pressure scenario of plant process unit/equipment, due to process upset or during startups & shutdowns and for the planned combustion of gases over relatively short periods of time at a refinery or petrochemical plant to ensure the safe and efficient disposal of relieved gases or liquids.

## What is the Solution !?



Flare Recovery

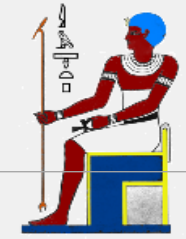
Multi-Approaches

## What is the Flare !?





## GAS FLARE RECOVERY



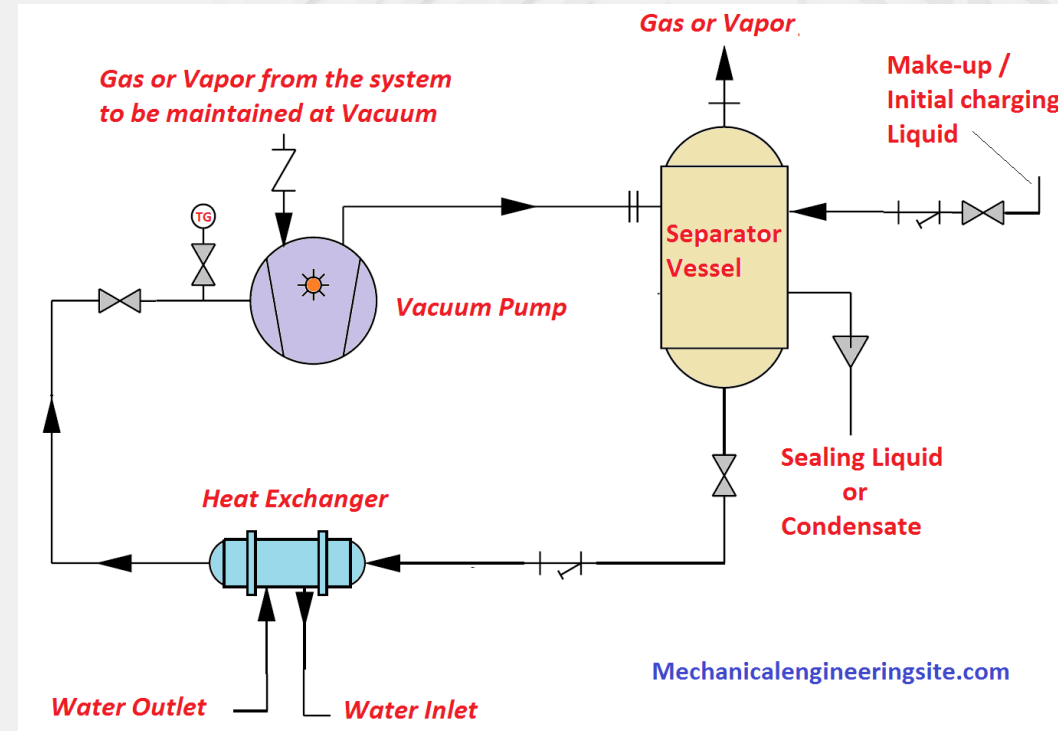
