

Saipem Energy International Saipem Energy International S.p.A.	CLIENTE: GNL Italia S.p.A.	Documento n.: 539178-A-000-ZR-0001 APPENDICE 02	
	LOCALITÀ: Italia		
	PROGETTO: Ammodernamento e Adeguamento Impianto GNL di Panigaglia	Rev. 4	Pag. 1 di 9

AMMODERNAMENTO E ADEGUAMENTO
IMPIANTO GNL DI PANIGAGLIA

DOCUMENTAZIONE DI PROGETTO

ALLEGATO 2
SCHEMI DI PROCESSO SEMPLIFICATI
e
BILANCI MATERIA

4	04/10/06	Aggiornamento	NSC	BCA	PCA
3	31/08/06	Aggiornamento	NSC	BCA	PCA
2	04/08/06	Aggiornamento	NSC	BCA	PCA
1	06/12/05	Emissione Finale	SEI	RR	AF
0	16/11/05	Prima emissione al Cliente	SEI	RR	AF
Rev.	DATA	Descrizione	Preparato	Verificato	Approvato

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1. OBJECT

The object of this note is to design the main equipments for the gasification, which are SCV, Nitrogen production and air compressors.

2. BASES OF DESIGN

We used fixed air flows: Air flow = 100 kgmol/h in each GNL_leggero simulations, and 940 kgmol/h in each GNL_medio simulations. Only in GNL_pesante simulations, the Air flow is adjusted to match maximum Wobbe Index (it has to be reduced by adding N₂).

The Wobbe Index must be between 47.31 MJ/Sm³ and 52.33 MJ/Sm³, or between 11 302 kcal/Sm³ and 12 450 kcal/Sm³.

In tank pumps: 3 of 630 m³/h capacity = 1 890 m³/h total (248 m HMT) Ok for every case.

Booster pumps: 5 of 410 m³/h capacity = 2 050 m³/h total (1 977 m HMT) Ok for every case.

We have considered every case without heat recuperation of the Turbogenerator. We took 17 400 kg/h (800 t/h SCV capacity) and 17 800 kg/h (825 t/h SCV capacity) for the fuel gas consumption of the SCVs and Turbogenerator. These values come from Rolls Royce offer for the Turbonerator (5 400 kg/h) plus our estimation for the SCVs coming from the offer for 150 t/h SCV (12 000 kg/h for 4 SCVs of 200 t/h so 12 400 for 5 SCVs of 165 t/h).

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3. SIMULATIONS

3.1. SITUATION 1

4 SCVs, capacity 200 t/h

7 N2 units, capacity 2 500 Nm3/h (total 17 500 Nm3/h = 18 477 Sm3/h maxi)

4 Air compressors, capacity 8 000 Nm3/h (total 32 000 Nm3/h = 1 428 kgmol/h maxi)

GNL TYPE	MODE	PRODUCTION (bnSm3/year)	SCV FLOW (t/h)	AIR FLOW (kgmol/h)	NB AIR COMP.	N2 FLOW (Sm3/h)	HEAT / SCV (MW)	WOBBE INDEX
LEGGERO	D	9.404	200	100	1	979	39.38	12 064
	ND	9.412	200	100	1	979	39.86	12 091
MEDIO	D	8.794	200	940	3	9 199	37.79	12 175
	ND	8.797	200	940	3	9 199	38.27	12 207
PESANTE	D	7.278	182.5	1 428	4	13 975	32.54	12 450
	ND	6.144	155	1 428	4	13 975	27.89	12 450

To be able to produce 8 bnSm3/year, it is necessary to add 2 air compressors (up to 2 142 kgmol/h of air maxi) in order to get the maximum of N2 capacity (obtained with 1 888 kgmol/h of air)

GNL TYPE	MODE	PRODUCTION (bnSm3/year)	SCV FLOW (t/h)	AIR FLOW (kgmol/h)	NB AIR COMP.	N2 FLOW (Sm3/h)	HEAT / SCV (MW)	WOBBE INDEX
PESANTE	D	7.991	200	1 600	5	15 658	35.70	12 450
	ND	7.977	200	1 860	6	18 203	36.06	12 450

