

LEAN SIX SIGMA GREEN BELT PROJEKAT

*Smanjenje tehničkih gubitaka gasa u cilju povećanja
proizvodnje električne energije na objektu SOS Majdan*

Vođa projekta: Svetlana Markov

Datum: 4.4.2023.

Definisanje

5W2H Method

W

WHAT?

Oscilovanje
sistenskog pritiska
prouzrokuje tehničke
gubitke gasa



H

HOW
MUCH?

500-3000
/dan (gasa)

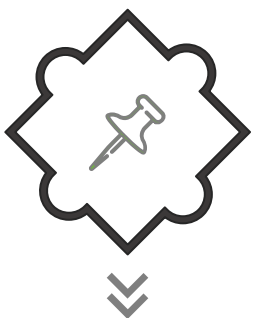
Grejanje 10
maćinstava!

MENADŽMENT
CENTAR
BEOGRAD



Definisanje cilja

SMART



Specific

- Smanjenje tehničkih gubitaka gasa
 - Povećanje proizvodnje električne energije
- Lokacija : SOS Majdan



Measurable

- ↓ teh. gubitaka: 40%
↑ proizvodnje EE: 30%



Ambitious

Problematika kojom se niko nije bavio



Realistic

- SCADA
- OPEX
- SOPPS (Održavanje)

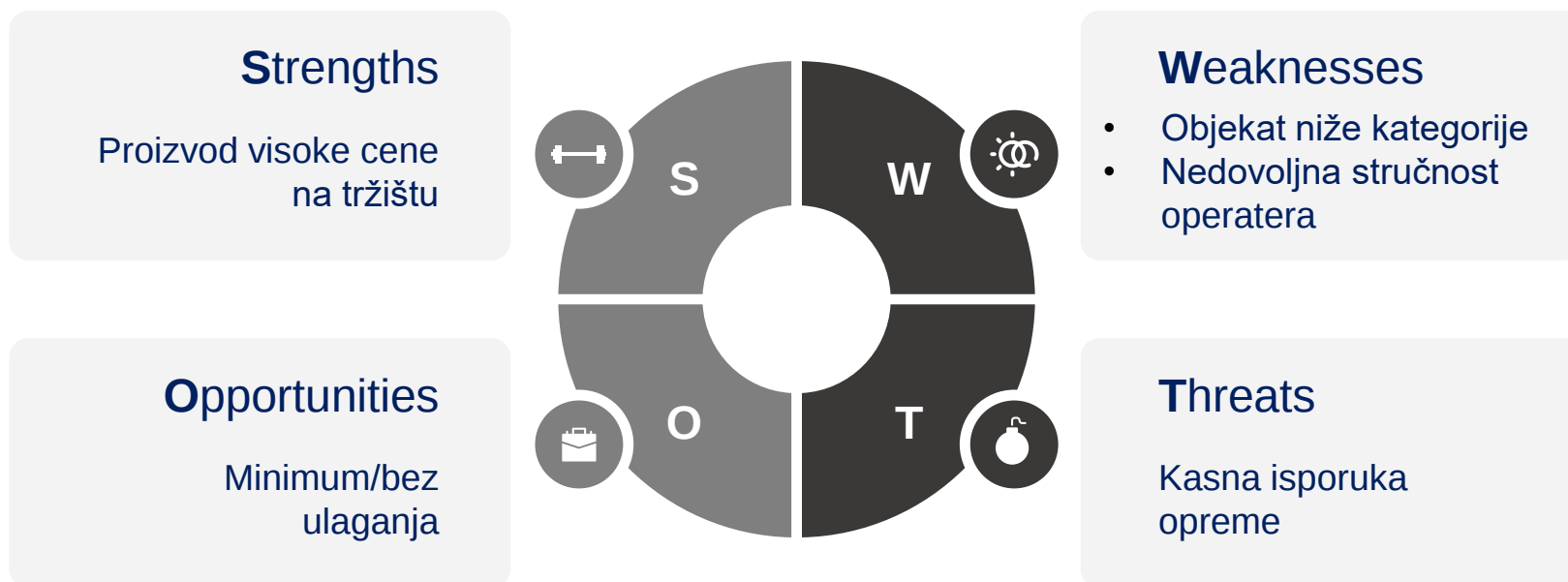


Time framed

Januar 2023.god.