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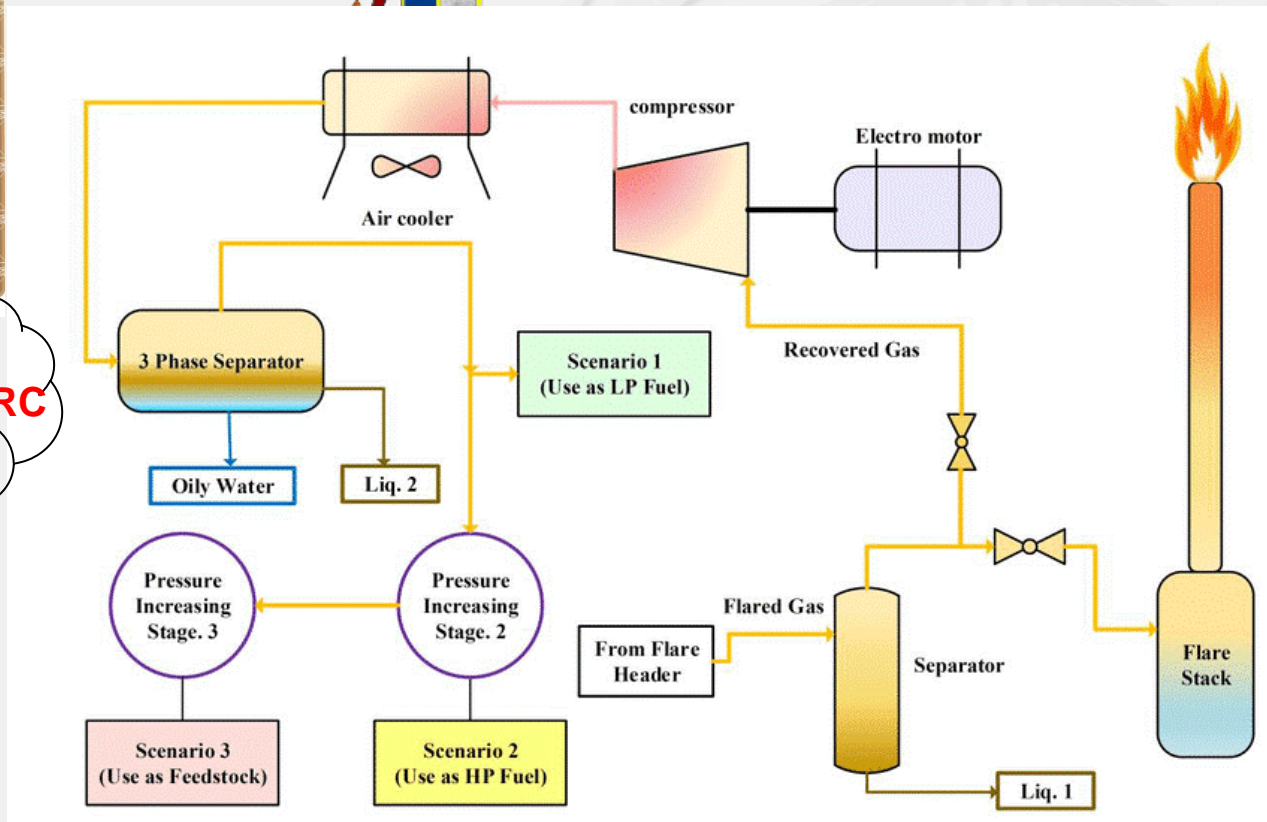
- A liquid-ring compressor is ideal for flare gas or off gas.
- Such gas usually contains liquids, dust and dirt particles.
- Intensive contact between gas and operating fluid enables nearly isothermal compression.
- A liquid-ring compressor can withstand with ease wet process streams and fouling that would **DAMAGE** other mechanical compressors.







