

ANNEX 3



3D presentations and technical design drawings

ANNEX 3: 3D PRESENTATIONS AND TECHNICAL DESIGN DRAWINGS

This Annex includes:

- a) 3D presentations of the 20 and 80 cow house modules
- b) Technical Design Drawings (TDs) of the 4 cow house modules
- c) Technical Design Drawings (TDs) of biogas installations
Biogas Energy calculation example diesel to biogas
Biogas Energy calculation example
Biogas BOQ example

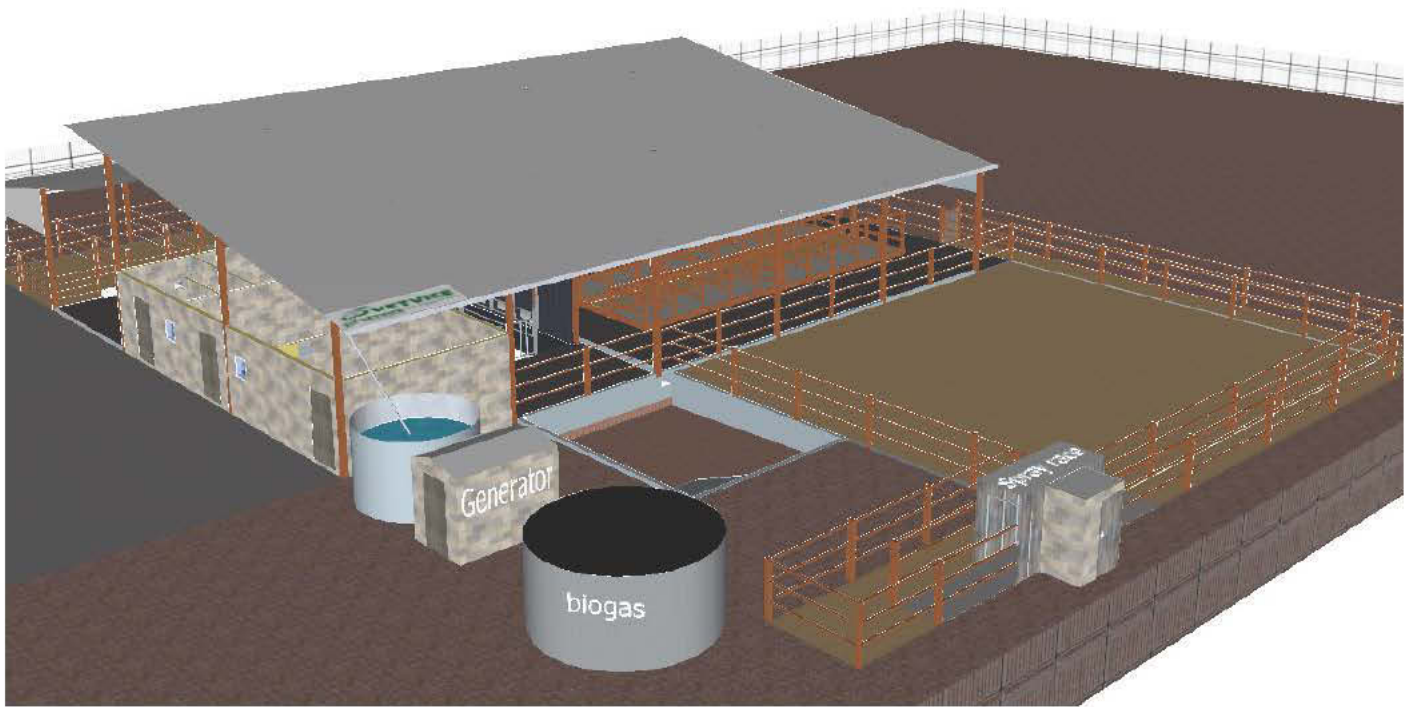


Figure 23. Screenshot Annex 3.a 3D 20 Cows module



Screenshot Annex 3.c 3D 80 Cows module steel feed rail.