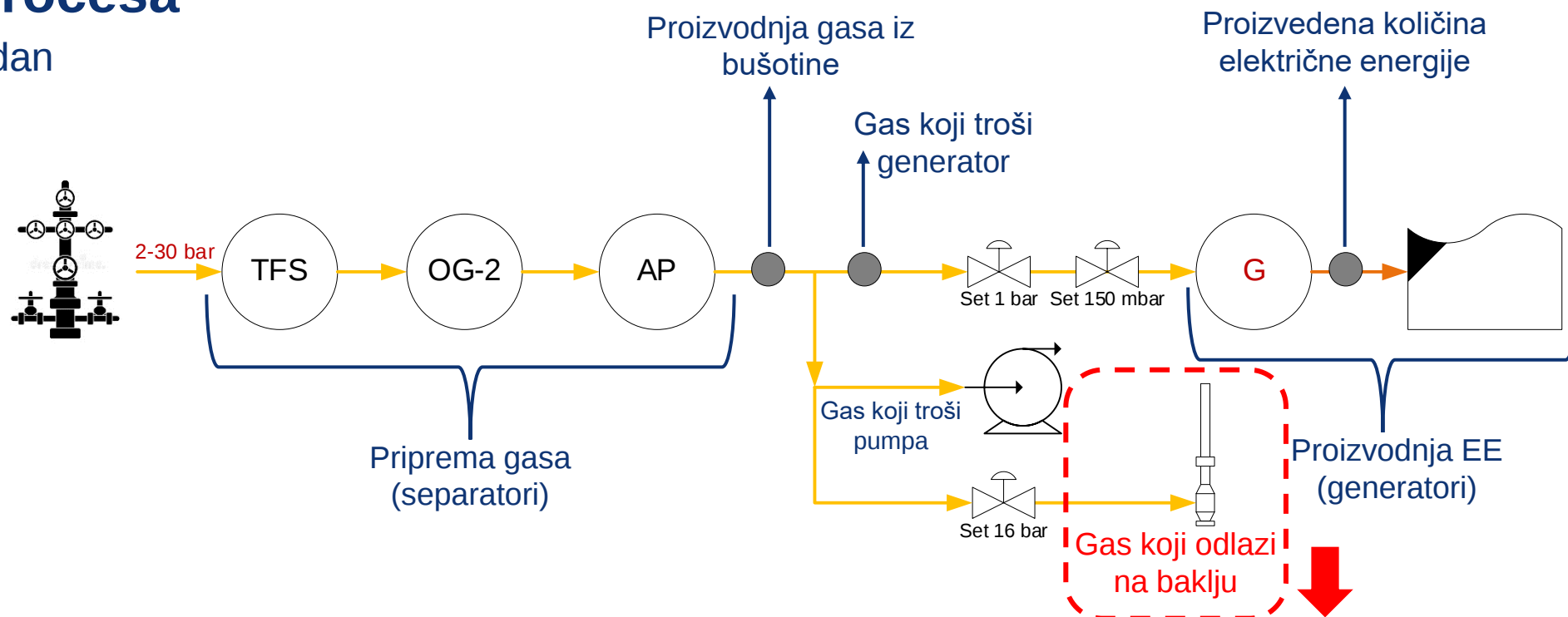
Strategija

SWOT analiza



Opis procesa

SOS Majdan



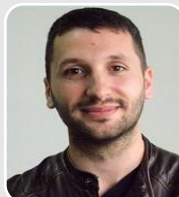
$$Q_{\text{gas iz bušotine}} - Q_{\text{generator}} - Q_{\text{pumpe}} = Q_{\text{baklja}}$$

m^3/h (merilo 1)
 m^3/h (merilo 2)
 m^3/h (paušal)
 m^3/h (rač.vrednost)

Tim

RACI matrica

Vlasnik procesa



Darko Popović

Rukovodilac
brigade gas Bačka

Vođa projekta



Svetlana Markov

Vodeći inženjer za
planiranje,
operativnu i
tehničku podršku

Ekspert



Jovan Dopuđa

Rukovodilac
službe za
planiranje i
koordinaciju

Glavni članovi tima



Svetlana Markov

Vodeći inženjer za
planiranje,
operativnu i
tehničku podršku



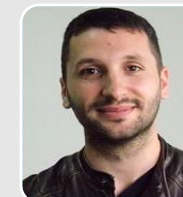
Maja Pisarov

Vodeći inženjer za
bilansiranje
električne energije
i KPG



Stefan Salji

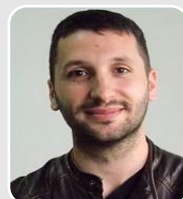
Specijalista za
pripremu i otpremu
nafta



Darko Popović

Rukovodilac
brigade gas Bačka

RACI matrica

					
	 	 	 	 	 