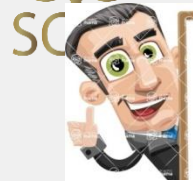
How can we utilize the LRC for an FRU?



- A liquid-ring compressor Scheme Main Components;
- A liquid separator compressor Scheme can Produce ;
  - Liquid Ring Compressor (Stages according to required produced Gas Specs)
  - LP Fuel Gas (only one stage compressor)
  - After Cooler (Additional compressor stage)
  - HP Fuel Gas (Additional compressor stage)
  - Feed Stock for SALES ( Additional 3<sup>rd</sup> compression stage)
  - Additional Compression stages ( According to scenarios)



# GAS FLARE RECOVERY- 1<sup>st</sup> APPROACH



**Sweet  
Associated  
Flare  
Gas  
Recovery**

**GAS  
805.5 Kg/hr.**

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	Overall	Vapour Phase	Liquid Phase
Vapour / Phase Fraction	1.0000	1.0000	0.0000
Temperature: (C)	33.35	33.35	33.35
Pressure: (kg/cm <sub>2</sub> _g)	5.665	5.665	5.665
Molar Flow (Nm <sup>3</sup> /h(gas))	643.3	643.3	0.0000
Mass Flow (kg/h)	738.0	738.0	0.0000
Std Ideal Liq Vol Flow (m <sup>3</sup> /h)	1.854	1.854	0.0000
Molar Enthalpy (kJ/kgmole)	-9.289e+004	-9.289e+004	-2.093e+005
Molar Entropy (kJ/kgmole-C)	171.2	171.2	55.83
Heat Flow (Mkcal/h)	-0.6372	-0.6372	0.0000
Liq Vol Flow @Std Cond (barrel/day)	2.407e+005	2.407e+005	0.0000

Water
Temperature 101.7 C
Pressure 288.3 kg/cm <sub>2</sub> _g
Molar Flow 32.90 Nm <sup>3</sup> /h(gas)

Water

**2299 Kg**

Material Streams					
	Blend-1	Water	Well stream 2	Gas	Liquid
Vapour Fraction	0.0000	0.0000	0.0000	0.7380	1.0000
Temperature C	101.7	101.7	93.27	33.35	33.35
Pressure kg/cm <sub>2</sub> _g	288.3	288.3	288.3	5.665	5.665
Molar Flow Nm <sup>3</sup> /h(gas)	218.3	32.90	921.0	679.9	241.0
Mass Flow kg/h	1461	26.44	2299	2299	149
Liquid Volume Flow m <sup>3</sup> /h	1.795	0.0285	1.778	1.778	1.83
Heat Flow Mkw/h	-0.8110	-0.0175e-002	-1.584	-1.584	-0.0709

COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)
Nitrogen	5.5155	0.007382	154.51
Oxygen	0.00000	0.000000	0.00000
CO	0.00000	0.000000	0.00000
CO2	12.047	0.01848	529.97
Water	0.00000	0.000000	0.00000
Propane	0.00000	0.000000	0.00000
i-Butane	0.00000	0.000000	0.00000
LP Separator	78.47	0.640430	7676.0
Other	0.00000	0.000000	0.00000

COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION
Nitrogen	0.21951	0.007648	6.1491	0.008332
Oxygen	0.00000	0.000000	0.00000	0.000000
CO	0.00000	0.000000	0.00000	0.000000
CO2	0.46526	0.016210	20.476	0.027744
Ammonia	0.00000	0.000000	0.00000	0.000000
H2S	0.00000	0.000000	0.00000	0.000000
H2O	0.22668	0.007898	4.0837	0.005533
Hydrogen	0.00000	0.000000	0.00000	0.000000
Methane	18.949	0.660194	304.00	0.411900
Ethylene	0.00000	0.000000	0.00000	0.000000

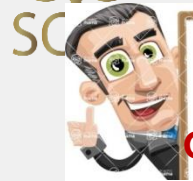
COMPONENTS	MOLAR FLOW (kgmole/h)	MOLE FRACTION	MASS FLOW (kg/h)	MASS FRACTION
2-Mpentane	0.00000	0.000000	0.00000	0.000000
3-Mpentane	0.00000	0.000000	0.00000	0.000000
n-Hexane	11.049	0.014789	952.19	



# GAS FLARE RECOVERY- 2<sup>nd</sup> APPROACH



الجامعة العراقية للعلوم والتكنولوجيا  
جامعة القادسية

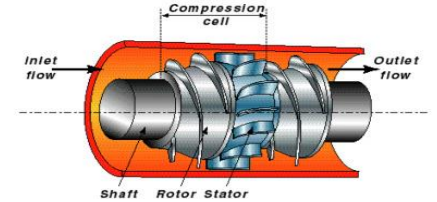
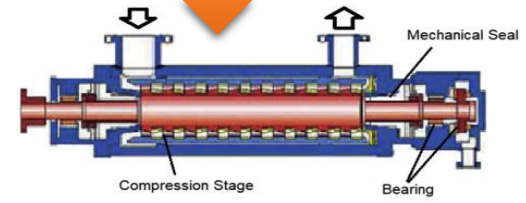
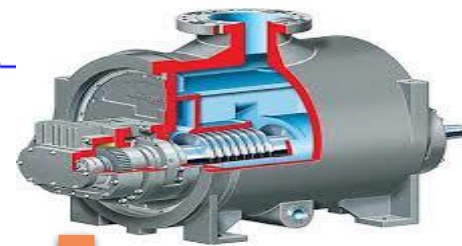


Upstream Multiphase Pump Recovery



NO TIME , NO COST AND NO USAGE AT WELLS SITE !!!