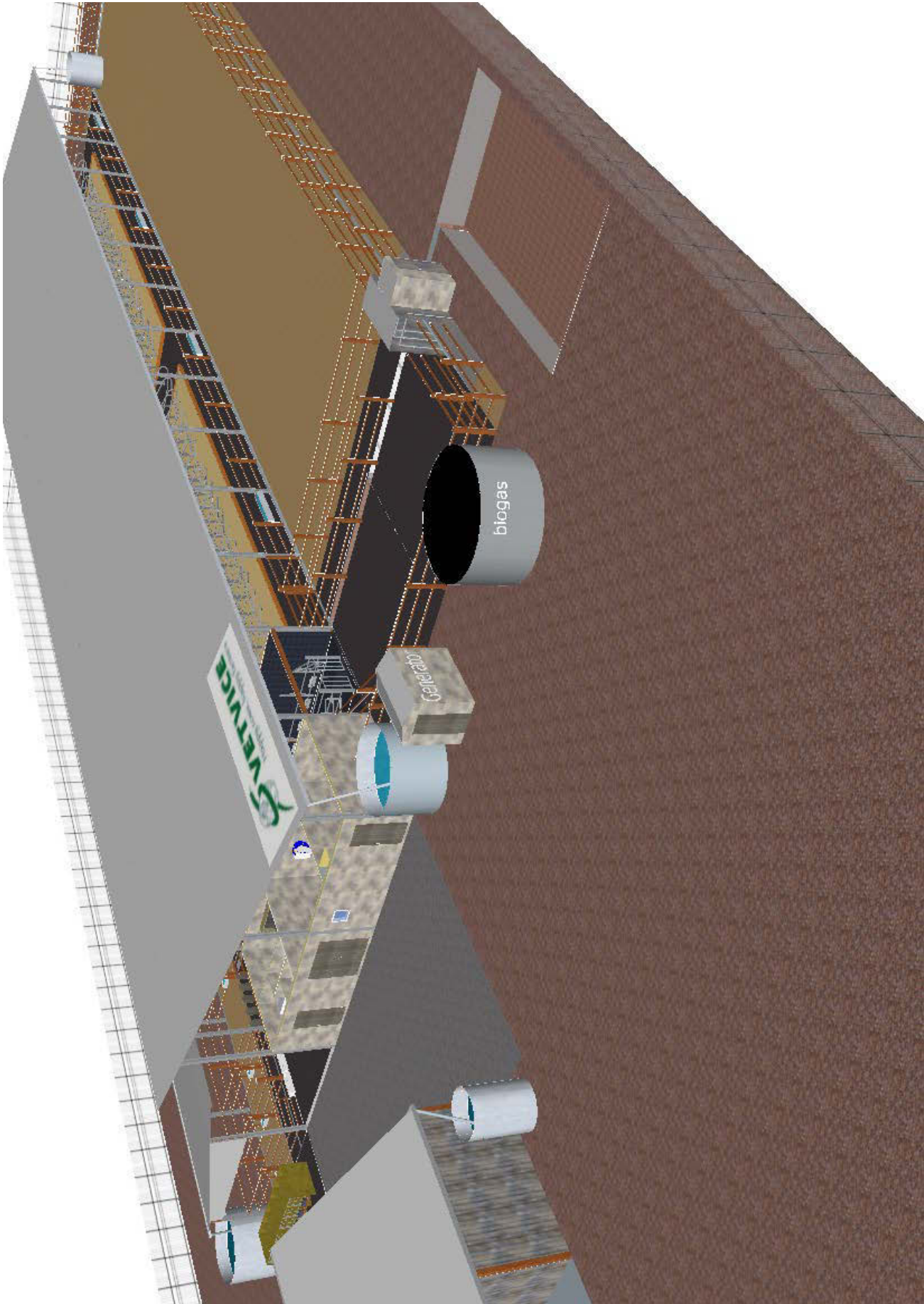
3.a 3D 20 Cows module



3.b 3D 80 Cows module steel feed fence & stall dividers



3.c 3D 80 Cows module steel feed