

*NATIONAL IRANIAN GAS COMPANY*  
**Optimization and Modification  
of Dehydration Process in  
Gavarzin Gas Plant**

*SARKHOON & QESHM GAS TREATING COMPANY*

*TECHNICAL & ENGINEERING SERVICES*

*PROCESS ENGINEERING*

*BY: ABOLFAZL ATASH JAMEH*

Abolfazl Atash Jameh-Sarkhoon & Qeshm Gas Treating Company-IRAN

# History of Plant

Commission of plant in 1979 at north of Persian Golf in Qeshm Island

Capacity of plant  
100MMSCFD

Dehydration Solvent:  
TEG

Water dew point  $-9.5^{\circ}\text{C}$  or  
water content 60.95 ppm

IGS for water content  $110 \text{ mg/Sm}^3$

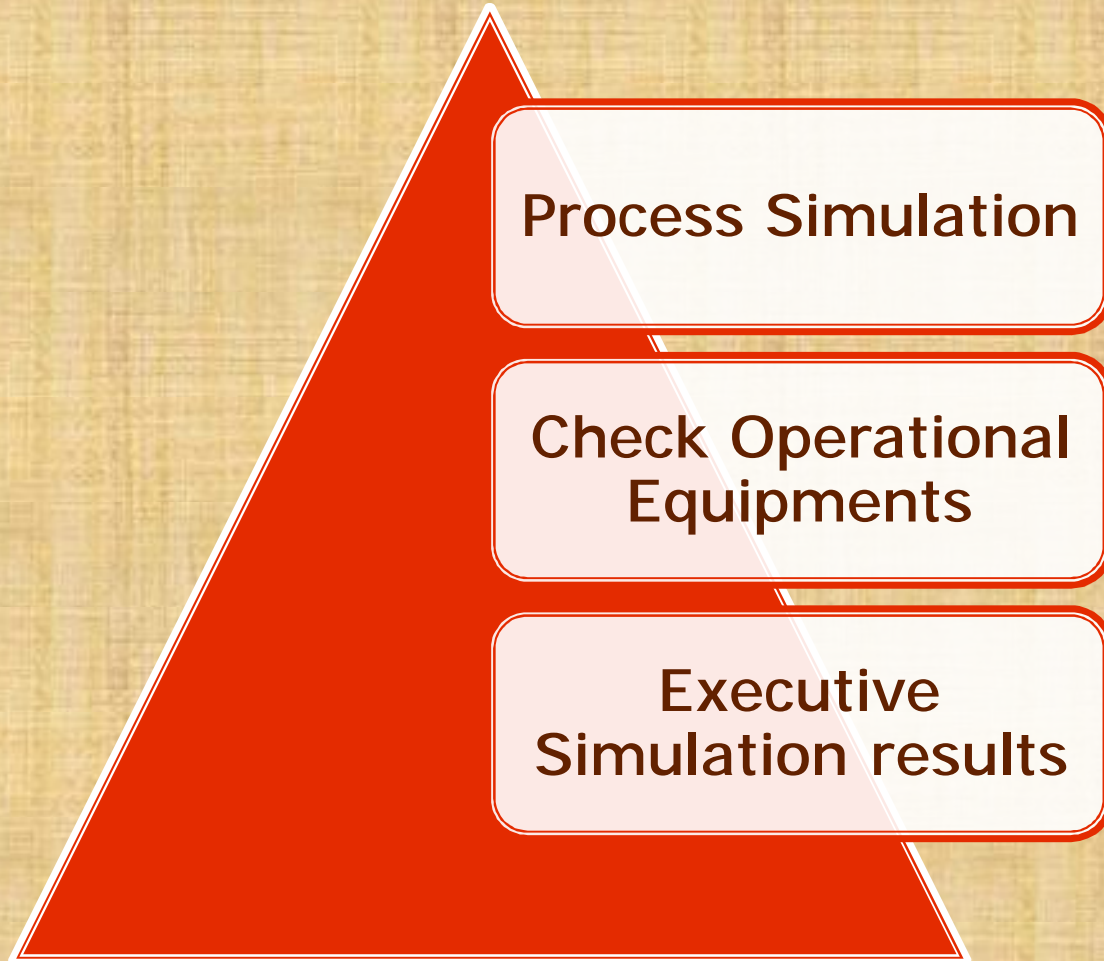


# Main Objectives of Modification

Produce On SPEC Sales  
Gas in Plant

Consideration of Concerns  
for Commissioning of CNG  
Station In Qeshm Island  
Due to High Water Dew  
Point of Natural Gas

# ROOT Cause Survey



# Simulation of plant with Hysys Simulator



Using DEG 1.5 GPM  $\Rightarrow$  W.C 92ppm



Using TEG 1.5gpm  $\Rightarrow$  W.C 65ppm



Water Dew Point - 3.4 °C @ DEG



Water Dew Point - 7.4 °C @TEG



Reboiler Temp @ TEG 204 °C



Reboiler Temp @ DEG max 175 °C



# Results of Software

DEG FEED

Worksheet

	Mass Fractions
n-Heptane	0.000000
n-Octane	0.000000
n-Nonane	0.000000
n-Decane	0.000000
Cyclohexane	0.000000
Benzene	0.000000
Nitrogen	0.000000
H2O	0.150000
TEGlycol	0.000000
DEGlycol	0.850000
CO2	0.000000
H2S	0.000000

DEG DEW

Operation Name: DEG DEW

Stream: gas from c-101

Dew Point

Water Dew Point [C]	
HC Dew Point [C]	

General

Vapour/Phase Fraction	1.0000
Temperature [C]	37.20
Pressure [bar_g]	50.19
Mole Weight	18.43
Z Factor	0.9088

Water Content

lb water / MMSCF	28.9832
mg water / m3	465.142

Wobbe Dew Point / Water Content Heat Capacities About

Delete OK Ignored

# Results of Software

DEG FEED

Worksheet	Mass Fractions
Conditions	
Properties	
Composition	
Notes	
K Value	
n-Heptane	0.000000
n-Octane	0.000000
n-Nonane	0.000000
n-Decane	0.000000
Cyclohexane	0.000000
Benzene	0.000000
Nitrogen	0.000000
H2O	0.020000
TEGlycol	0.000000
DEGlycol	0.980000
CO2	0.000000
H2S	0.000000
Total	1.00000

Edit... Basis...

