DOCKETED	
Docket Number:	19-ERDD-01
Project Title:	Research Idea Exchange
TN #:	234903
Document Title:	Kolodji CorpBlack Swan, LLC Comments - Advanced Combustion - Request for Information - Part 2 of 2
Description:	N/A
Filer:	System
Organization:	Kolodji Corp/Black Swan, LLC
Submitter Role:	Public
Submission Date:	9/24/2020 4:55:59 PM
Docketed Date:	9/24/2020

Comment Received From: Kolodji Corp/Black Swan, LLC
Submitted On: 9/24/2020
Docket Number: 19-ERDD-01

Advanced Combustion - Request for Information - Part 2 of 2

Additional submitted attachment is included below.

Black Swan, LLC

Marc Straub
General Manager – Membranes, Vice President – Technology
Generon IGS, Inc.
Arcy Lane 992, Building 992
Pittsburg, CA 94565

September, 24th 2020

Brian Kolodji, PE and President
Black Swan, LLC
5612 Segovia Way
Bakersfield, CA 93306

Ref.: **19-ERDD-01, Research Idea Exchange for "FUTURE SOLICITATION ON OXYGEN-ENRICHED COMBUSTION"**

Honorable Chair Hochschild:,

Generon IGS, is a manufacturer and employer of about 40 people in California and we are operating in the bay area for more than 40 years. Generon is a spin-off of Dow Chemical and was incorporated in 2001 and we are 100% privately owned. Generon manufactures air and gas separation membranes, and specifically the highest performance and lowest pressure/energy/ cost Black Swan Wig Membranes for

GENERON

Black Swan, LLC

oxy-combustion. These membranes are hollow-fiber membranes that can be used in systems for power plants, industrial boilers, refinery, chemical and oil&gas industry and have been used mostly for oxygen production from air. Generon is one of four membrane manufactures in the gas processing industry located in California, and one of dozens of companies in the world that manufactures hollow-fiber membranes, but we are the only membrane company in California that spin their own commercial hollow-fibers here in California and the only membrane manufacturer that offers the patent pending highest performing/lowest capital/ operating cost membrane in the world, the Black Swan Wig Membrane..

Black Swan, LLC from Bakersfield, California has developed the patent pending Black Swan Wig™ membrane and the Black Swan Membrane Air Enrichment (MAE™) Process. Kolodji Corp is an engineering company with a common owner, Brian Kolodji, with both corporate entities being California based out of Kern County California, and have operations of pilot plants with Black Swan, LLC energy carbon management technology. Black Swan Membrane Air Enriched (MAE) oxy-combustion technology reduces fuel consumption, and associated greenhouse gas (CO_2) emissions, both by up to 40% without reducing duty (steam or power generation) in power plants or any industrial plant that fires fuel and air. Black Swan technology produces up to 43% enriched oxygen from air that replaces the combustion air going to the furnace with only a simple low cost modification to the burner of the power plant or boiler. Black Swan, LLC Waste Heat Recovery and Flue Gas Extraction and Biosequestration technologies add more value by producing even more returns on energy savings, making and reducing usage of potable water, and producing food from CO_2 emissions. Additionally, the priority pollutant concentration of the flue gas is reduced, specifically for NO_x and CO emissions. These emissions can be reduced by up to 70%. A case study showing reduction in natural gas usage without impacting duty is provided for a biogas fired power plant. Biogas is a 100% sustainable renewable fuel, but because of the low heating value, biogas requires over 10% fuel supplementation with natural gas, a non-renewable fuel. With oxygen enrichment to only 24%, biogas is able to sustain combustion without supplemental non-renewable natural gas. Data below show comparative technology energy consumption. PROMAX™ (as licensed by Kolodji Corp) simulations below show elimination of the use of natural gas using oxygen enrichment and exclusively biogas, while retaining the same duty performance for the power plant.