D	R, A	R	R	C	
M	I	R	A, I	I	R
A	R, A	R	C	C	
I	I	C	C	R, A	R
C	R, A	R	C	I	I

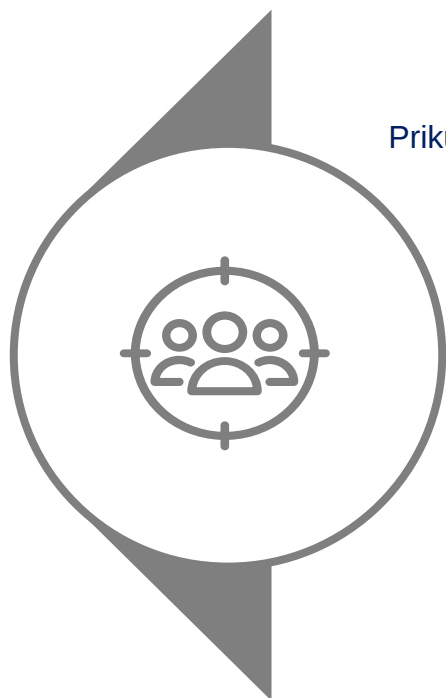
• **R**ensponsibility
(izvršilac)

• **A**ccountability
(menadžer)

• **C**onsulting
(za konsultovanje)

• **I**nformation
(za izveštavanje)

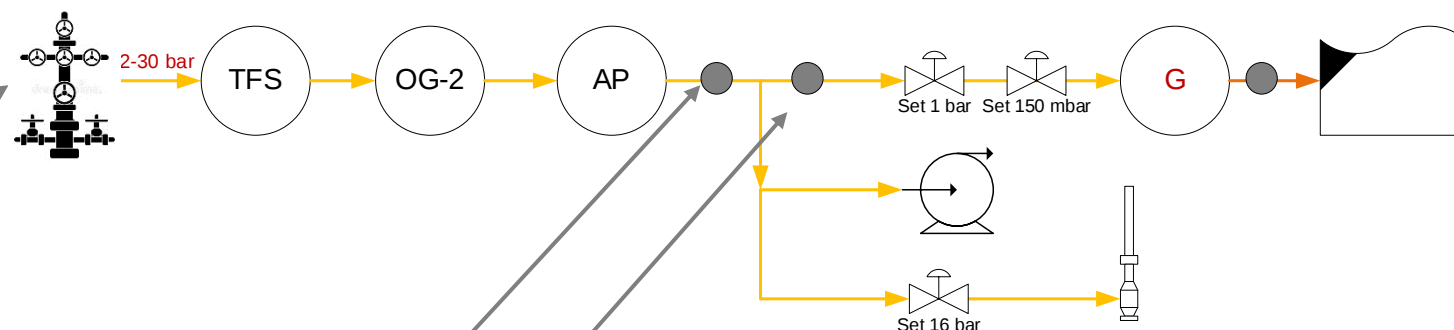
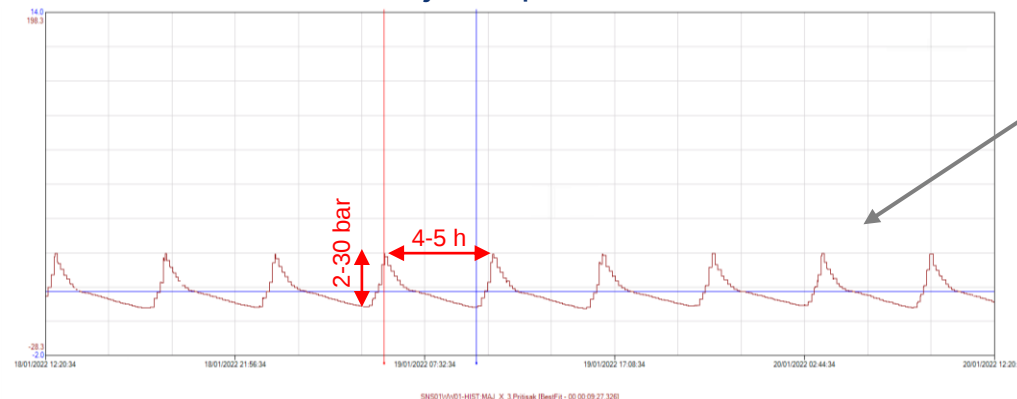
Gantogram



Merenje

Preuzimanje podataka sa SCADA sistema 

- Bušotina sa oscilirajućim pritiskom



- Q,P gasa (MM-104), Qsp (MM-106)