HEAT



Well stream Gas	
Temperature	101.7 C
Pressure	288.3 kg/cm <sup>2</sup> _g
Molar Flow	781.5 Nm <sup>3</sup> (gas)

Blend-1	
Temperature	101.7 C
Pressure	288.3 kg/cm <sup>2</sup> _g
Actual Volume Flow	2.714 m <sup>3</sup> /h

water	
Temperature	101.7 C
Pressure	288.3 kg/cm <sup>2</sup> _g
Actual Volume Flow	2.758002 m <sup>3</sup> /h

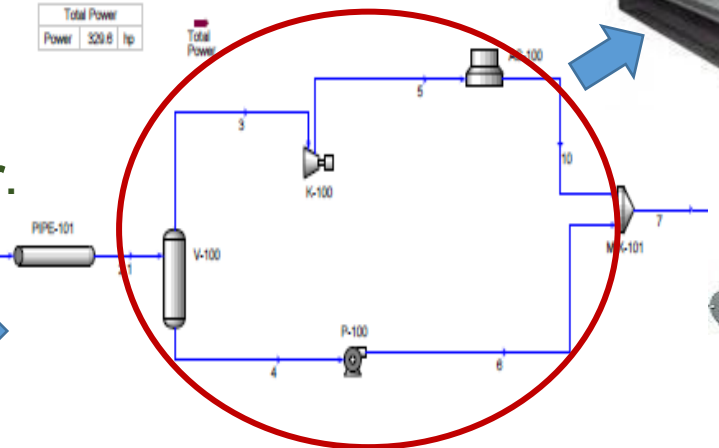
2299 Kg/hr.

805.5 Kg/hr

1461 Kg/hr

26.44 Kg/hr

Total Power	
Power	320.6 hp



Material Streams							
	Blend-1	water	1	2	3	4	5
Vapour Fraction	0.0000	0.0000	0.0000	0.7404	1.0000	0.0000	1.0000
Temperature C	101.7	101.7	95.10	84.13	84.00	84.00	209.8
Pressure kg/cm <sup>2</sup> _g	288.3	288.3	288.3	2.100	2.094	2.094	24.81
Molar Flow Nm <sup>3</sup> (gas)	320.2	32.90	1141	1141	844.8	298.0	844.8
Mass Flow kgh	2183	26.44	3157	3157	1083	2074	1083
Liquid Volume Flow m <sup>3</sup> /h	2.823	0.0285	4.978	4.978	2.485	2.494	2.485
Heat Flow Mkal/h	-1.212	-0.817e-002	-2.007	-2.098	-0.0200	-1.178	-0.8398

	6	Well stream Gas	1.1	2.1	7	9	10
Vapour Fraction	0.0000	1.0000	0.0000	0.7405	0.9820	0.5307	0.8284
Temperature C	84.04	101.7	95.04	84.00	84.20	51.25	80.00
Pressure kg/cm <sup>2</sup> _g	24.81	288.3	288.1	2.094	24.81	24.37	35.00
Molar Flow Nm <sup>3</sup> (gas)	298.0	781.5	1141	1141	1141	1141	844.8
Mass Flow kgh	2074	947.1	3157	3157	3157	3157	1083
Liquid Volume Flow m <sup>3</sup> /h	2.494	2.328	4.978	4.978	4.978	4.978	2.485
Heat Flow Mkal/h	-1.178	-0.7872	-2.098	-2.098	-2.145	-2.171	-0.9802