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3.2. SITUATION 2

5 SCVs, capacity 165 t/h

7 N2 units, capacity 2 500 Nm³/h (total 17 500 Nm³/h = 18 477 Sm³/h maxi)

6 Air compressors, capacity 8 000 Nm³/h (total 48 000 Nm³/h = 2 142 kgmol/h maxi)

GNL TYPE	MODE	PRODUCTION (bnSm ³ /year)	SCV FLOW (t/h)	AIR FLOW (kgmol/h)	NB AIR COMP.	N2 FLOW (Sm ³ /h)	HEAT / SCV (MW)	WOBBE INDEX
LEGGERO	D	9.700	165	100	1	979	32.51	12 065
	ND	9.708	165	100	1	979	32.89	12 092
MEDIO	D	9.072	165	940	3	9 199	31.21	12 180
	ND	9.075	165	940	3	9 199	31.60	12 211
PESANTE	D	8.241	165	1 660	5	16 246	29.47	12 450
	ND	8.101	162.6	1 888	6	18 477	29.30	12 450

3.3. HEAT RECUPERATION

We expect having 35 MW recuperation from the Turbogenerator. This will allow reducing the fuel gas consumption of the SCVs to 13 800 kg/h (4 SCV of 200 t/h) and to 14 100 kg/h (5 SCV of 165 t/h). The gain of natural gas production should allow a fast payback time for the recuperation exchanger.

GNL TYPE	MODE	PRODUCTION (bnSm ³ /year)	SCV FLOW (t/h)	FUEL GAS FOR SCV (kg/h)	DELTA PRODUCTION With/Without Recuperation (MSm ³ /year)
MEDIO	D	9.113	165	14100	41
	ND	9.117	165	14100	42
MEDIO	D	8.834	200	13800	40
	ND	8.838	200	13800	41

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4. CONCLUSION

SITUATION 1

It would be possible to reach the annual production of 8 bnSm³/year in every configuration, except in PESANTE. This type of GNL limits the production because of its High Wobbe Index. To decrease until the maximum allowed, the need of N₂ is very high. With the 4 envisaged air compressors, the N₂ maximum production is still not enough to produce at SCVs capacity.

In one year it would be possible to produce 8 bnSm³ of gas, as the type of GNL would be mixed and as with LEGGERO the production can be 9.4 bnSm³/year.

The problem is that the scope of daily production can not be done with PESANTE.

To reach the daily production in PESANTE, **it is necessary to add 2 air compressors**. The N₂ production is then enough to run at SCVs capacity. The gas production would be just below the scope, that is to say **7.98 instead of 8 bnSm³/year**. GNL Italia has to say if it is acceptable.

SITUATION 2

To reach the daily production in PESANTE, **it is necessary to add 2 air compressors**. With a total SCVs capacity of 825 t/h, it is not only possible to produce the daily production, but also to have an **annual flexibility even with only PESANTE during all the year : 8.101 bnSm³/year minimum**.

If we look at the MEDIO annual production, we can see that in this situation we can **gain 270 MSm³/year** (9.07 bnSm³/year) compared to the 8.8 bnSm³/year which were demanded in the scope. It may be attractive for GNL Italia.

CHOICE OF SCVs CAPACITY AND NUMBER OF AIR COMPRESSORS

GNL Italia has to decide if 17.55 millionSm³/day instead of 22.86 millionSm³/day is acceptable or not. If not, it is necessary to add 2 air compressors.