Merenje

Preuzimanje podataka sa SCADA sistema u vidu zbirnog izveštaja



				Stanje Merila			Sr. Vrednost		Proizvedeno		
Pogon	Lokacija	Merno Mesto	Datum	Početno (Sm³)	Krajnje (Sm³)	Total (Sm³)	Temp. (°C)	Prit. (bar)	Total (Sm³)		
Severni Banat	SOS Majdan	M.M.-104		total za pogon:					458,622		
				total za lokaciju:					458,622		
				Zbirno merenje kolicine gasa visokog pritiska					282,872		
			01/02/2022	dnevni total:					9,976		
				31/01 21:00	39,008,344	31/01 22:00	39,008,604	260	6.4	11.0	260
				31/01 22:00	39,008,604	31/01 23:00	39,008,852	248	5.9	7.3	248
				31/01 23:00	39,008,852	01/02 00:00	39,009,084	232	5.6	3.9	232
				00:00	39,009,084	01:00	39,009,476	392	6.2	7.0	392
				01:00	39,009,476	02:00	39,010,584	1108	8.4	15.5	1,108
				02:00	39,010,584	03:00	39,010,820	236	6.6	13.2	236
				03:00	39,010,820	04:00	39,011,052	232	5.8	10.0	232
				04:00	39,011,052	05:00	39,011,276	224	5.2	6.7	224
				05:00	39,011,276	06:00	39,011,496	220	4.6	4.5	220
				06:00	39,011,496	07:00	39,012,528	1032	6.0	13.8	1,032
				07:00	39,012,528	08:00	39,013,024	496	6.7	14.8	496
				08:00	39,013,024	09:00	39,013,280	256	5.8	12.5	256
				09:00	39,013,280	10:00	39,013,536	256	5.9	8.7	256
				10:00	39,013,536	11:00	39,013,772	236	6.3	5.2	236
				11:00	39,013,772	12:00	39,014,112	340	7.0	6.8	340
				12:00	39,014,112	13:00	39,015,252	1140	9.3	16.2	1,140
				13:00	39,015,252	14:00	39,015,512	260	8.0	14.1	260
				14:00	39,015,512	15:00	39,015,772	260	7.7	10.6	260
				15:00	39,015,772	16:00	39,016,020	248	7.7	6.8	248
				16:00	39,016,020	17:00	39,016,252	232	7.0	4.2	232
				17:00	39,016,252	18:00	39,017,228	976	7.6	13.4	976
				18:00	39,017,228	19:00	39,017,808	580	8.0	14.5	580
				19:00	39,017,808	20:00	39,018,068	260	6.0	11.8	260
				20:00	39,018,068	21:00	39,018,320	252	4.8	8.1	252
			02/02/2022	dnevni total:					10,012		