MEG DEW

Operation Name: MEG DEW

Stream: gas from c-101

Dew Point

Water Dew Point [C]:

HC Dew Point [C]:

General

Vapour/Phase Fraction	1.0000
Temperature [C]	37.55
Pressure [bar_g]	50.19
Mole Weight	18.43
Z Factor	0.9092

Water Content

lb water / MMSCF	5.77005
mg water / m3	92.6016

Wobbe Dew Point / Water Content Heat Capacities About

Delete OK Ignored

DEG FEED

Worksheet	Stream Name	DEG FEED
Conditions	Vapour / Phase Fraction	0.00000
Properties	Temperature [C]	48.889
Composition	Pressure [bar_g]	55.158
Notes	Molar Flow [m3/h_(gas)]	93.16
	Mass Flow [kg/h]	380.86
	Liquid Volume Flow [USGPM]	1.500



# Checking Operational Equipments

Performing  
improving of  
Bubble Caps



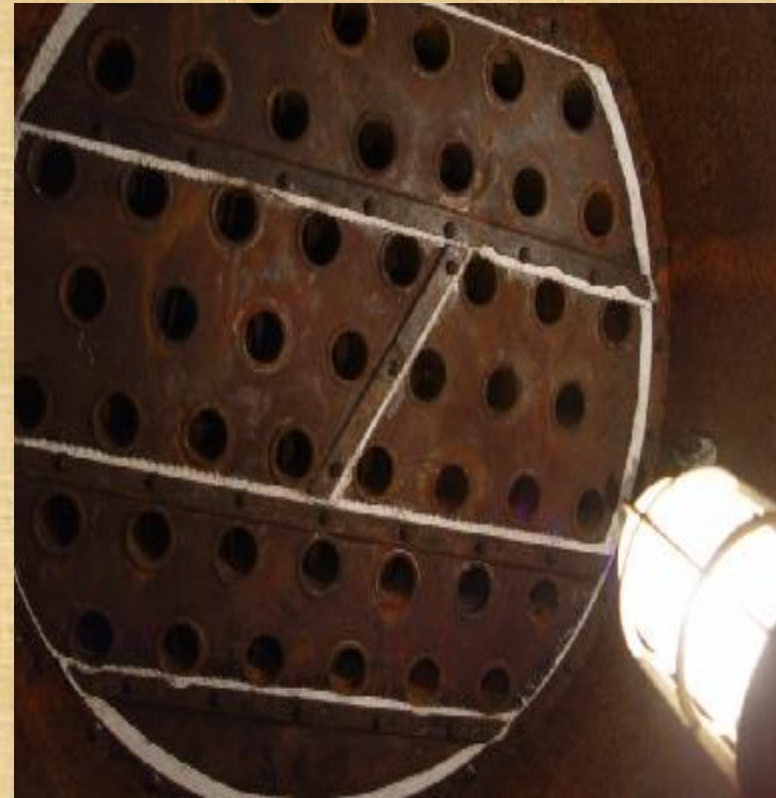
More  
Supervisory on  
Bubble cap  
installation



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Local of bubble caps leakage  
Adding new sealing on caps  
Appropriate sealing on trays