rail & wooden stall dividers



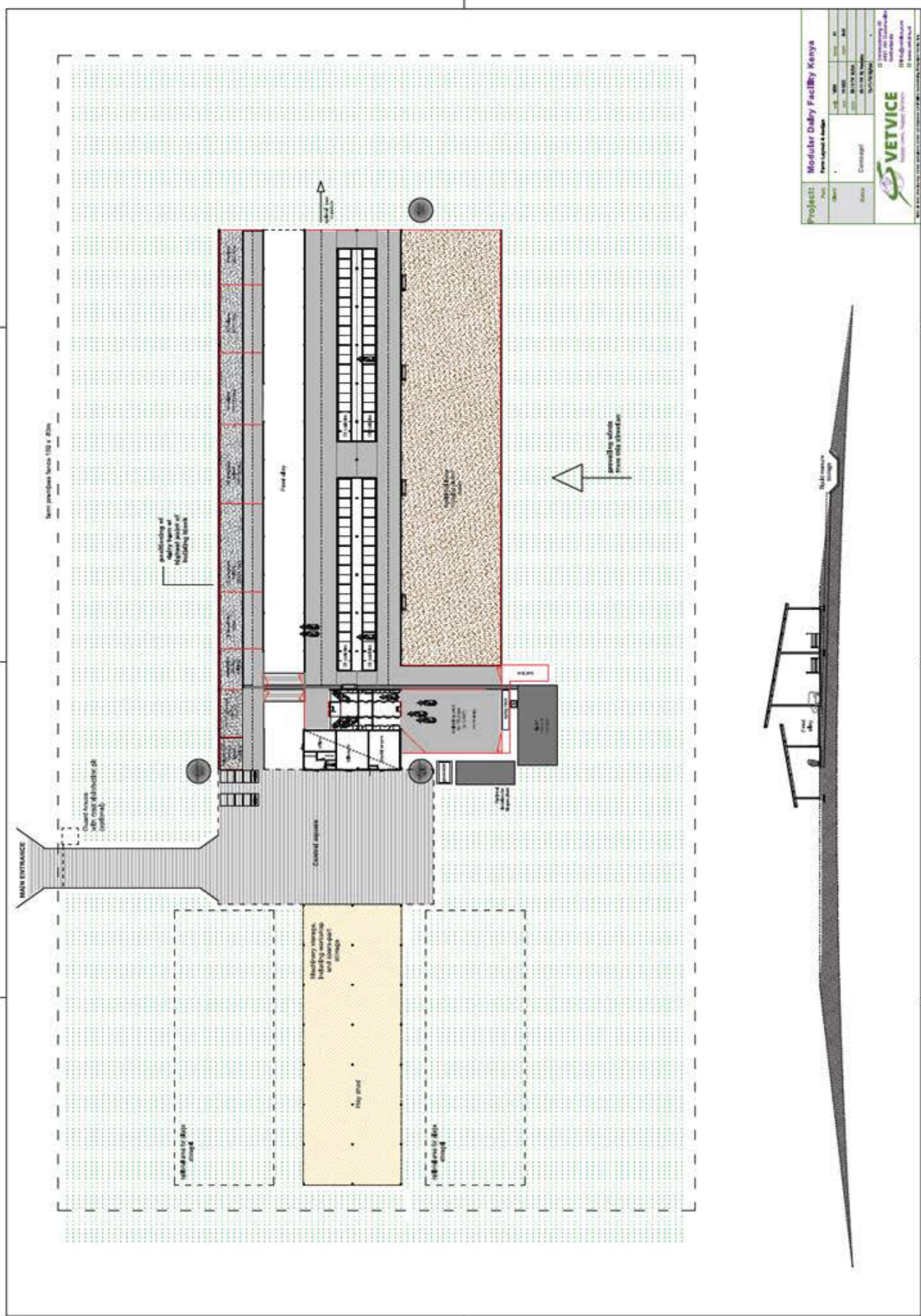
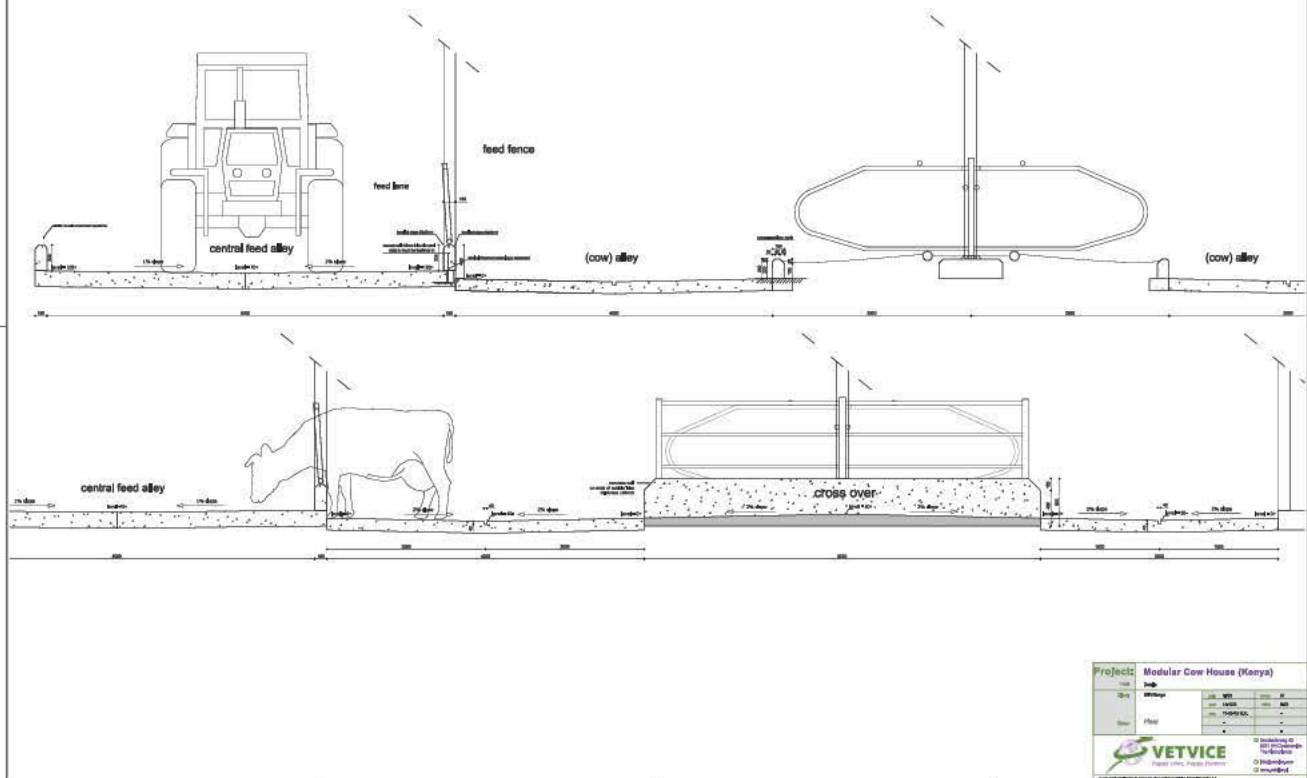
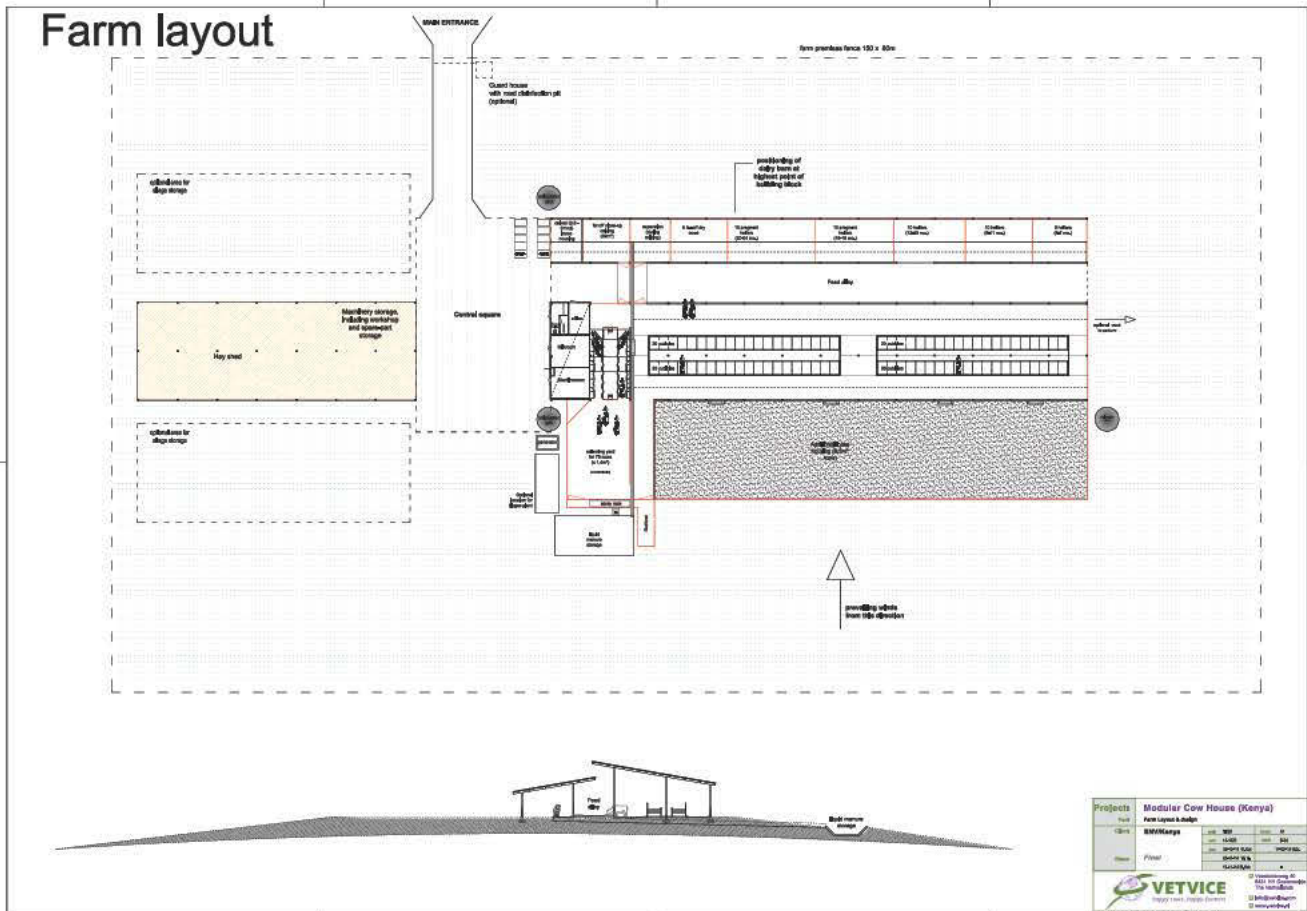