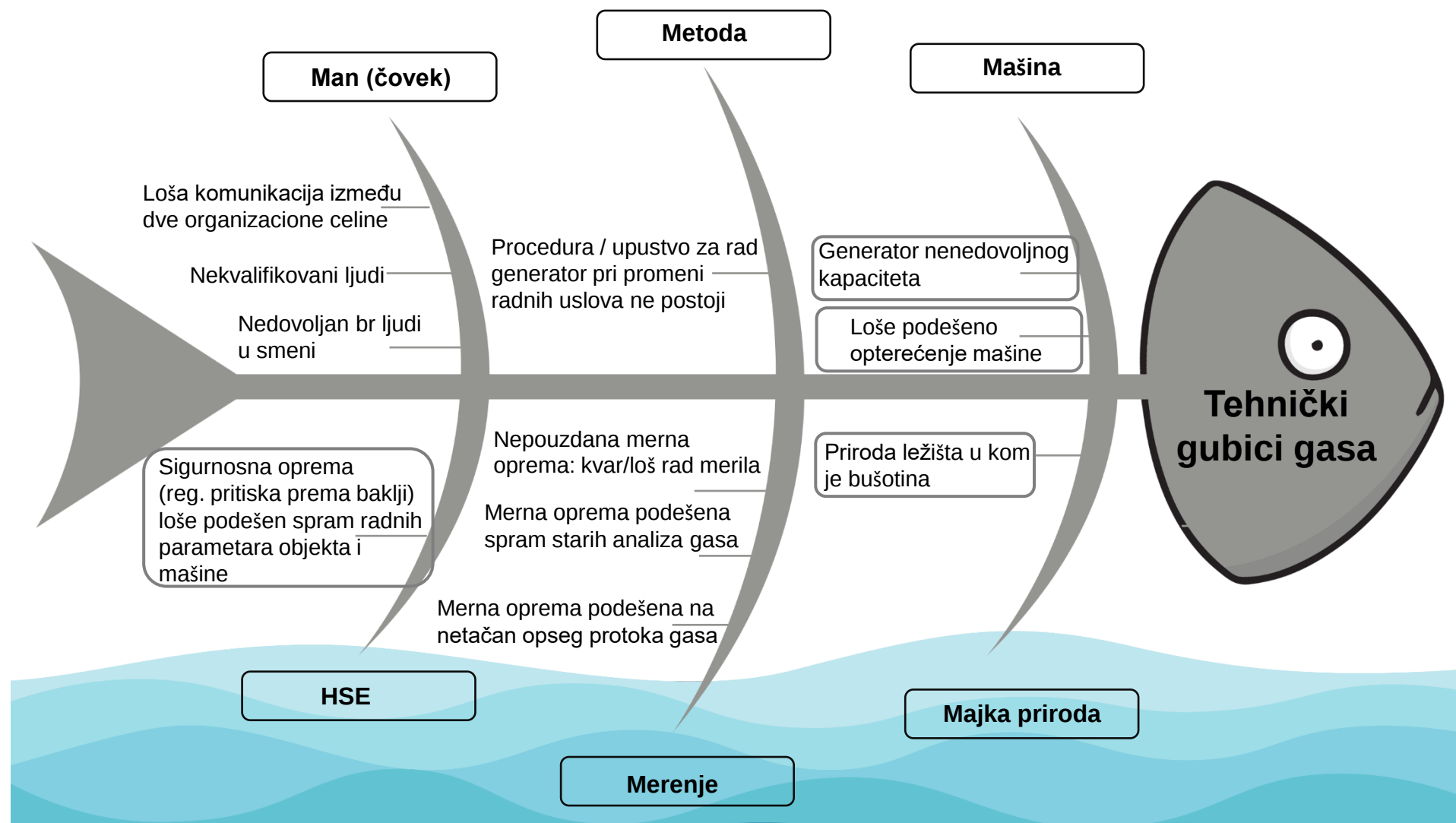
M.M.-106		Sopstvena postrojenja - Kogeneratora Majdan								175,750
01/02/2022		dnevni total:								6,086
31/01 21:00	34,923,647	31/01 22:00	34,923,885	238	31.7	11.0				
31/01 22:00	34,923,885	31/01 23:00	34,924,122	237	33.8	7.2				
31/01 23:00	34,924,122	01/02 00:00	34,924,348	226	35.6	3.7				
01/02 00:00	34,924,348	01:00	34,924,695	347	35.6	6.9				
01:00	34,924,695	02:00	34,924,991	296	31.0	15.3				
02:00	34,924,991	03:00	34,925,228	237	30.7	13.1				
03:00	34,925,228	04:00	34,925,466	238	32.1	10.0				
04:00	34,925,466	05:00	34,925,697	231	33.9	6.6				
05:00	34,925,697	06:00	34,925,929	232	35.1	4.4				
06:00	34,925,929	07:00	34,926,282	353	32.2	13.6				
07:00	34,926,282	08:00	34,926,519	237	30.1	14.8				
08:00	34,926,519	09:00	34,926,757	238	30.5	12.4				
09:00	34,926,757	10:00	34,926,988	231	32.1	8.6				
10:00	34,926,988	11:00	34,927,220	232	34.1	5.1				
11:00	34,927,220	12:00	34,927,539	319	34.5	6.7				
12:00	34,927,539	13:00	34,927,857	318	30.2	16.0				
13:00	34,927,857	14:00	34,928,094	237	29.3	14.0				
14:00	34,928,094	15:00	34,928,332	238	30.6	10.5				
15:00	34,928,332	16:00	34,928,563	231	32.5	6.7				
16:00	34,928,563	17:00	34,928,789	226	34.7	4.2				
17:00	34,928,789	18:00	34,929,027	238	32.0	13.3				
18:00	34,929,027	19:00	34,929,264	237	30.0	14.3				
19:00	34,929,264	20:00	34,929,496	232	31.0	11.7				
20:00	34,929,496	21:00	34,929,733	237	32.9	8.0				
02/02/2022		dnevni total:								6,126