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# Some Other Tests



Metering of associated water with  
natural gas 70 lit /hr



@ Design Con 1.5 m<sup>3</sup> Water /MMSCM



@ Operation Con 0.85 m<sup>3</sup> water  
/MMSCM



Analyzing of Natural gas to towers

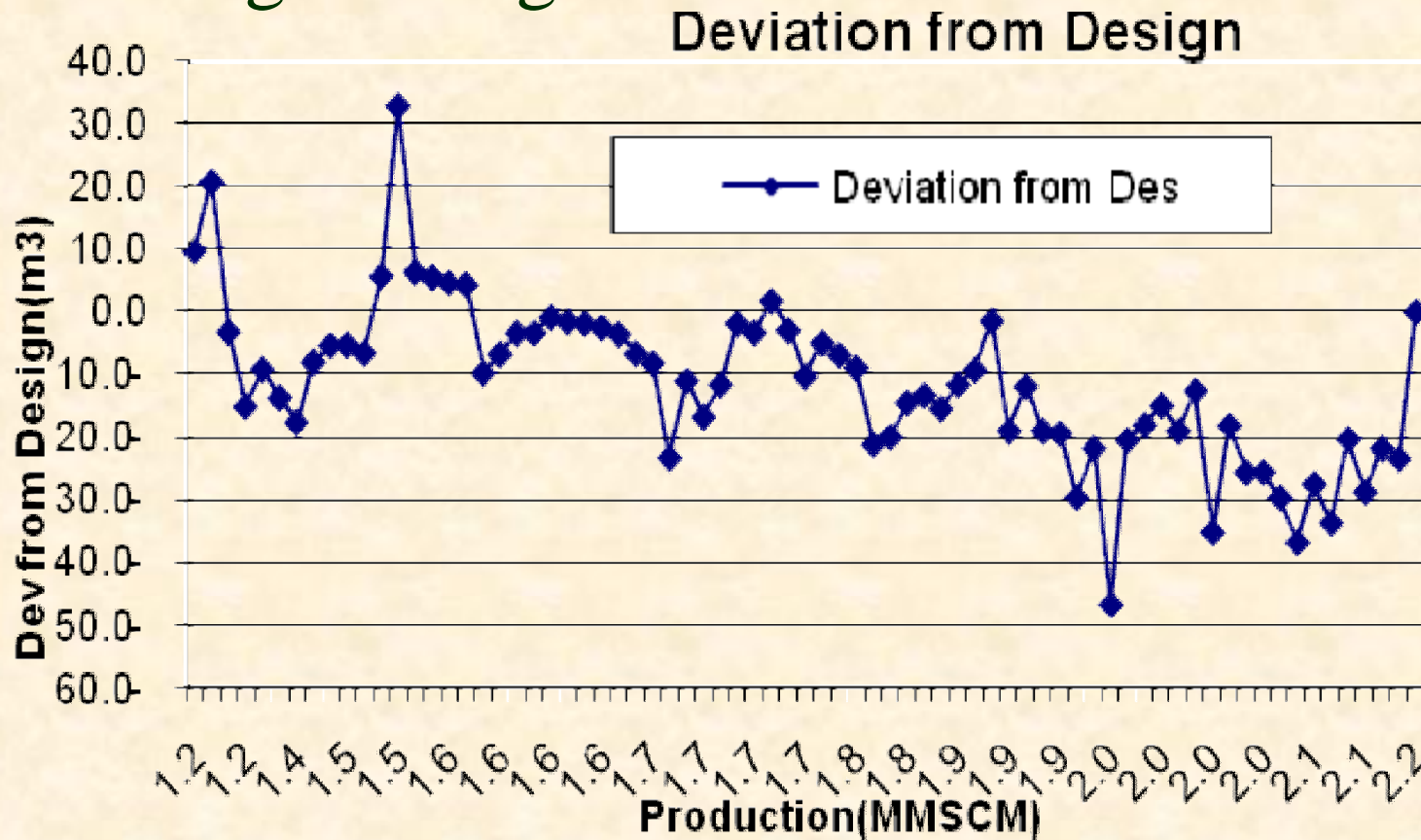


@ Des Con C6+ =0.29% Op 0.46%



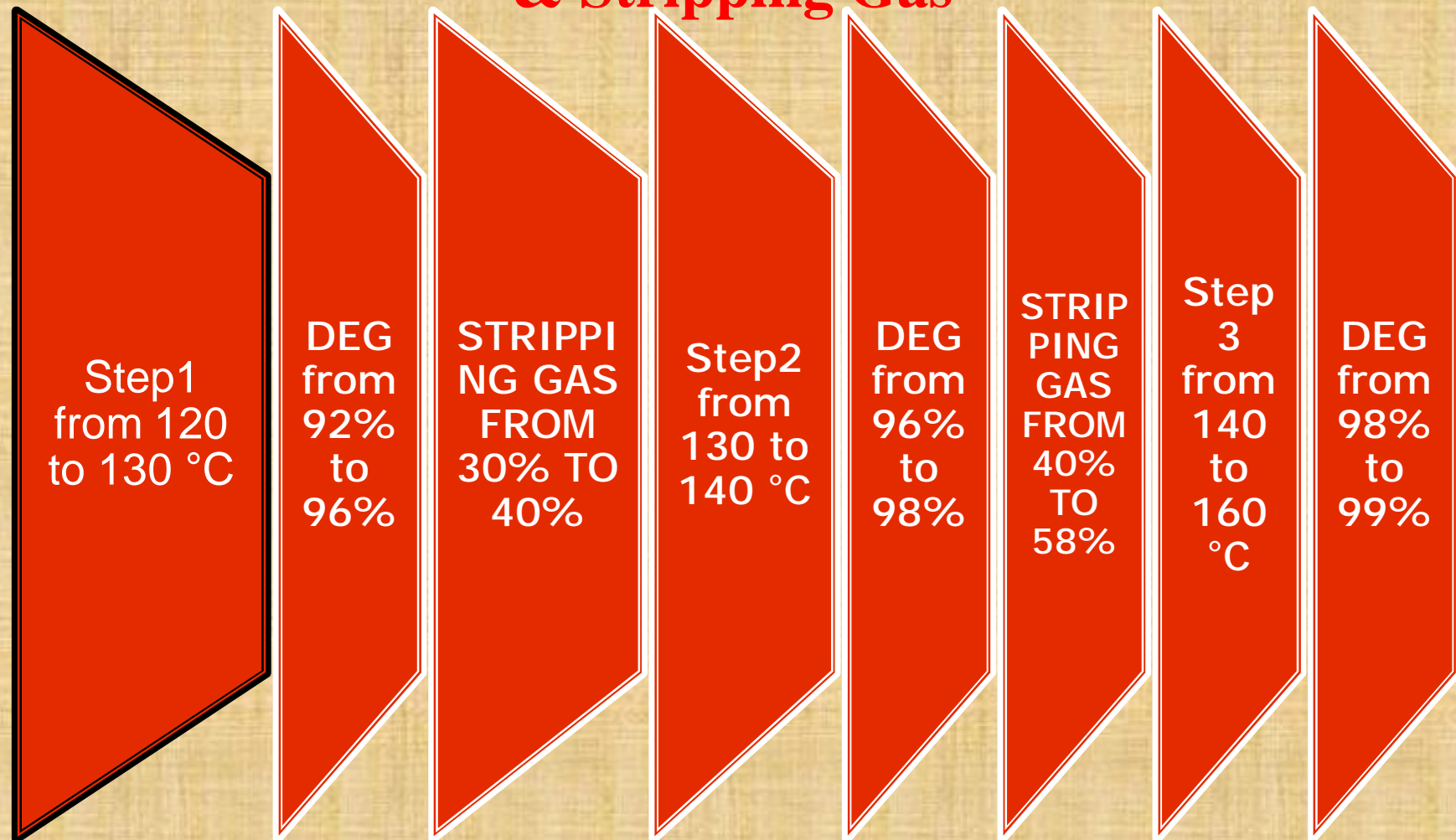
# The Study of Document

n Data gathering from 1998 to 2008



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# Executive the result of simulation, Change of Reboiler Temperature & Stripping Gas





# Analyzer Before modification

## Analysis Report

پالایش گاز سرفون و قشم

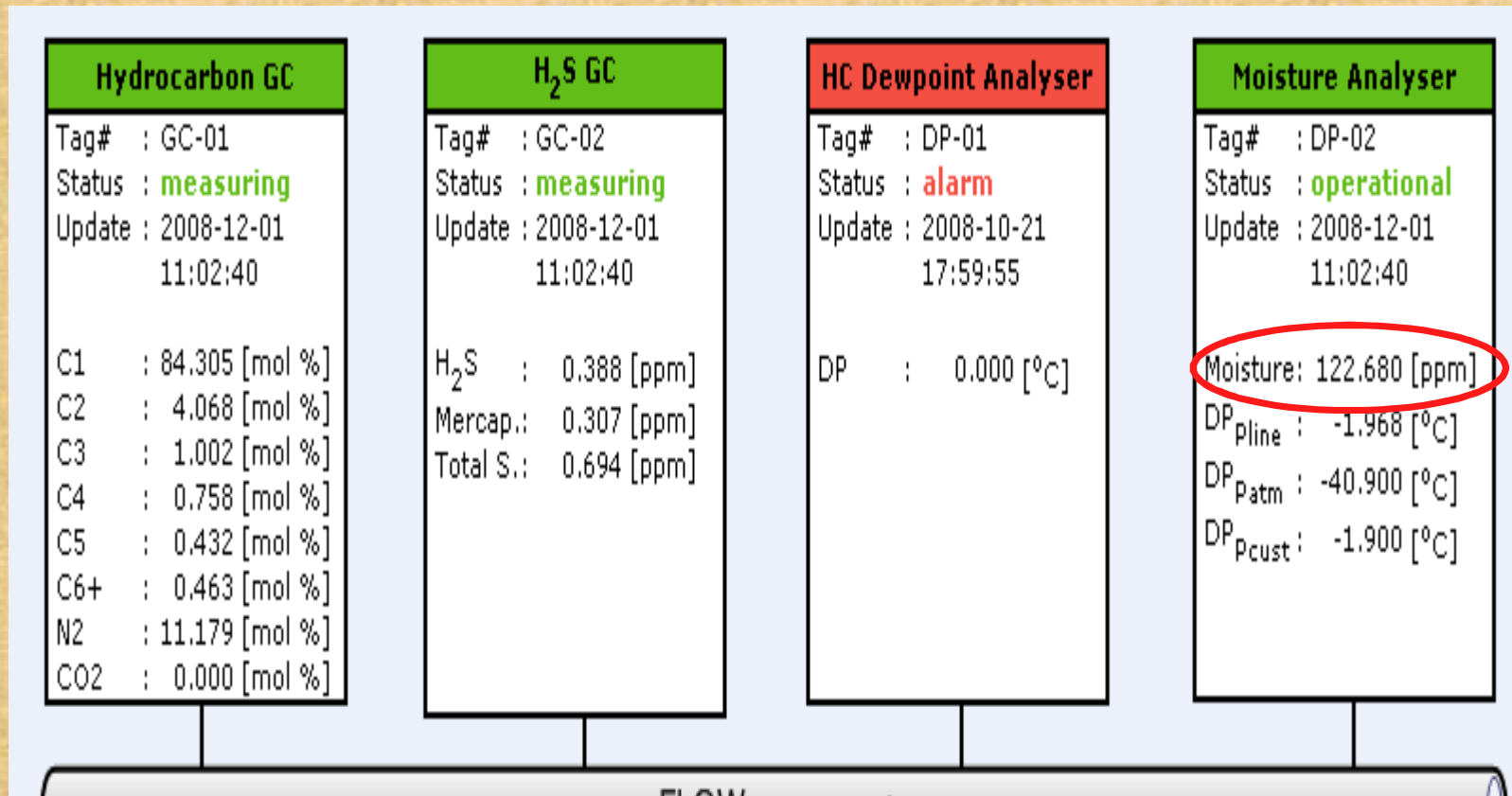
Plant : Qeshm  
 Analyser Shelter : AS-01  
 Print Date : 06-Dec-2008 9:15  
 Sample date/time : 25-Jul-2007 12:32  
 Ref. Conditions : 15/15°C at 101.325kPa  
 Calc. Standards : ISO5167, ISO6976, ISO12213-2 (AGA8)