	Energy Consumption		
	1 tpd [kWh/ ton O2]	**25 tpd** [kWh/ ton O2]	**100 tpd** [kWh/ ton O2]
Cryogenic ASU	n/a	n/a	**11.1**
O2-PSA	**52.5**	n/a	n/a
O2-VPSA	n/a	**14.6**	**12.6**
Traditional "NITROX" Membrane Process	**18.8**	**18.8**	**18.8**
Black Swan / Generon	**10.0**	**10.0**	**10.0**

GENERON

Black Swan, LLC

COMMENTS FOR DELIVERY 2020

PROMAX BIOMASS POWER PLANT SIMULATIONS

CASE 1 DATA:

BIOGAS SUPPLEMENTED WITH NATURAL GAS USING AIR >>>>

CASE 2 DATA:

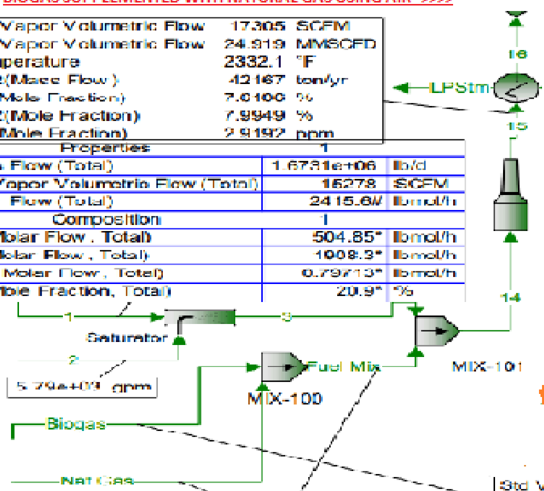
<<< BIOGAS ONLY WITH MEMBRANE AIR ENRICHMENT

Std Vapor Volumetric Flow	17305	SCFM
Std Vapor Volumetric Flow	24.919	MMSCFD
Temperature	2332.1	°F
CO2(Mass Flow)	42167	ton/yr
O2(Mole Fraction)	7.6106	%
CO2(Mole Fraction)	7.9949	%
CO(Mole Fraction)	2.9192	ppm

13632	SCFM
19.63	MMSCFD
2818	°F
43060	ton/yr
6.7802	%
10.581	%
101.83	ppm

Properties	1	
Mass Flow (Total)	1.6731e+06	lb/d
Std Vapor Volumetric Flow (Total)	15278	SCFM
Molar Flow (Total)	2415.6#	lbmol/h
Composition	1	
O2(Molar Flow, Total)	504.85*	lbmol/h
N2(Molar Flow, Total)	1908.3*	lbmol/h
CO2(Molar Flow, Total)	0.79713*	lbmol/h
O2(Mole Fraction, Total)	20.9*	%

1	
1.2846e+06	lb/d
11080	SCFM
1847.6#	lbmol/h
1	
443.42*	lbmol/h
1404.2*	lbmol/h
0*	lbmol/h
24*	%



Fuel Mix	
90	°F
20	psia
1.4228e+05	lb/d
230.58	lbmol/h
25.711	lb/lbmol
1458.3	SCFM
Fuel Mix	
64.5	%
0	%
34.5	%
0	%

Std Vapor Volumetric Flow	1.83	MMSCFD
Water Content	7.6813	mg/l
CO2(Mole Fraction)	34.5	%
C1(Mole Fraction)	64.5	%
Water(Mole Fraction)	1	%

2.1 MMSCFD

Std Vapor Volumetric Flow	0.17	MMSCFD
C1(Mole Fraction)	95	%
CO2(Mole Fraction)	1	%
C2(Mole Fraction)	3	%
N2(Mole Fraction)	1	%