Figure 24. Annex 3.e TD Farm layout

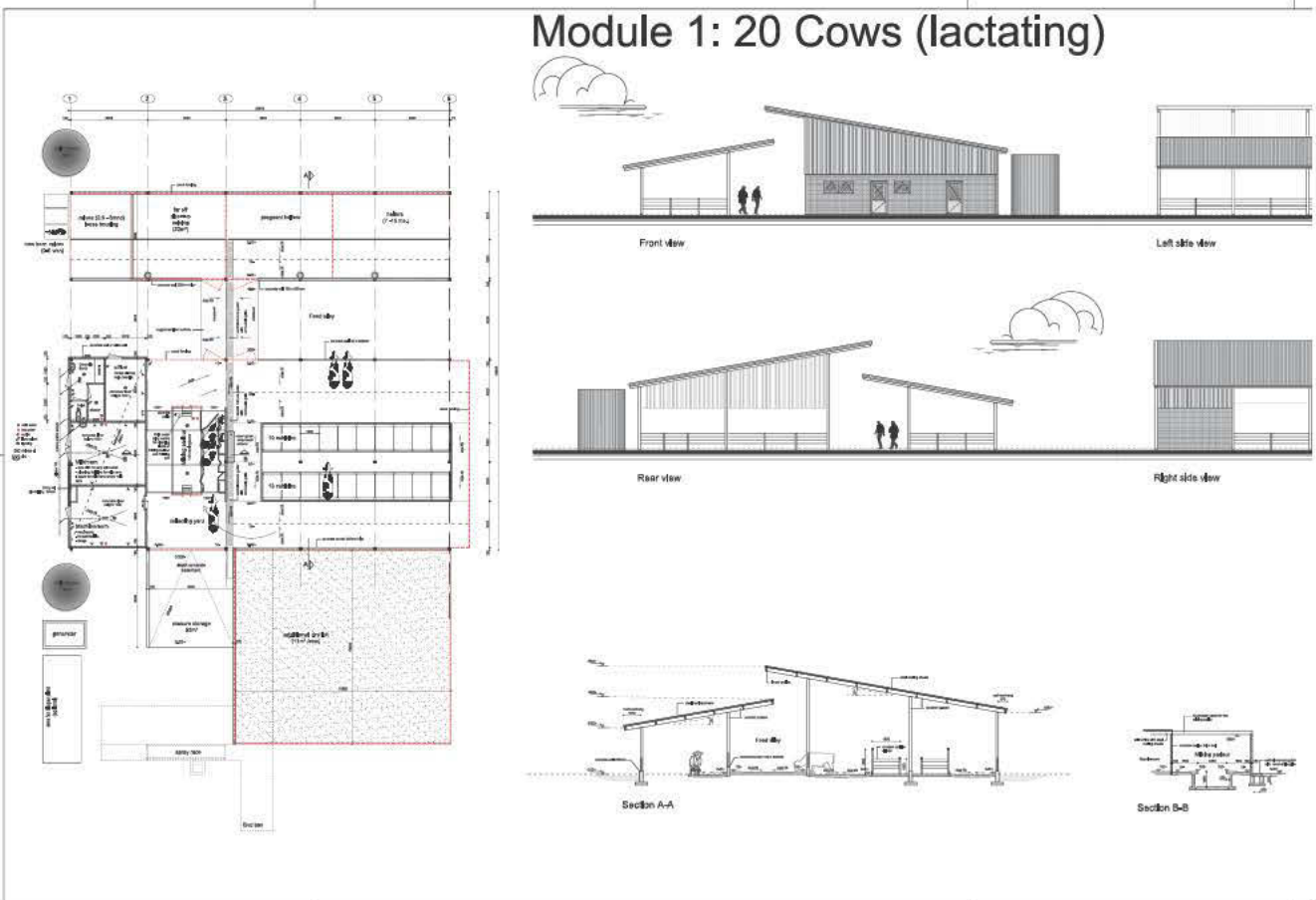
Details + cross