Description	Device	Sample date/time [dd/MM/yyyy HH:mm]	Value	Unit
C1	GC-01	25/07/2007 12:30	83,253	[mol%]
C2	GC-01	25/07/2007 12:30	1,743	[mol%]
C3	GC-01	25/07/2007 12:30	0,996	[mol%]
C4	GC-01	25/07/2007 12:30	0,754	[mol%]
C5	GC-01	25/07/2007 12:30	0,440	[mol%]
C6+	GC-01	25/07/2007 12:30	0,499	[mol%]
N2	GC-01	25/07/2007 12:30	11,115	[mol%]
CO2	GC-01	25/07/2007 12:30	0,000	[mol%]
H2S	GC-02	25/07/2007 12:30	0,392	[ppm]
Mercaptan	GC-02	25/07/2007 12:30	0,347	[ppm]
Total Sulfur	GC-02	25/07/2007 12:30	0,740	[ppm]
HC Dewpoint	DP-01	20/02/2007 08:45	0,00	[°C]
Water Dewpoint	DP-02	25/07/2007 12:30	24,86	[°C]
Water Content	DP-02	25/07/2007 12:30	764,550	[ppm]
HSO	calculated	25/07/2007 12:30	36,46	[MJ/m3]
HIO	calculated	25/07/2007 12:30	32,92	[MJ/m3]
SPGRO	calculated	25/07/2007 12:30	0,65	
RHO0	calculated	25/07/2007 12:30	0,80	[kg/m3]
ZO	calculated	25/07/2007 12:30	0,9978	

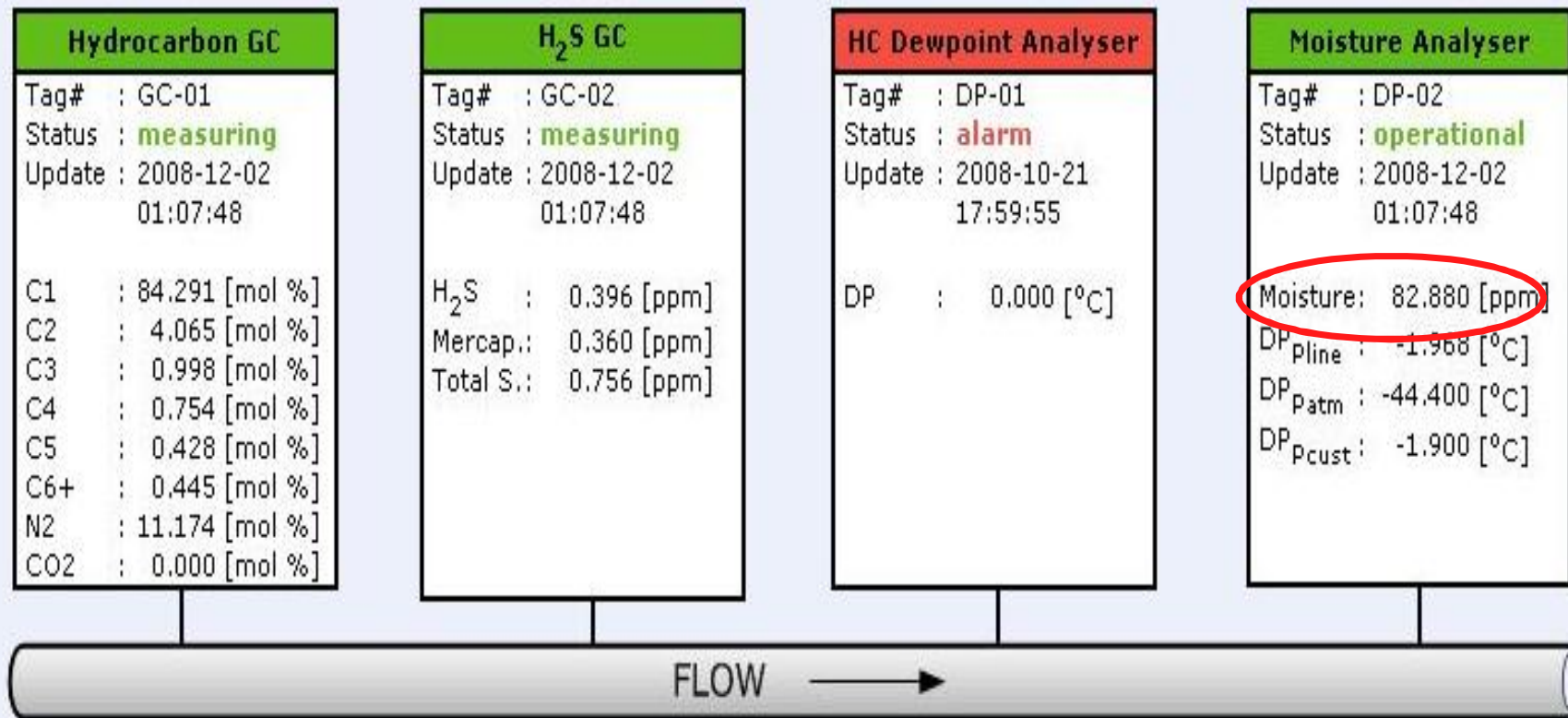
C1	GC-01	13/09/2006 09:20	82,263 [mol%]
C2	GC-01	13/09/2006 09:20	1,800 [mol%]
C3	GC-01	13/09/2006 09:20	0,988 [mol%]
C4	GC-01	13/09/2006 09:20	0,764 [mol%]
C5	GC-01	13/09/2006 09:20	0,419 [mol%]
C6+	GC-01	13/09/2006 09:20	0,489 [mol%]
N2	GC-01	13/09/2006 09:20	11,055 [mol%]
CO2	GC-01	13/09/2006 09:20	0,049 [mol%]
H2S	GC-02	13/09/2006 09:20	0,338 [ppm]
Mercaptan	GC-02	13/09/2006 09:20	0,330 [ppm]
Total Sulfur	GC-02	13/09/2006 09:20	0,667 [ppm]
HC Dewpoint	DP-01	13/09/2006 09:20	15,30 [°C]
Water Dewpoint	DP-02	13/09/2006 09:20	0,00 [°C]
Water Content	DP-02	13/09/2006 09:20	589,350 [ppm]
H50	calculated	13/09/2006 09:20	36,43 [MJ/m3]
H10	calculated	13/09/2006 09:20	32,90 [MJ/m3]
SPGR0	calculated	13/09/2006 09:20	0,65
RHO0	calculated	13/09/2006 09:20	0,80 [kg/m3]
Z0	calculated	13/09/2006 09:20	0,9978