0 MMSCFD

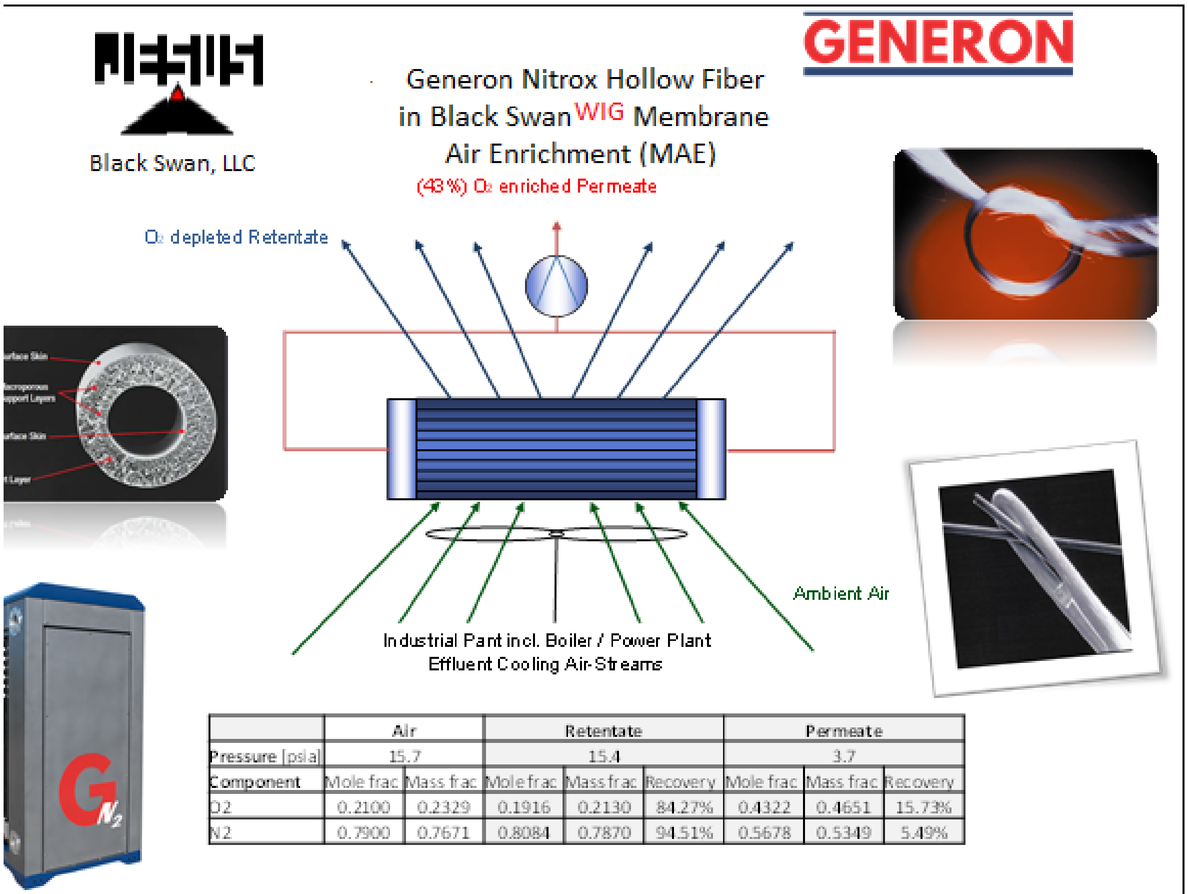
Properties	Fuel Mix	
Temperature(Total)	97.42	°F
Pressure(Total)	20	psia
Mass Flow (Total)	1.3154e+05	lb/d
Molar Flow (Total)	219.6	lbmol/h
Molecular Weight(Total)	24.959	lb/lbmol
Std Vapor Volumetric Flow (Total)	1388.9	SCFM
Composition	**Fuel Mix**	
C1(Mole Fraction, Total)	67.093	%
C2(Mole Fraction, Total)	0.255	%
CO2(Mole Fraction, Total)	31.653	%
N2(Mole Fraction, Total)	0.085	%