section flooring



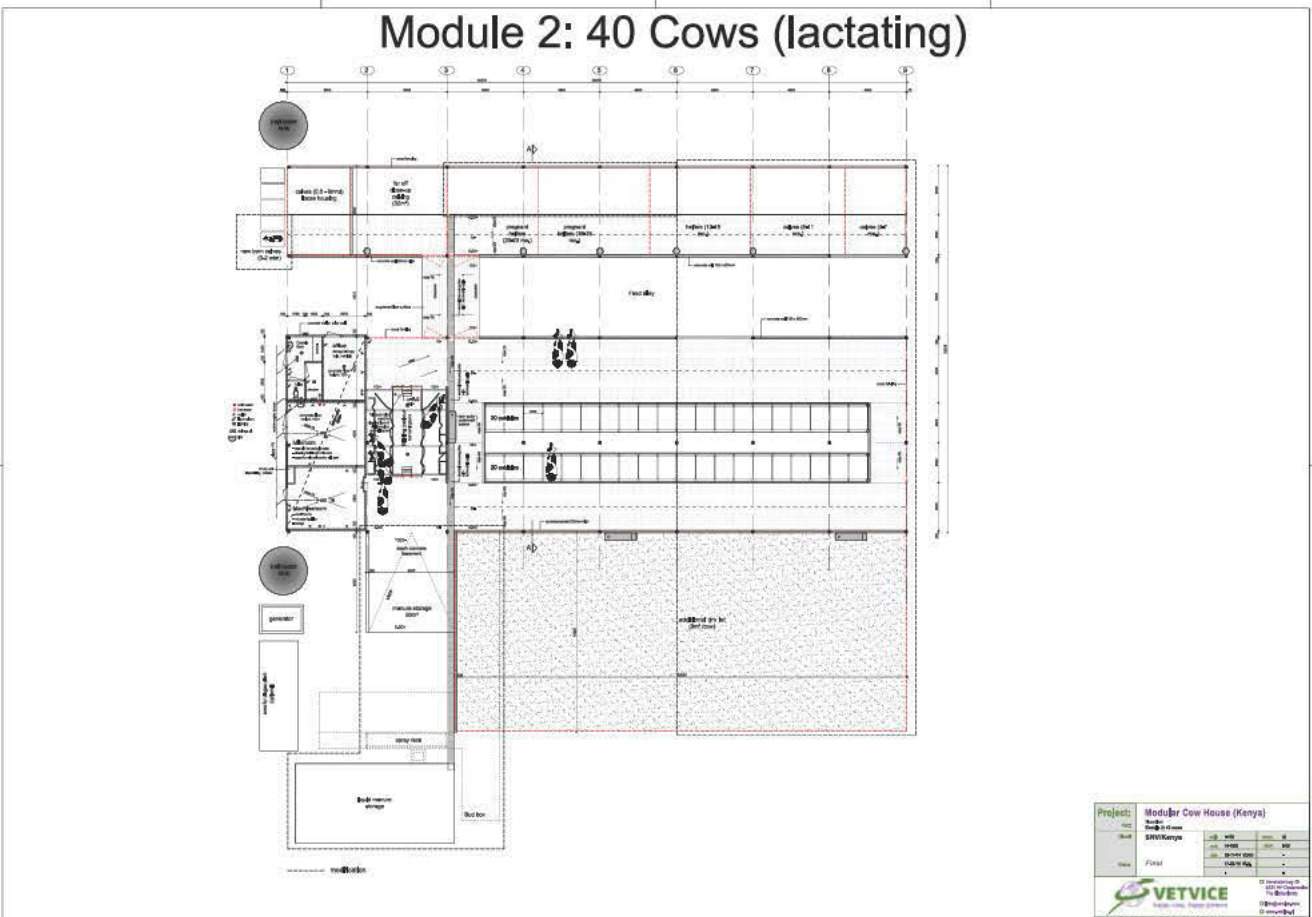
Farm layout