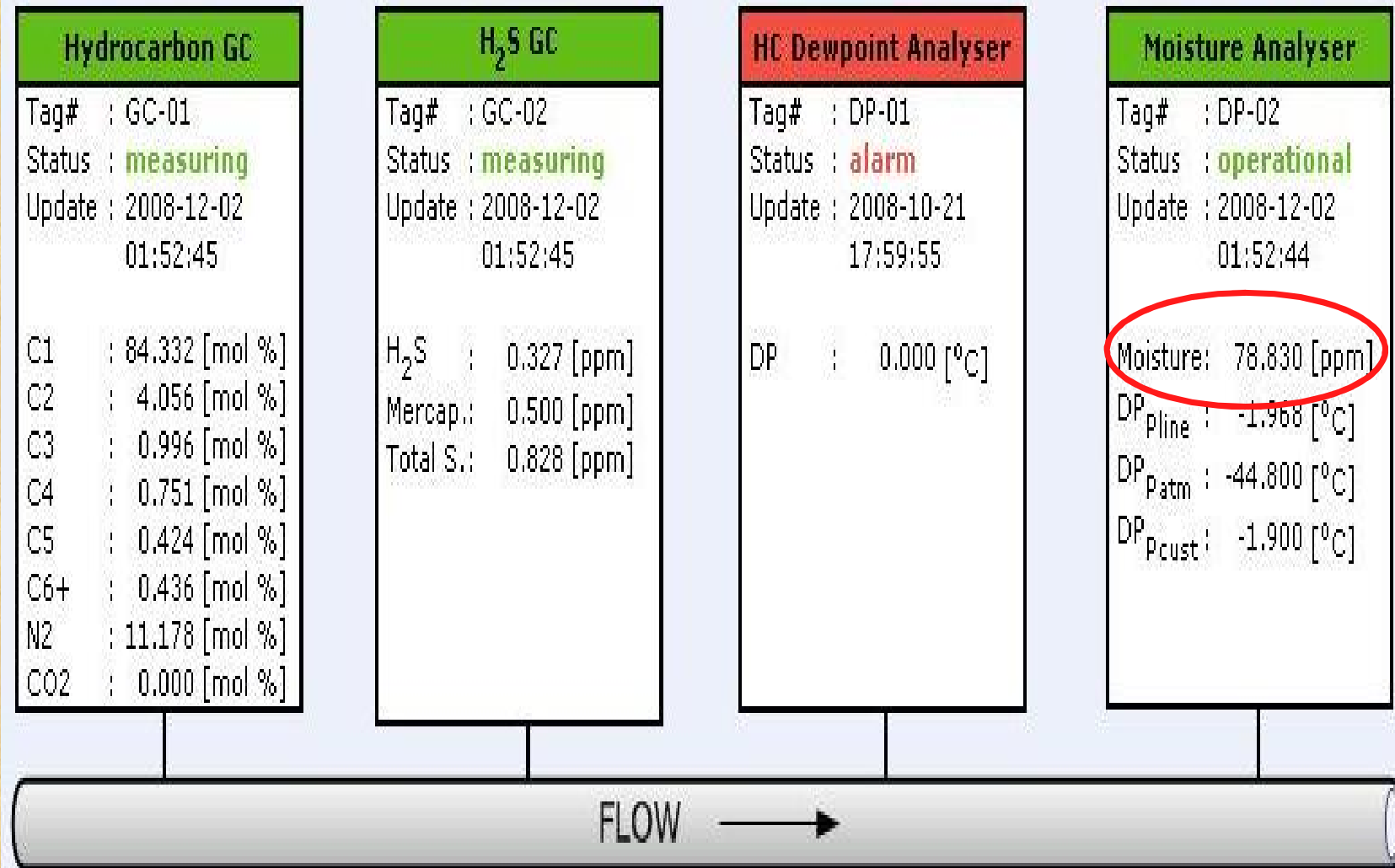
# Results of On-Line Analyser



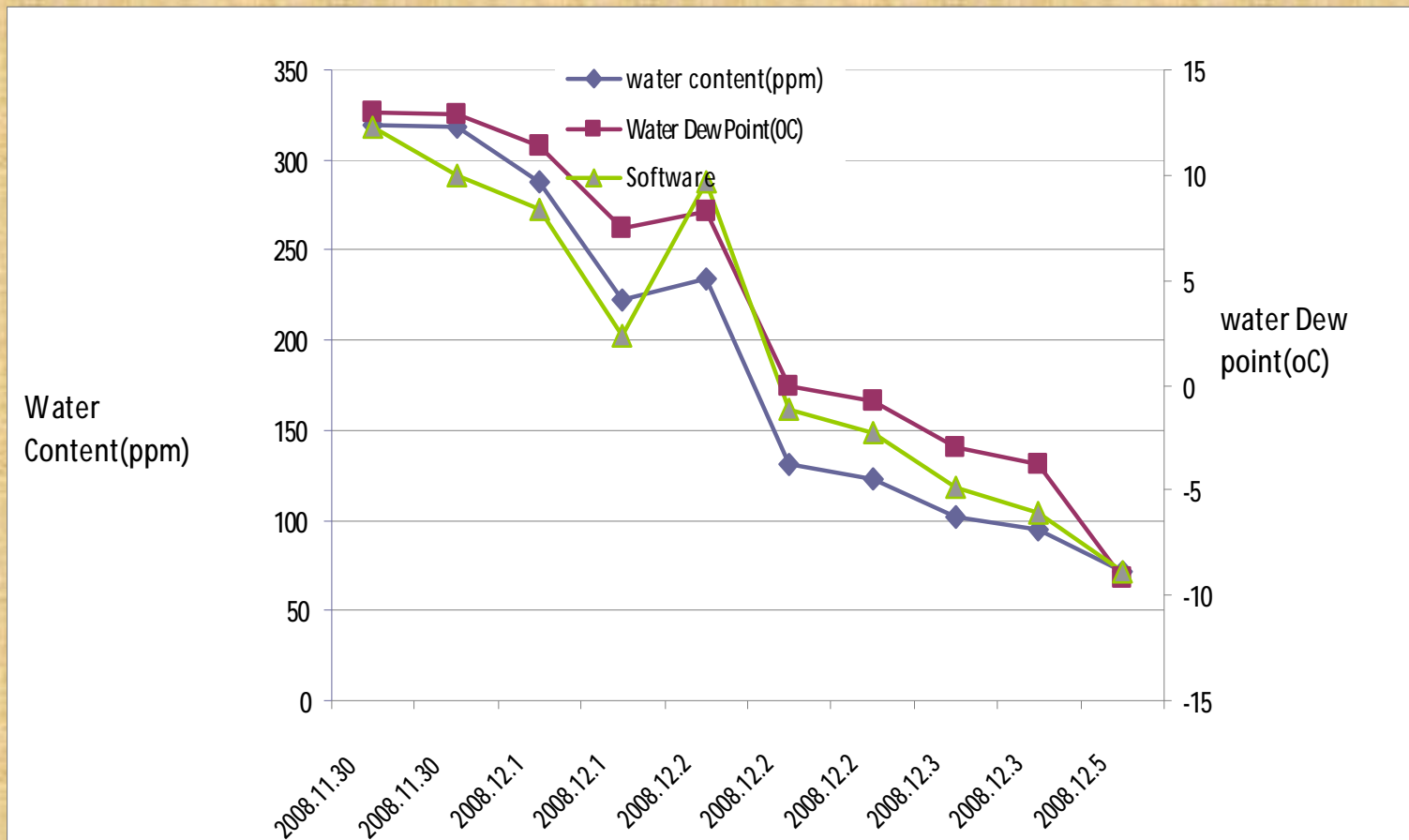
# Trend of improving in stage Final Test based on on-line Analyser







# Great Achievement on November 2008



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# Advantages & Disadvantage of TEG TO DEG

## Advantage

MORE D.P DEPRESSION

## Disadvantages

HIGH HEATING CONSUMTION

LOWER APPROCH OF DEGRADATION TEMP  
AND OPERATION TEMP (207 0c & 204 0c)  
(for DEG 175 0c versus 120 -160 0C)

Stripping gas



# CONCLUSION 1

Approaching  
to supply  
on-spec  
production  
according to  
Iranian Gas  
Standard  
(IGS)



Making  
a safe side  
for Natural  
consumers  
in CNG  
Stations  
as fuel for  
cars



Reduction of  
maintenance  
cost on  
pipe line  
transmission  
of natural  
gas due to be  
dried  
natural gas.