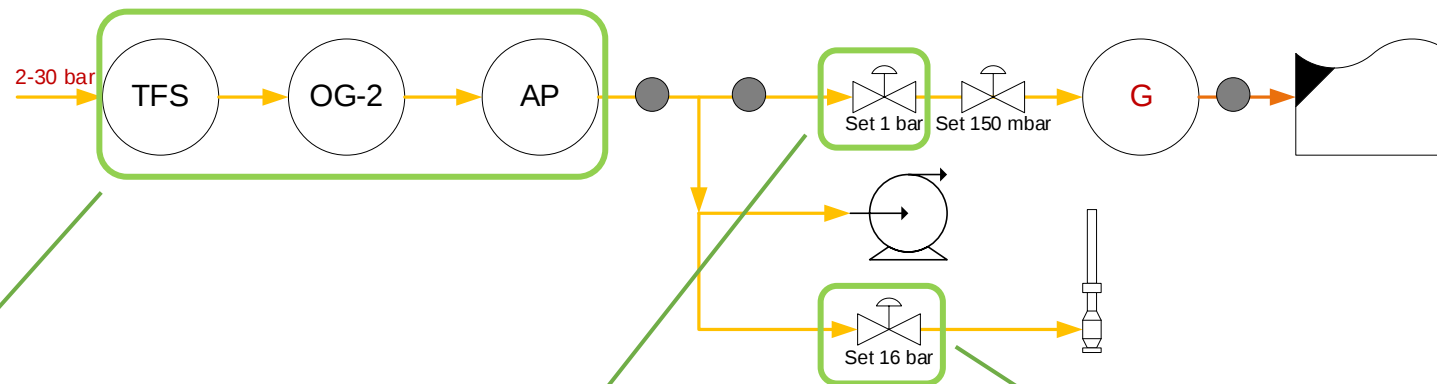
PODACI PRE MERE

Q gasa (MM-104) = 10.000 m3/dan
Q sp (MM-106) = 6.200 m3/dan
Q sp (paušal) = 1.000 m3/dan
Q baklja (rač. vred.) = 2.800 m3/dan
EE = 10.8 MWh



Išikava





TFS, OG-2, AP:
 $P_{\text{max radni}} = 60 - 70 \text{ bar}$
 Cevovodi:
 $P_{\text{max radni}} = 100 \text{ bar}$



$P_{\text{max radni}} = 25 \text{ bar}$



$P_{\text{set}} = 16 \text{ bar}$
 $P_{\text{max set}} = 20 - 30 \text{ bar}$

Akcioni plan

Red. br	ŠTA? 	KO? 	KAD? 	STATUS
1.	Pustiti RN prema izvođačima (SOPPS) za prepodešavanje setovane vrednosti PCV 1 Iskomunicirati sa izvođačima oko detalja posla	Darko Popović	28.11.2022.	Urađeno
2.	Obavestiti Sektor Energetike o planiranim aktivnostima i načinu daljeg rada generatora sa novim režimom rada	Maja Pisarov	30.11.2022.	Urađeno
3.	Uvođenje izvođača (SOPPS) u posao kao i definisanje daljih koraka operatera na objektu i operatera uz generaciono postrojenje	Stefan Salji Darko Popović	2.12.2022.	Urađeno
4.	Prepodešavanje setovane vrednosti PCV 1 na max 24 bar	SOPPS	2.12.2022.	Urađeno
5.	Praćenje parametara rada objekta preko SCADA sistema i informisanje o postignim rezultatima	Darko Popović	2.12.2022.	Urađeno
6.	Kontrola rada sistema sa novim režimom rada	Svetlana Markov Maja Pisarov	3.12.2022- 13.1.2023.	Urađeno
7.	Napisati proceduru za rad generatora pri promeni radnih parametara objekta	Maja Pisarov	31.12.2022.	Urađeno
8.	Obučiti sve operatere spram napisanog uputstva i izvršiti testiranje	Stefan Salji	30.1.2023.	U toku
9.	Proveriti poštovanje procedure	Darko Popović	28.2.2023.	U toku