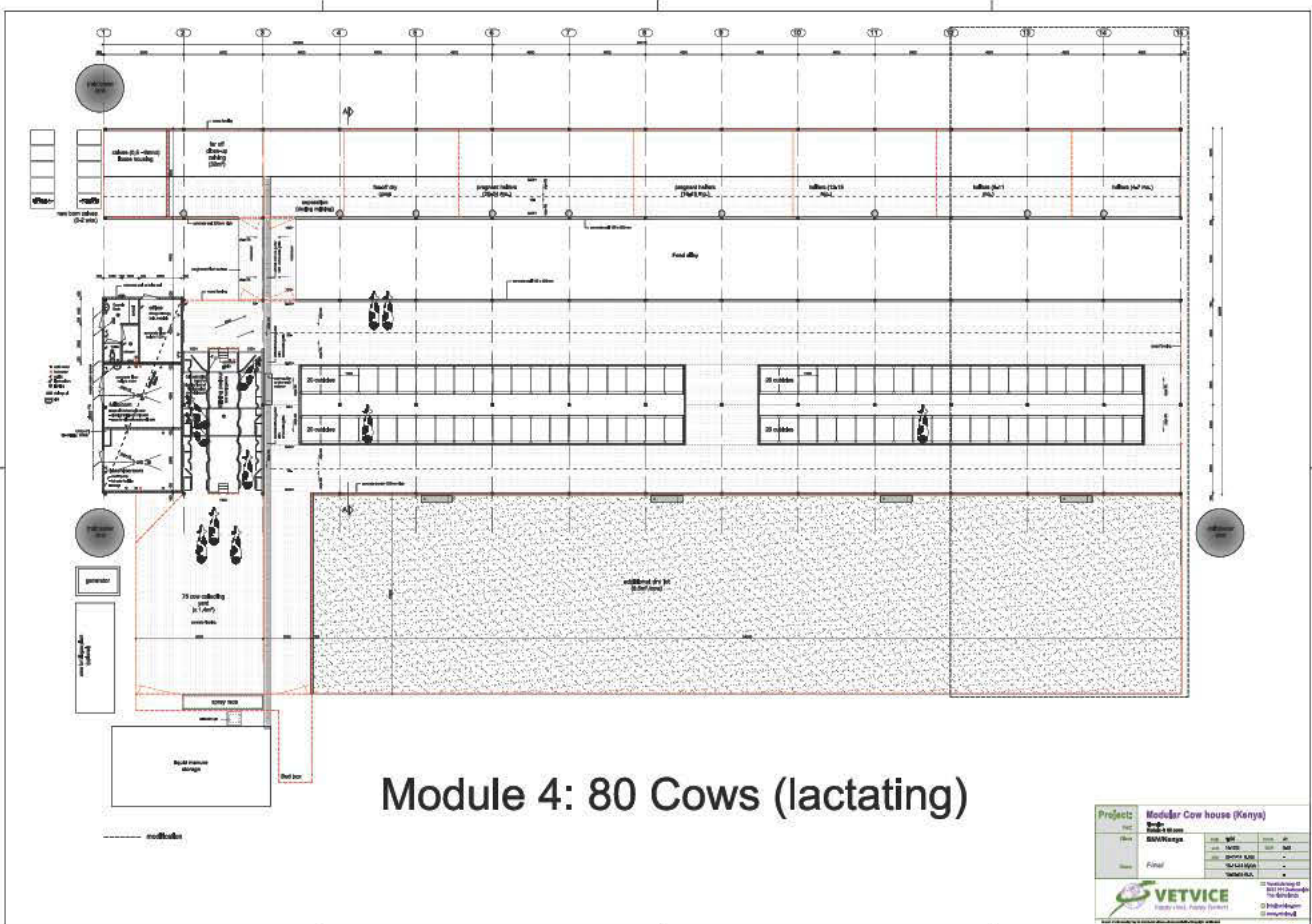
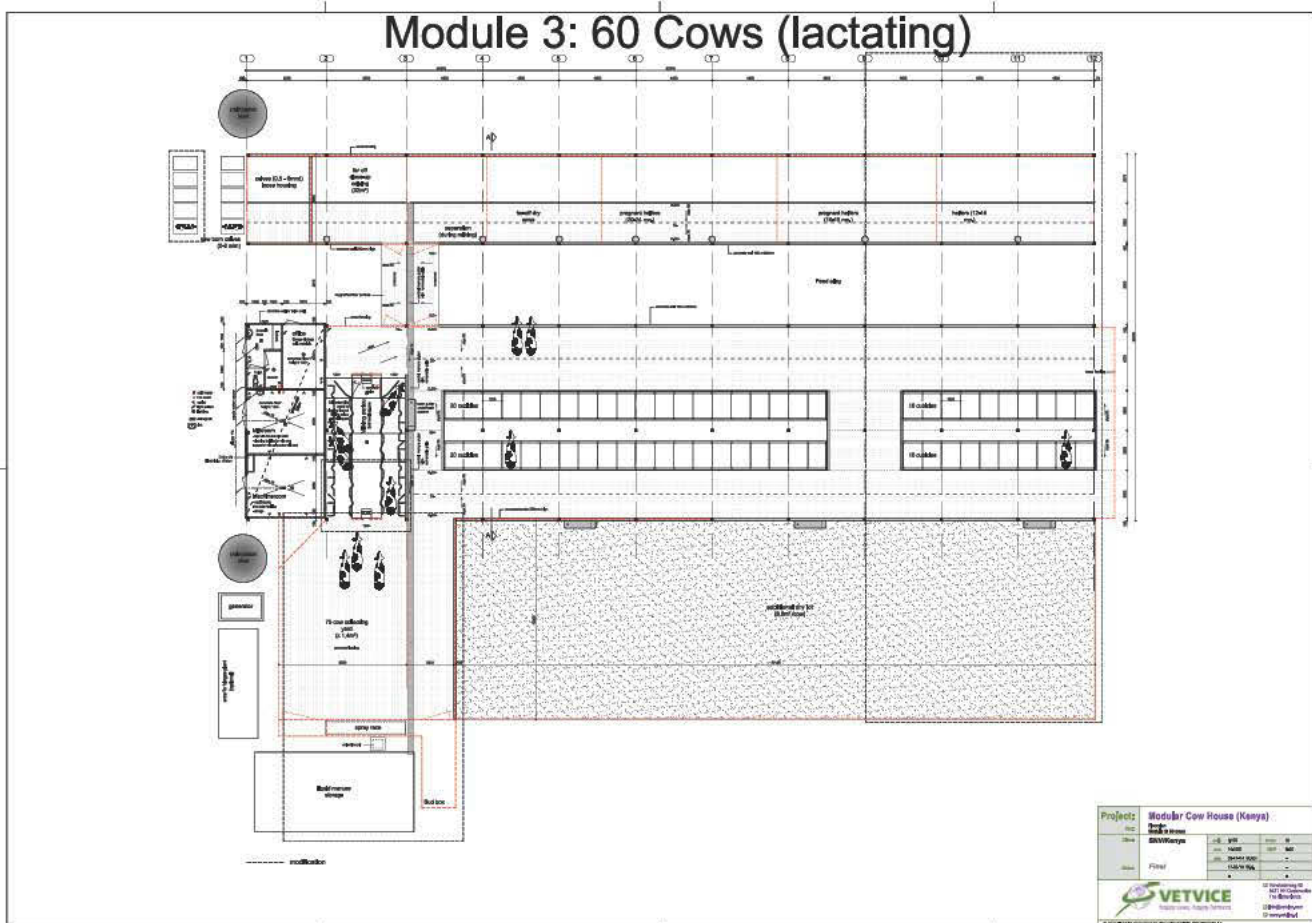
Module 1: 20 Cows (lactating)