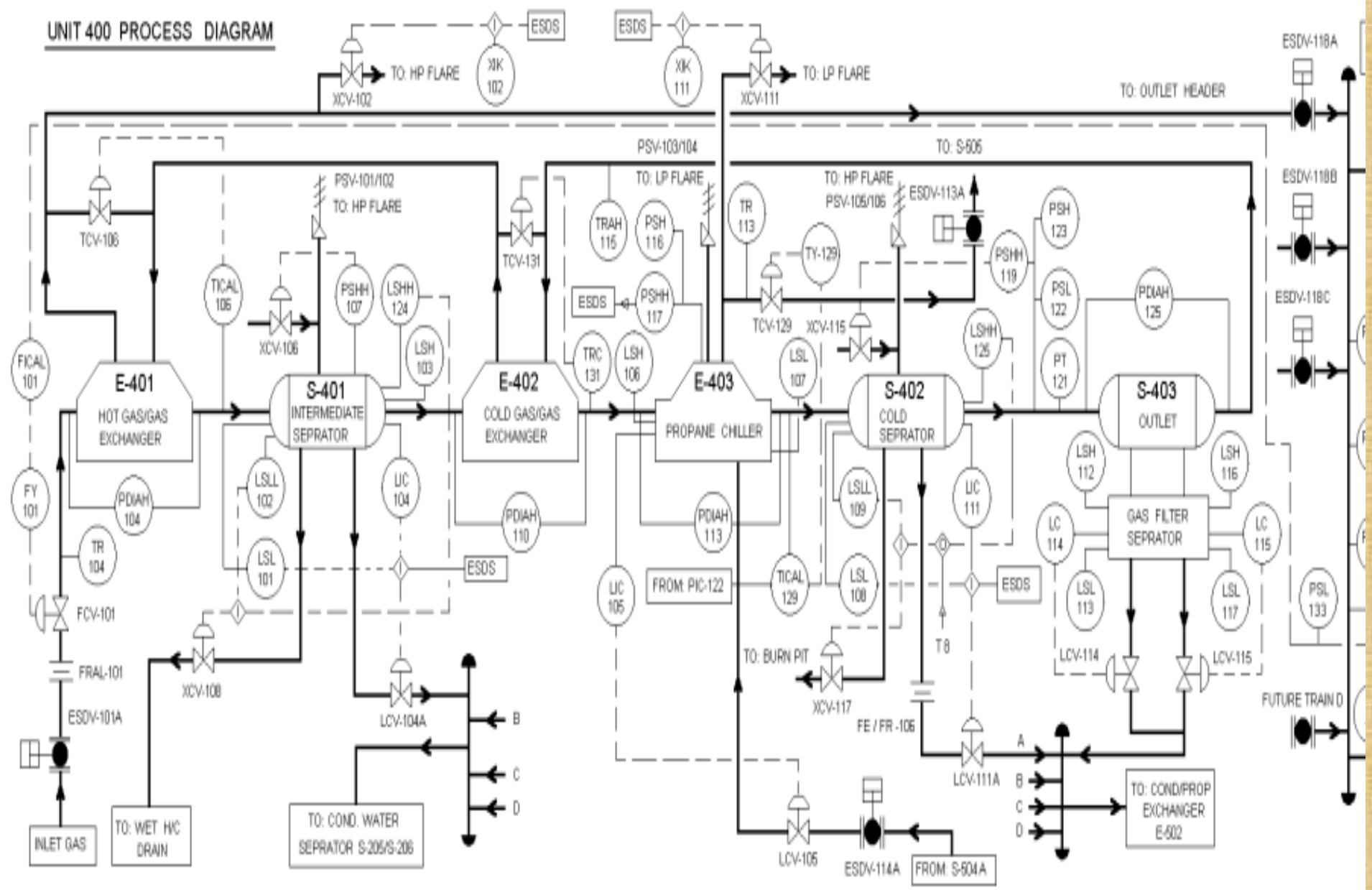


A Potential  
Total  
Income  
(\$/YEAR)  
67,000,000

# **A Short look at H/C Dew Point Modification of Sarkhoon Gas Plant**

**Abolfazl Atash Jameh-Sarkhoon & Qeshm Gas Treating Company-IRAN**

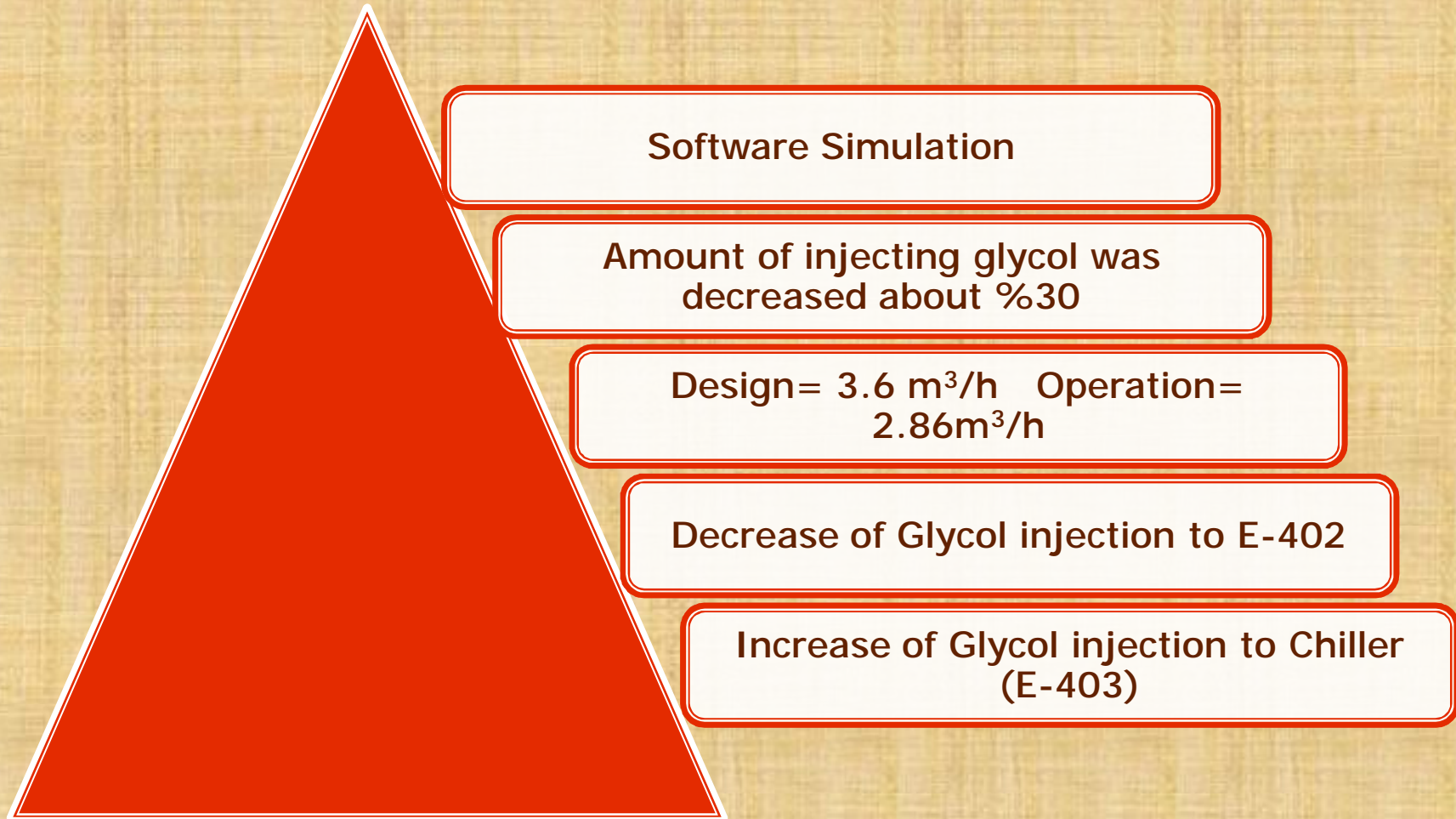
**UNIT 400 PROCESS DIAGRAM**



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# Root Cause Survey



# Hydrate has been formed in final filter at dehydration unit



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# Software Simulation

Hydrate Formation Utility: Hydrate Formation ...

-20.3685 C

**Performance**

Formation Temperature at Stream Pressure

Formation Temperature [C]	-20.3685
Hydrate Type Formed	Type I & II
Calculation Mode	Free Water Found

Formation Pressure at Stream Temperature

Formation Pressure [bar_g]	449.4817
Hydrate Type Formed	Type I & II
Calculation Mode	Free Water Found

Design Performance Dynamics

DEG TO 400A

-4.825e+005 kJ/kgmole

**Worksheet**

Stream Name	DEG TO 400A
Vapour / Phase Fraction	0.00000
Temperature [C]	50.000
Pressure [bar_g]	71.287
Molar Flow [m3/h (gas)]	312.2
Mass Flow [kg/h]	940.99
Liquid Volume Flow [m3/h]	0.8500
Molar Enthalpy [kJ/kgmole]	-4.825e+005
Molar Entropy [kJ/kgmole-C]	56.201
Heat Flow [kJ/h]	-6.3702e+06
Std Liq Vol Flow [m3/h]	0.8440

Worksheet Attachments Dynamics User Variables

OK

Delete Define from Other Stream...

Hydrate Formation Utility: Hydrate Formation ...

3.8883 C

**Performance**

Formation Temperature at Stream Pressure

Formation Temperature [C]	3.8883
Hydrate Type Formed	Type I & II
Calculation Mode	Free Water Found

Formation Pressure at Stream Temperature

Formation Pressure [bar_g]	55.1594
Hydrate Type Formed	Type I & II
Calculation Mode	Free Water Found

Design Performance Dynamics

DEG TO 400A

Worksheet

	Mass Fractions
n-C15	0.000000
n-C16	0.000000
n-C17	0.000000
n-C18	0.000000
n-C19	0.000000
n-C20	0.000000
Nitrogen	0.000000
CO2	0.000000
H2S	0.000000
DEAmine	0.000000
DEGlycol	0.900000
H2O	0.100000

Total 1.00000

Edit... Basis...

Worksheet Attachments Dynamics User Variables

OK

Delete Define from Other Stream...

The image displays four screenshots of the Hydrate Formation Utility software interface, arranged in a 2x2 grid. The top row shows the 'Performance' tab for two different streams, and the bottom row shows the 'Worksheet' tab for the same streams.