Rezultati

Preuzimanje podataka sa SCADA sistema u vidu zbirnog izveštaja



Merno Mesto	Stanje Merila			Sr. Vrednost		Proizvedeno	
	Početno (Sm³)	Krajnje (Sm³)	Total (Sm³)	Temp. (°C)	Prit. (bar)	Total (Sm³)	
	total za pogon:					581,764	
	total za lokaciju:					581,764	
M.M.-104	Zbirno merenje kolicine gasa visokog pritiska (Majdan)					100,192	
11/03 21:00	39,402,036	11/03 22:00 39,402,508	472	5.5	17.9	472	
11/03 22:00	39,402,508	11/03 23:00 39,402,964	456	4.5	10.6	456	
11/03 23:00	39,402,964	12/03 00:00 39,403,264	300	3.4	5.5	300	
00:00	39,403,264	01:00 39,403,600	336	2.9	4.1	336	
01:00	39,403,600	02:00 39,404,128	528	3.7	18.6	528	
02:00	39,404,128	03:00 39,404,596	468	3.0	19.1	468	
03:00	39,404,596	04:00 39,405,000	404	1.7	10.1	404	
04:00	39,405,000	05:00 39,405,296	296	0.8	4.9	296	
05:00	39,405,296	06:00 39,405,536	240	0.5	2.7	240	
06:00	39,405,536	07:00 39,405,964	428	1.4	14.1	428	
07:00	39,405,964	08:00 39,406,440	476	2.8	21.1	476	
08:00	39,406,440	09:00 39,406,884	444	4.5	14.9	444	
09:00	39,406,884	10:00 39,407,196	312	6.0	9.0	312	
10:00	39,407,196	11:00 39,407,472	276	7.5	5.6	276	
11:00	39,407,472	12:00 39,407,852	380	9.5	11.3	380	
12:00	39,407,852	13:00 39,408,464	612	11.3	22.1	612	
13:00	39,408,464	14:00 39,408,896	432	11.0	16.7	432	
14:00	39,408,896	15:00 39,409,264	368	11.2	10.4	368	
15:00	39,409,264	16:00 39,409,540	276	11.2	6.4	276	
16:00	39,409,540	17:00 39,409,880	340	11.5	8.0	340	
17:00	39,409,880	18:00 39,410,508	628	12.3	22.3	628	
18:00	39,410,508	19:00 39,410,948	440	9.8	18.2	440	
19:00	39,410,948	20:00 39,411,376	428	8.1	11.5	428	
20:00	39,411,376	21:00 39,411,656	280	6.7	6.7	280	
dnevni total:						10,024	

Merno Mesto	Stanje Merila			Sr. Vrednost		Proizvedeno	
	Početno (Sm³)	Krajnje (Sm³)	Total (Sm³)	Temp. (°C)	Prit. (bar)	Total (Sm³)	
	total za pogon:					581,764	
	total za lokaciju:					581,764	
M.M.-106	Sopstvena postrojenja - Kogeneratora Majdan					94,731	
05/03 21:00	35,141,279	05/03 22:00 35,141,621	342	33.6	9.5	342	
05/03 22:00	35,141,621	05/03 23:00 35,142,009	388	27.5	21.7	388	
05/03 23:00	35,142,009	06/03 00:00 35,142,443	434	29.7	15.4	434	
00:00	35,142,443	01:00 35,142,906	463	33.8	7.3	463	
01:00	35,142,906	02:00 35,143,184	278	35.2	3.3	278	
02:00	35,143,184	03:00 35,143,549	365	33.4	9.3	365	
03:00	35,143,549	04:00 35,143,937	388	27.4	21.6	388	
04:00	35,143,937	05:00 35,144,377	440	30.0	15.3	440	
05:00	35,144,377	06:00 35,144,811	434	34.2	7.4	434	
06:00	35,144,811	07:00 35,145,107	296	35.5	3.3	296	
07:00	35,145,107	08:00 35,145,460	353	34.1	7.4	353	
08:00	35,145,460	09:00 35,145,842	382	27.3	22.0	382	
09:00	35,145,842	10:00 35,146,270	428	28.6	17.1	428	
10:00	35,146,270	11:00 35,146,734	464	32.5	9.9	464	
11:00	35,146,734	12:00 35,147,093	359	35.8	4.4	359	
12:00	35,147,093	13:00 35,147,481	388	35.3	8.0	388	
13:00	35,147,481	14:00 35,147,863	382	28.1	22.1	382	
14:00	35,147,863	15:00 35,148,291	428	29.4	17.3	428	
15:00	35,148,291	16:00 35,148,754	463	32.9	10.4	463	
16:00	35,148,754	17:00 35,149,125	371	36.0	4.9	371	
17:00	35,149,125	18:00 35,149,490	365	34.7	9.6	365	
18:00	35,149,490	19:00 35,149,878	388	28.1	22.3	388	
19:00	35,149,878	20:00 35,150,306	428	29.4	17.1	428	
20:00	35,150,306	21:00 35,150,775	469	33.1	10.1	469	
dnevni total:						8,530	