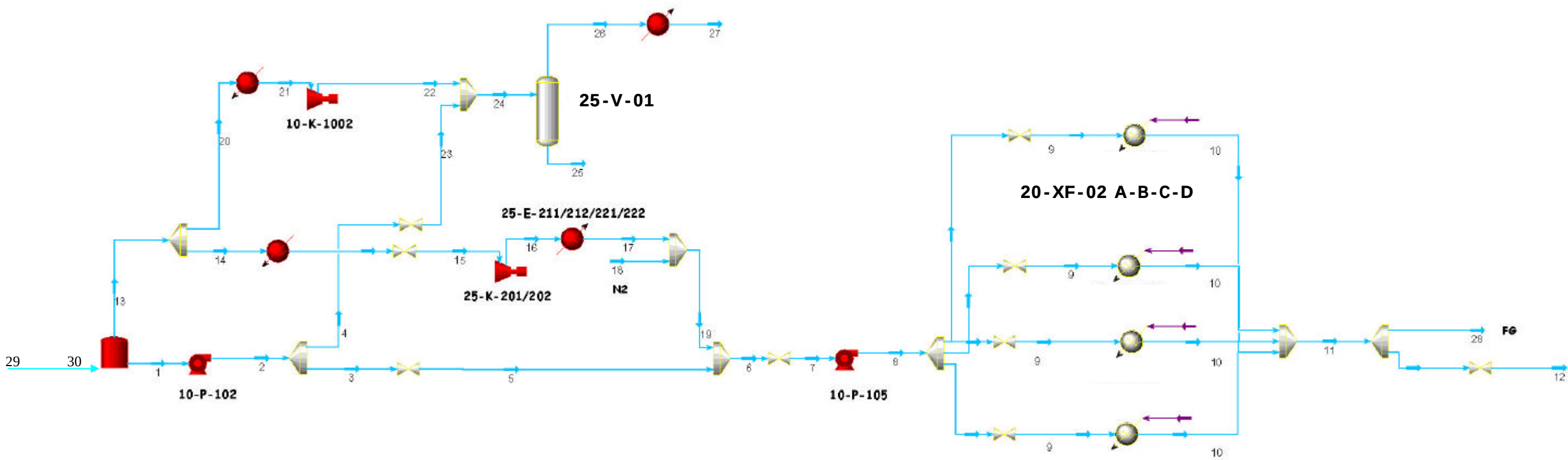
Once we will have the SCVs offer, it will be possible to decide if it is better to install 4 SCVs of 200 t/h each or 5 SCVs of 165 t/h each. It will depend on the total investment, of the annual NO_x emissions and the interest of GNL Italia with the possible annual additional production.

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5. SCHEMI DI PROCESSO SEMPLIFICATI