**Top Left Screenshot (Performance):** The 'Formation Temperature at Stream Pressure' section is circled in red. The 'Formation Temperature [C]' is -5.8816. The 'Hydrate Type Formed' is 'Type I & II' and the 'Calculation Mode' is 'Free Water Found'. The 'Formation Pressure at Stream Temperature' section shows a 'Formation Pressure [bar\_g]' of 508.7860, 'Hydrate Type Formed' as 'Type I & II', and 'Calculation Mode' as 'Free Water Found'.

**Top Right Screenshot (Performance):** The 'Formation Temperature at Stream Pressure' section is circled in red. The 'Formation Temperature [C]' is -29.5868. The 'Hydrate Type Formed' is 'Type I & II' and the 'Calculation Mode' is '<empty>'. The 'Formation Pressure at Stream Temperature' section shows a 'Formation Pressure [bar\_g]' of 1100.1145, 'Hydrate Type Formed' as 'Type I & II', and 'Calculation Mode' as 'Free Water Found'.

**Bottom Left Screenshot (Worksheet):** The 'Mass Fractions' table is shown. The 'DEGlycol' row is circled in red. The total mass fraction is 1.00000.

Component	Mass Fraction
n-C15	0.000000
n-C16	0.000000
n-C17	0.000000
n-C18	0.000000
n-C19	0.000000
n-C20	0.000000
Nitrogen	0.000000
CO2	0.000000
H2S	0.000000
EAmine	0.000000
DEGlycol	0.950000
H2O	0.050000

**Bottom Right Screenshot (Worksheet):** The 'Conditions' table is shown for stream 'DEG TO 400A'.

Property	Value
Vapour / Phase Fraction	0.000000
Temperature [C]	50.000
Pressure [bar_g]	71.287
Molar Flow [m3/h_(gas)]	262.5
Mass Flow [kg/h]	946.74
Liquid Volume Flow [m3/h]	0.8500
Molar Enthalpy [kJ/kgmole-C]	-5.364e+005
Molar Entropy [kJ/kgmole-C]	47.206
Heat Flow [kJ/h]	-5.9554e+06
Std Liq Vol Flow [m3/h]	0.8495



# Operational Conditions

After the deduction every day the dew point every train is the most will equip by the lab and the amount of glycol injection was changed into considering drop pressure of heat exchanger, chiller, final filter and dew point same train and after the changes for 24 hours, maximum effort had been done to other parameters does not change.

The whole flow of glycol has increased after making optimal amount injection to chiller and gas/gas heat exchanger to reduce output gas temperature from chiller to below  $-12\text{ }^{\circ}\text{C}$ .

Glycol injection pump pressure (P-601) has increased to 76 barg to increase the amount of glycol injection.

During 24 hours one of the problems it was clear that within S- 601 (flash drum) of glycol regeneration unit increase in the fluid was in the sense that at most contraceptive flows could be transferred from unit  $3.2\text{ m}^3/\text{hr}$ .