PODACI POSLE MERE

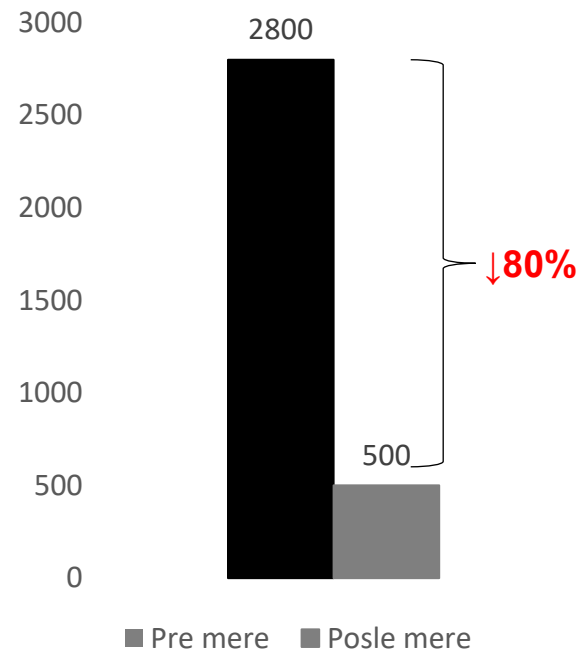
Q gasa (MM-104) = 10.000 m3/dan
 Q sp (MM-106) = 8.500 m3/dan
 Q sp (paušal) = 1.000 m3/dan
 Q baklja (rač. vred.) = 500 m3/dan
 EE = 19.1 MWh



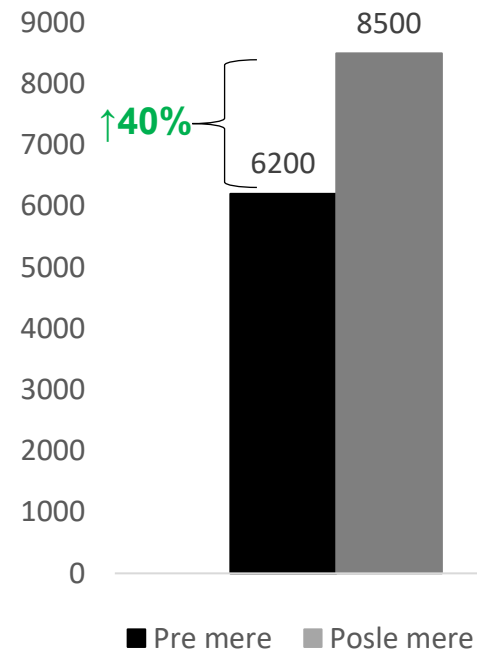
Rezultati

Poređenje i dobit

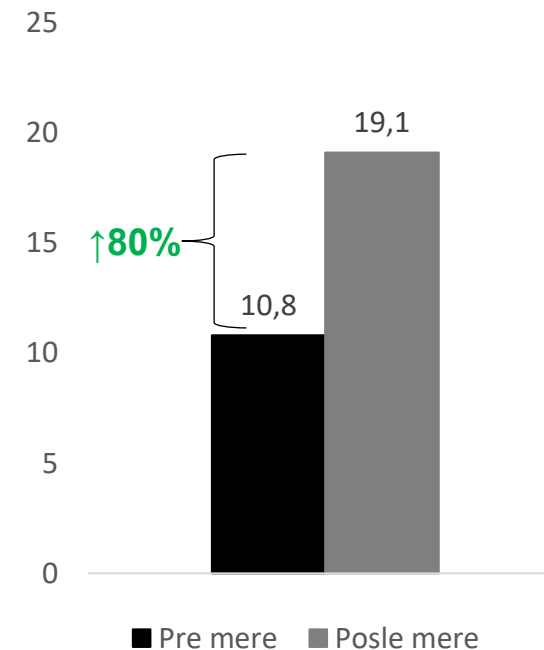
Tehnički gubici



Gas za generatore



Električna energija



$$\begin{aligned} &\text{Pre mere (set 22 bar)} && \text{Posle mere (set 16 bar)} \\ &\frac{(Q_{ee} \times Br \text{ dana} \times Cena_{sr})}{MWh_1 * 350 \text{ dana} \quad 270\text{€}} && \frac{(Q_{ee} \times Br \text{ dana} \times Cena_{sr})}{MWh_2 * 350 \text{ dana} \quad 270\text{€}} \end{aligned}$$



Dobit
780.000 € / god

Kako dalje

Predlozi poboljšanja

- Zamena PCV 1 i PCV 2 sa novim (set 30 bar)
- Bufer rezervoar za skladištenje gasa

→ Veći OPEX/CAPEX troškovi

→ Dugo vreme za realizaciju

→ Provera isplativosti ulaganja spram životnog veka bušotine/objekta

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