**What Comes to our minds, when we first see a FLARE?**  
**GAS FLARE RECOVERY - MULTI APPROACHES**

**1st Approach - LRC**

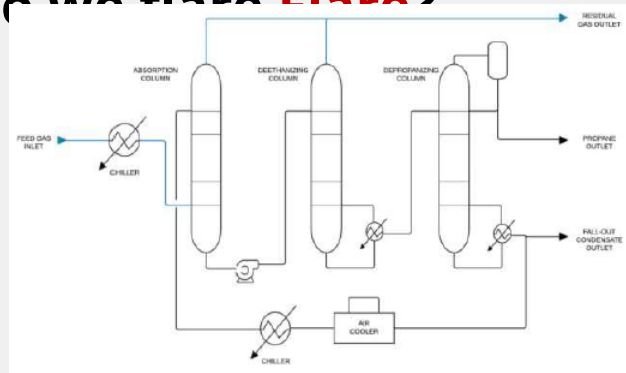
**Case 1 - 200 MM SCFD!**

**Case 2 - Gas Power Generation**

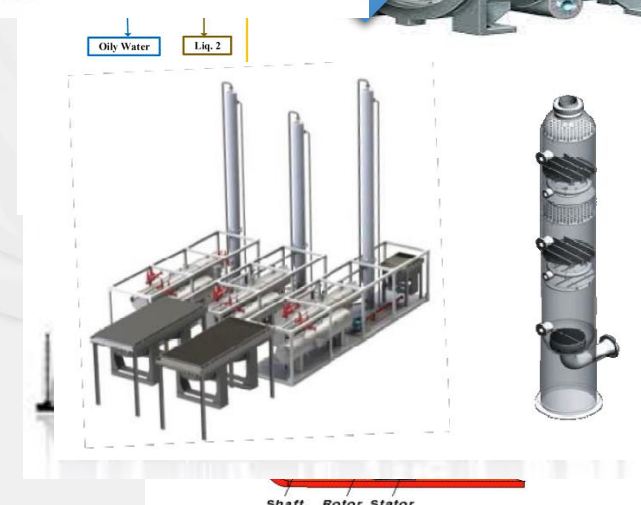
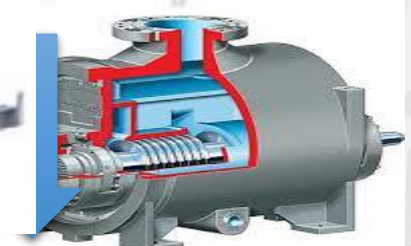
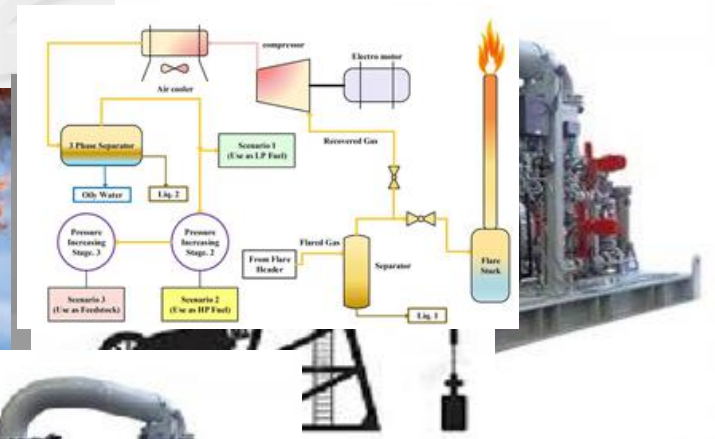
**2nd Approach - MPP**

**3rd Approach - C3 Recovery**

**Why do we flare Flare?**



Country's Needs





## ACKNOWLEDGEMENT



*I acknowledge all the support of His Excellency Engineer Tarek El Molla The Minister of Egyptian Petroleum Resources.*

*And all the support of my Company **PETROJET** especially His excellency Engineer **WALEED LOTFI** The chair man.*

*Also all my colleagues and managers from PETROJET and from other sister production companies such as KPC and Abu Queer and our vendors such as HONEYWELL , BONNATII , OIL TEAM and ENTRAG as well.*