# Survey Capacity of Glycol Regeneration Unit (Unit 600)

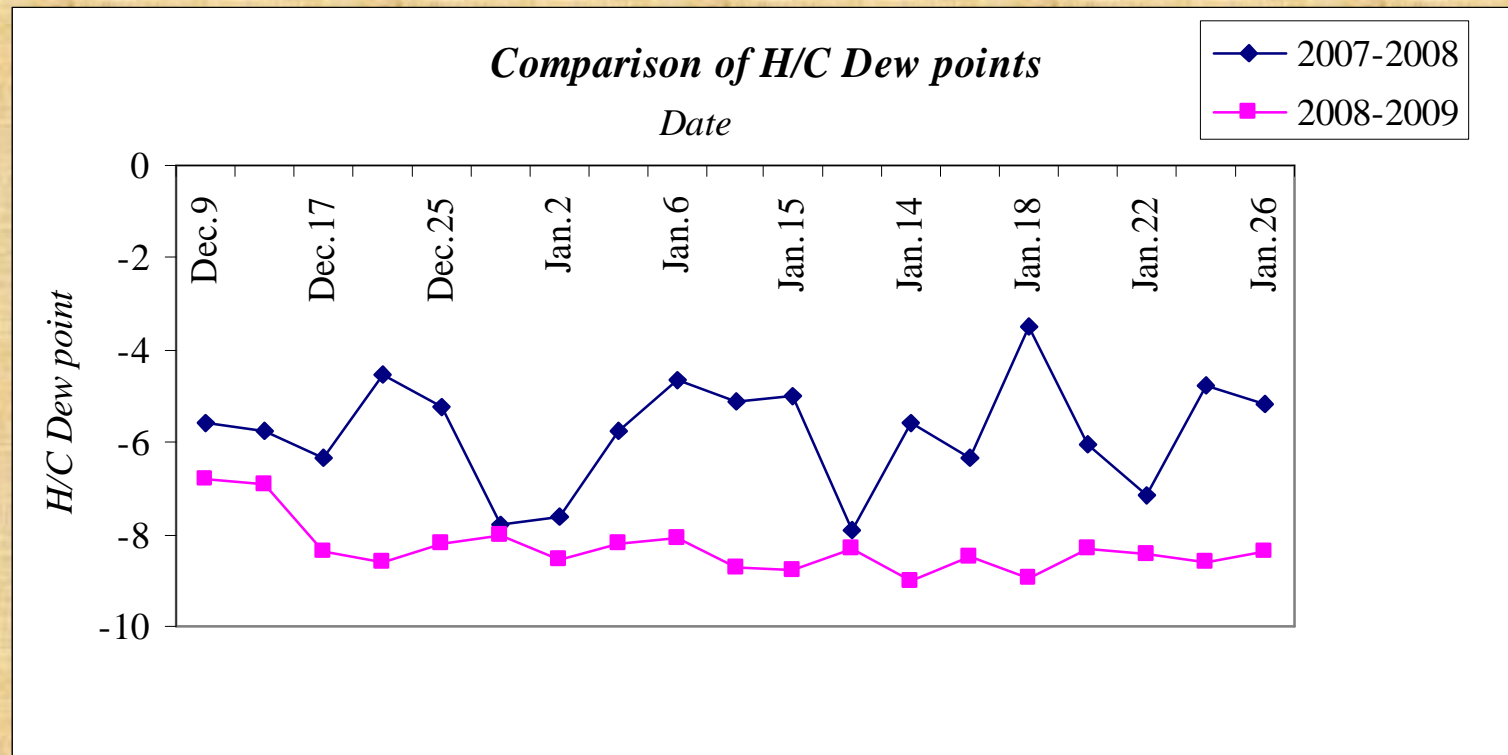
According to the fact that the process restriction after flash drum, entrance filters and heat exchangers of glycol regeneration package had been tested.

Then focused on drop pressure of heat exchangers package and clear that fourth heat exchanger and coil reboiler have been done decrease in flow about  $0.2 \text{ m}^3/\text{hr}$ .

With regard to main drop pressure in heat exchanger that prescript to increase flash drum pressure from 3.8 barg to 5.5 barg.

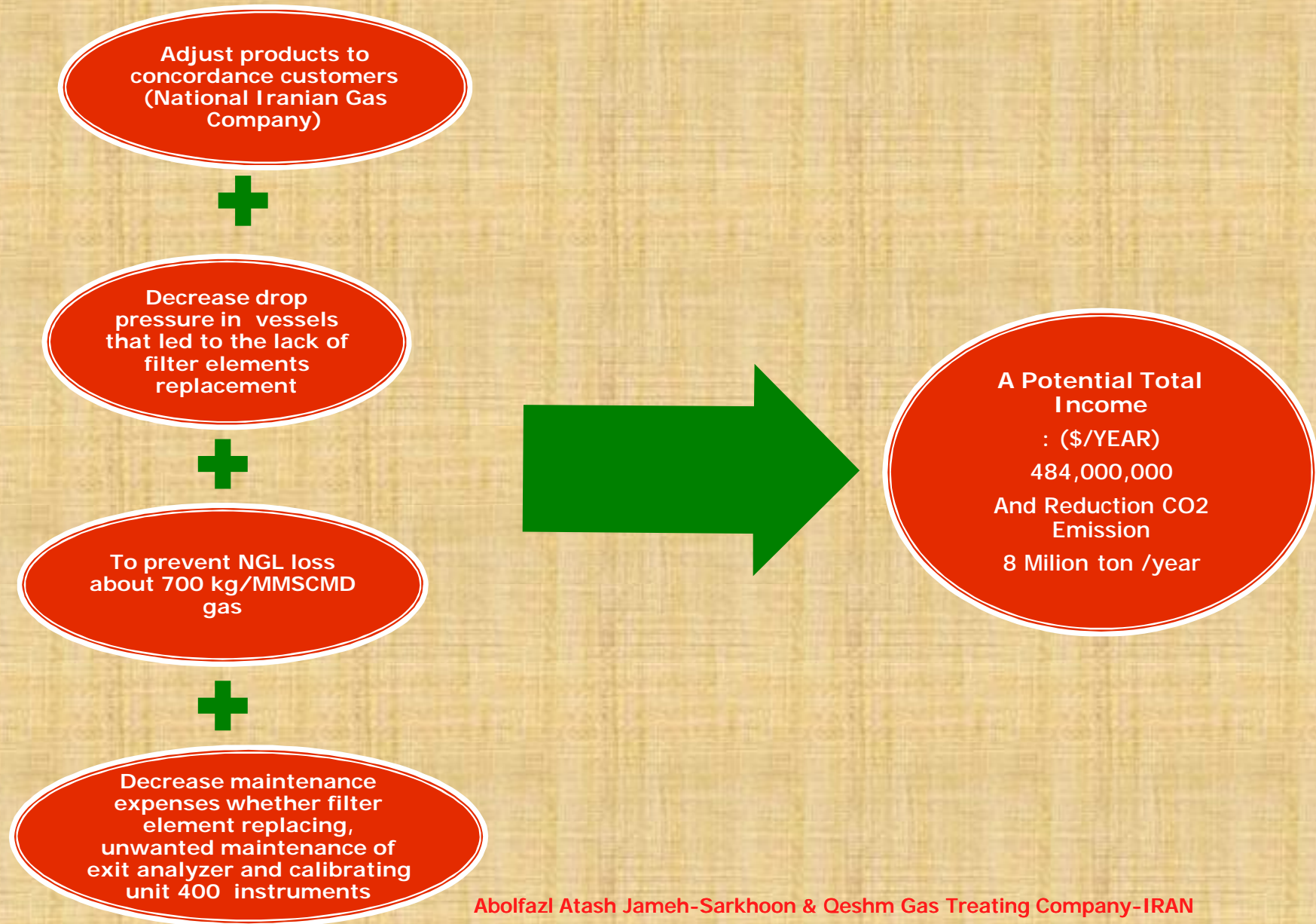
Then flash drum pressure have been increased during 5 days from 3.8 barg to 5.5 barg and hereby the flow could be transferred to glycol regeneration unit have been increased from  $3.4 \text{ m}^3/\text{hr}$  to  $4 \text{ m}^3/\text{hr}$ .

# Comparison of Hydrocarbon Dew points in times 2007-2008 and 2008-2009





# CONCLUSION 2



Thank You For Attention



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