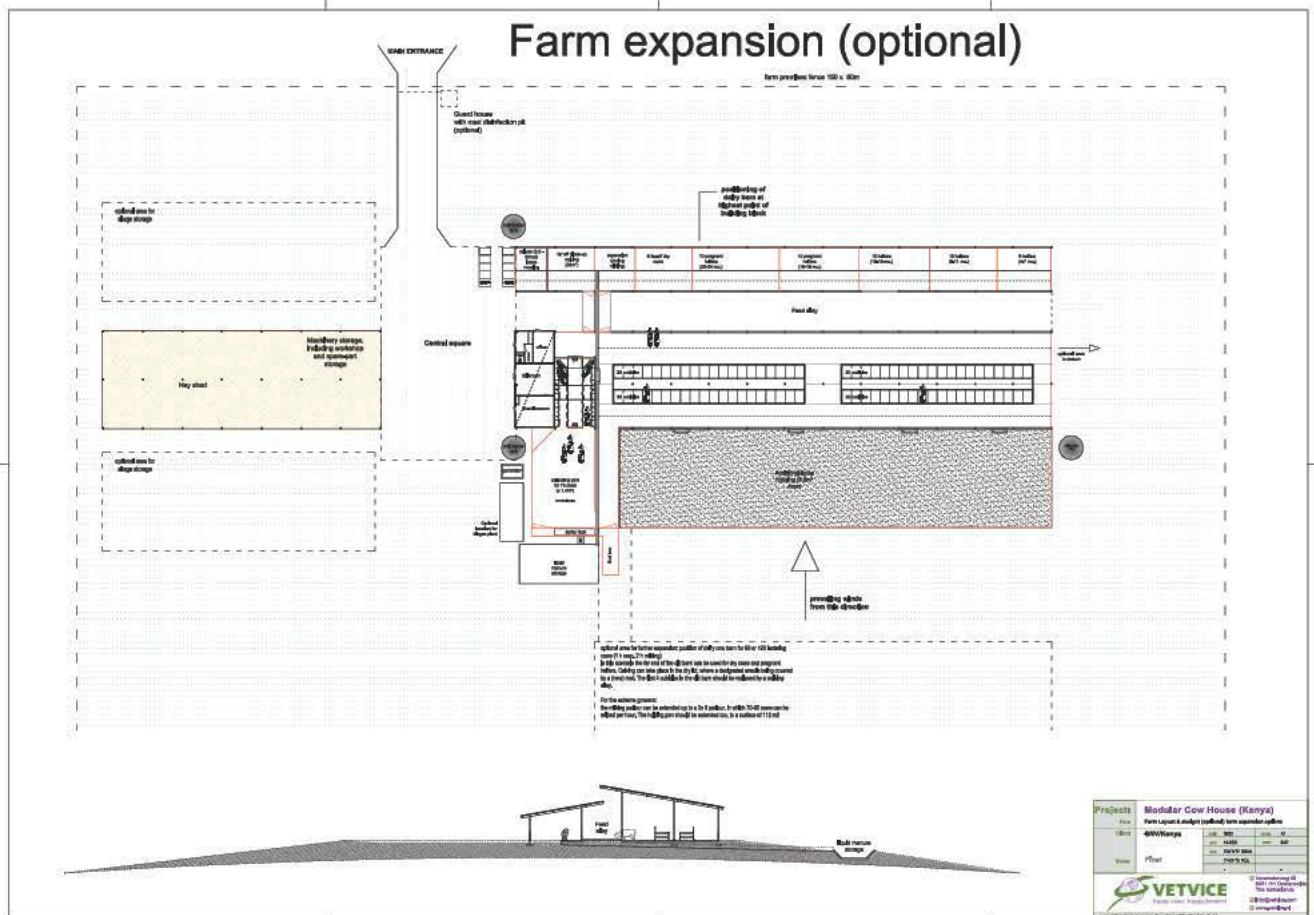
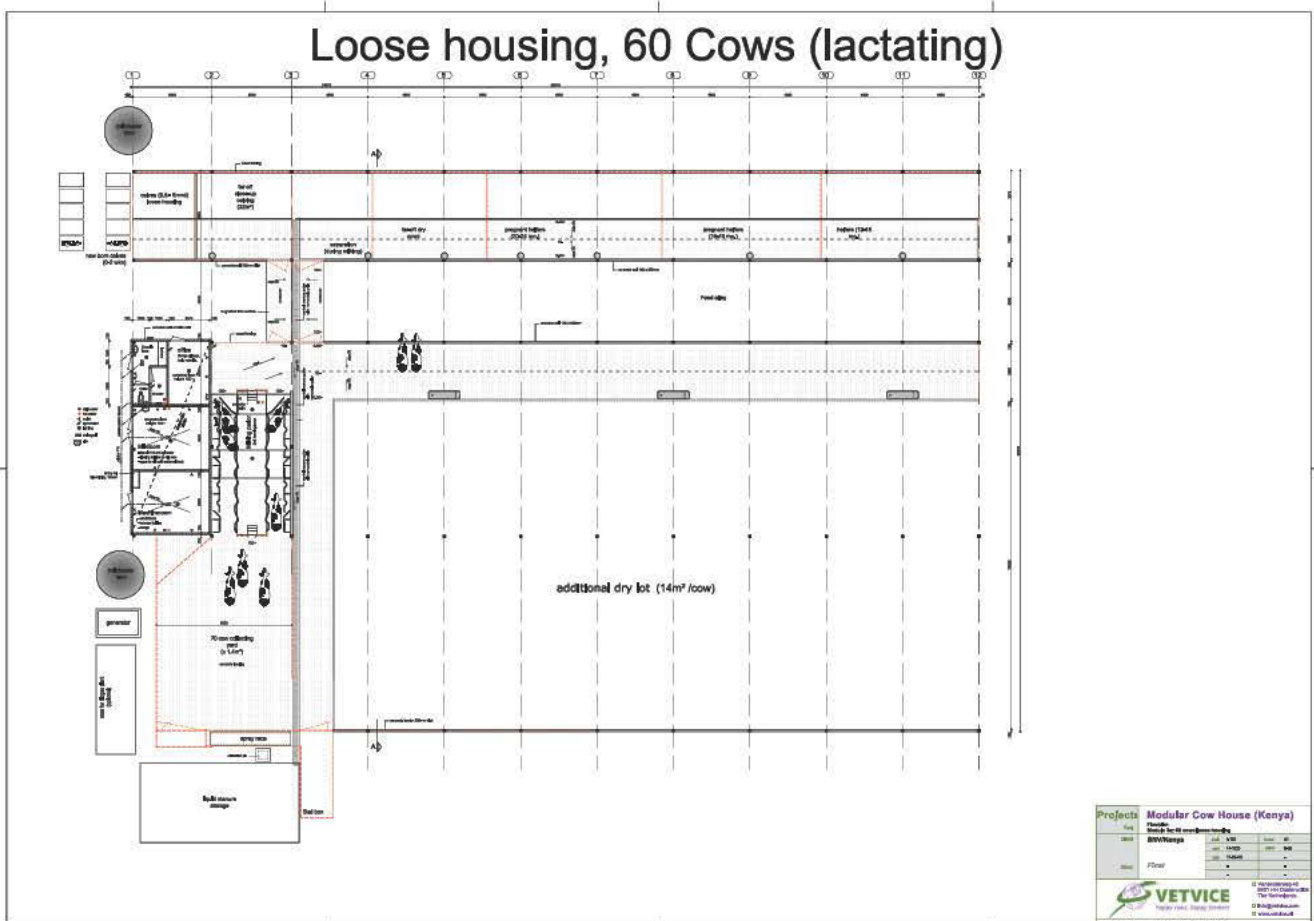