5.1. SCHEMA SEMPLIFICATO DISCARICA 8 MILIARDI

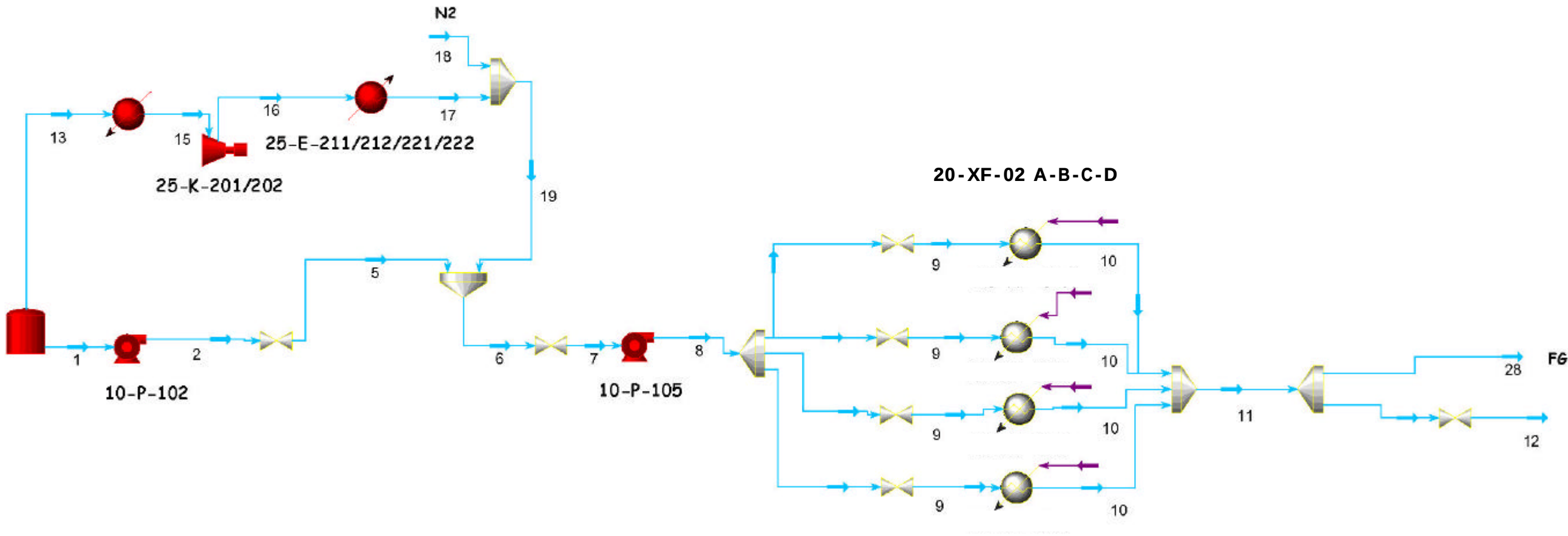
DISCARICA - 8 MILIARDI



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5.2. SCHEMA SEMPLIFICATO NON DISCARICA 8 MILIARDI

NON DISCARICA - 8 MILIARDI



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6. BILANCI MATERIA

		Annual production (bnSm3/year) at metanodotto
Without Heat Recuperation		
4 SCV 200 t/h - 7 unità azoto 2 500 Nm3/h - 4 Air compressors 8 000 Nm3/h	DISCARICA_ GNL PESANTE_ MAXI AIR CAPACITY 4 * 8000 Nm3	7.278
	NON DISCARICA_ PESANTE_ MAXI AIR CAPACITY 4 * 8000 Nm3	6.144
	DISCARICA_ GNL LEGGERO_ 4 SCV 200 t/h + 7 UNITA AZOTO 2500 Nm3	9.404
	DISCARICA_ GNL MEDIO_ 4 SCV 200 t/h + 7 UNITA AZOTO 2500 Nm3	8.794
	NON DISCARICA_ LEGGERO_ 4 SCV 200t/h + 7 UNITA AZOTO 2500 Nm3	9.412
	NON DISCARICA_ GNL MEDIO_ 4 SCV 200t/h + 7 UNITA AZOTO 2500 Nm3	8.797
4 SCV 200 t/h - 7 unità azoto 2 500 Nm3/h - 6 Air compressors 8 000 Nm3/h	DISCARICA_ GNL PESANTE_ 4 SCV 200 t/h + 7 UNITA AZOTO 2500 Nm3	7.991
	NON DISCARICA_ PESANTE_ 4 SCV 200t/h + 7 UNITA AZOTO 2500 Nm3	7.977
5 SCV 165 t/h - 7 unità azoto 2 500 Nm3/h - 6 Air compressors 8 000 Nm3/h	DISCARICA_ GNL LEGGERO_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	9.7
	DISCARICA_ GNL MEDIO_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	9.072
	DISCARICA_ GNL PESANTE_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	8.241
	NON DISCARICA_ PESANTE_ 5 SCV 165 t/h + MAXI N2 CAPACITY 7 * 2500 Nm3	8.101
	NON DISCARICA_ LEGGERO_ 5 SCV 165t/h + 7 UNITA AZOTO 2500 Nm3	9.708
	NON DISCARICA_ GNL MEDIO_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	9.075
With 35 MW Heat Recuperation from the Turbine		
4 SCV 200 t/h - 7 unità azoto 2 500 Nm3/h - 6 Air compressors 8 000 Nm3/h	DISCARICA_ GNL MEDIO_ 4 SCV 200 t/h + 7 UNITA AZOTO 2500 Nm3	8.834
	NON DISCARICA_ GNL MEDIO_ 4 SCV 200t/h + 7 UNITA AZOTO 2500 Nm3	8.838
5 SCV 165 t/h - 7 unità azoto 2 500 Nm3/h - 6 Air compressors 8 000 Nm3/h	DISCARICA_ GNL MEDIO_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	9.113
	NON DISCARICA_ GNL MEDIO_ 5 SCV 165 t/h + 7 UNITA AZOTO 2500 Nm3	9.117