Names	Units	3	14	15	16
Temperature	°F	100	98.7	2.33e+03	350*
Pressure	psia	14.7	14.7	14.7	14.7
Mole Fraction Vapor	%	100	100	100	100
Mole Fraction Vapor	%	100	100	100	100
Mass Density	lb/ft^3	0.0696	0.0689	0.0138	0.0476
Molar Flow	lbmol/h	2.52e+03	2.74e+03	2.74e+03	2.74e+03
Mass Flow	lb/d	1.72e+06	1.86e+06	1.86e+06	1.86e+06
Molecular Weight	lb/lbmol	28.4	28.1	28.1	28.1
Std Vapor Volumetric Flow	SCFM	1.59e+04	1.73e+04	1.73e+04	1.73e+04
Vapor Volumetric Flow	ft^3/min	17133	18016	92984	20902
N2(Molar Flow)	lbmol/h	1908.3	1908.5	1908.5	1908.5
O2(Molar Flow)	lbmol/h	504.85	504.85	208.23	208.23
Water(Molar Flow)	lbmol/h	100.07	102.08	399.02	399.02
CO2(Molar Flow)	lbmol/h	0.79713	70.305	218.75	218.75
N2(Mole Fraction)	%	75.839	69.759	69.752	69.752
O2(Mole Fraction)	%	20.064	18.453	7.6106	7.6106
Water(Mole Fraction)	%	4.0007	3.7531	14.583	14.583
CO2(Mole Fraction)	%	0.03168	2.5698	7.9949	7.9949
Mass Cp	Btu/(lb*°F)	0.24740	0.2549	0.3305	0.26705
Ideal Gas CpCv Ratio		1.3945	1.3839	1.2714	1.3596
CpCv Ratio		1.3965	1.386	1.2714	1.3615
Dynamic Viscosity	cP	0.018683	0.01821	0.055063	0.023372
Thermal Conductivity	Btu/(h*ft*°F)	0.0154	0.015534	0.057988	0.020368

3	14	15	16
100	99.9	2.82e+03	350*
14.7	14.7	14.7	14.7
100	100	100	100
100	100	100	100
0.0698	0.0691	0.0118	0.0477
1.92e+03	2.16e+03	2.16e+03	2.16e+03
1.32e+06	1.46e+06	1.46e+06	1.46e+06
28.5	28.2	28.2	28.2
1.22e+04	1.36e+04	1.36e+04	1.36e+04
13104	14670	85993	21236
1404.2	1404.2	1404.2	1404.2
443.42	443.42	146.13	146.13
76.998	79.304	376.66	376.66
0	79.549	228.05	228.05
72.959	65.154	65.149	65.149
23.04	20.676	6.7802	6.7802
4.0007	3.6797	17.476	17.476
0	3.6911	10.581	10.581
0.2466	0.25588	0.34574	0.27055
1.3944	1.3803	1.2555	1.352
1.3964	1.3826	1.2555	1.354
0.018769	0.018149	0.061498	0.023186
0.015406	0.015565	0.0666	0.020272

GENERON

Black Swan, LLC



	Air		Retentate			Permeate		
Pressure [psia]	15.7		15.4			3.7		
Component	Mole frac	Mass frac	Mole frac	Mass frac	Recovery	Mole frac	Mass frac	Recovery
O2	0.2100	0.2329	0.1916	0.2130	84.27%	0.4322	0.4651	15.73%
N2	0.7900	0.7671	0.8084	0.7870	94.51%	0.5678	0.5349	5.49%

.

Due to the benefits of Black Swan, LLC/Generon Membrane Technology future green-field projects or re-vamped brown-field projects in California can benefit from technology made in California leading to reduced fuel consumption, reduced Green House Gas (CO2) emissions, reduced NOx emissions, and reduced water consumption, and increased agricultural production!. The technology can then be exported to the rest of the world to combat the Energy-Water-Food Nexus dilemma, Greenhouse gas accumulation in the atmosphere, and resolve climate change on a global level by 2030, sooner than California’s mandate of 2045.