Module 2: 40 Cows (lactating)

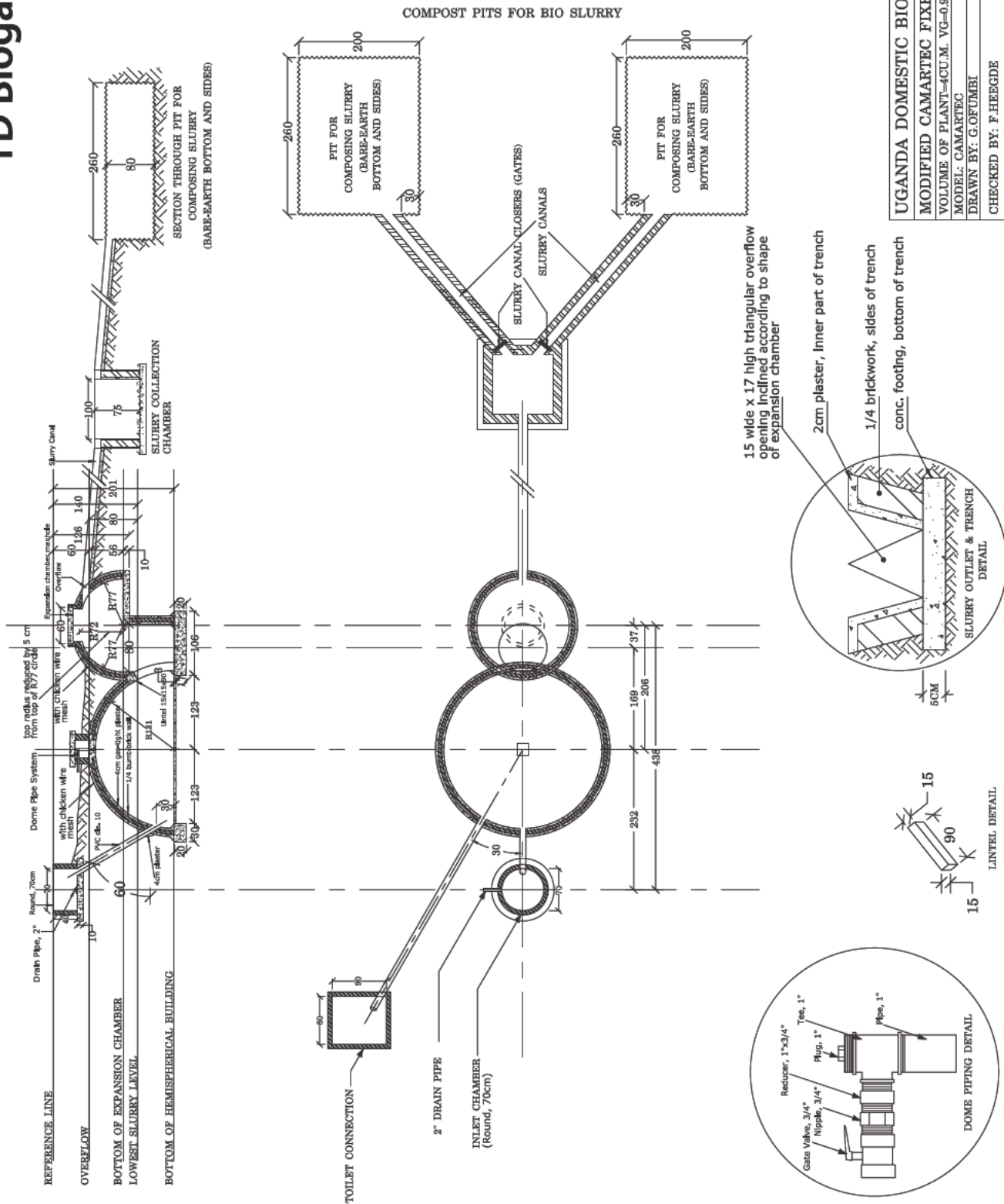


Project: Modular Cow House (Kenya)	
Client: SAKIK Kenya	Architect: VETVICE
Location: Kenya	Year: 2023
Area: 1000 sqm	Scale: 1:100
	



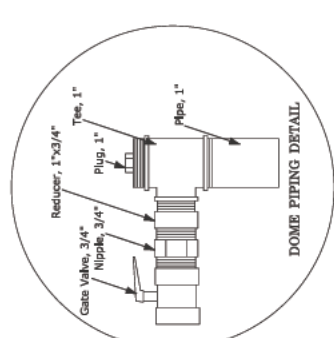
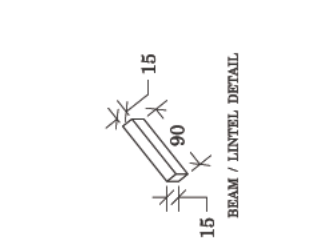
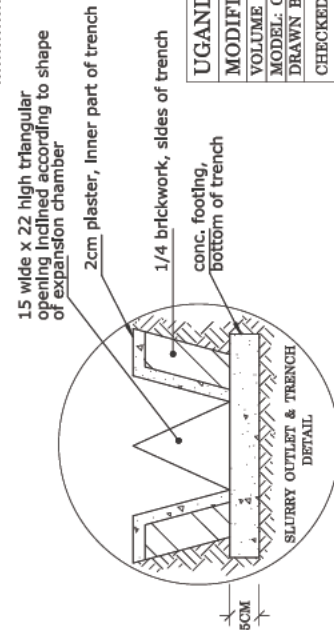
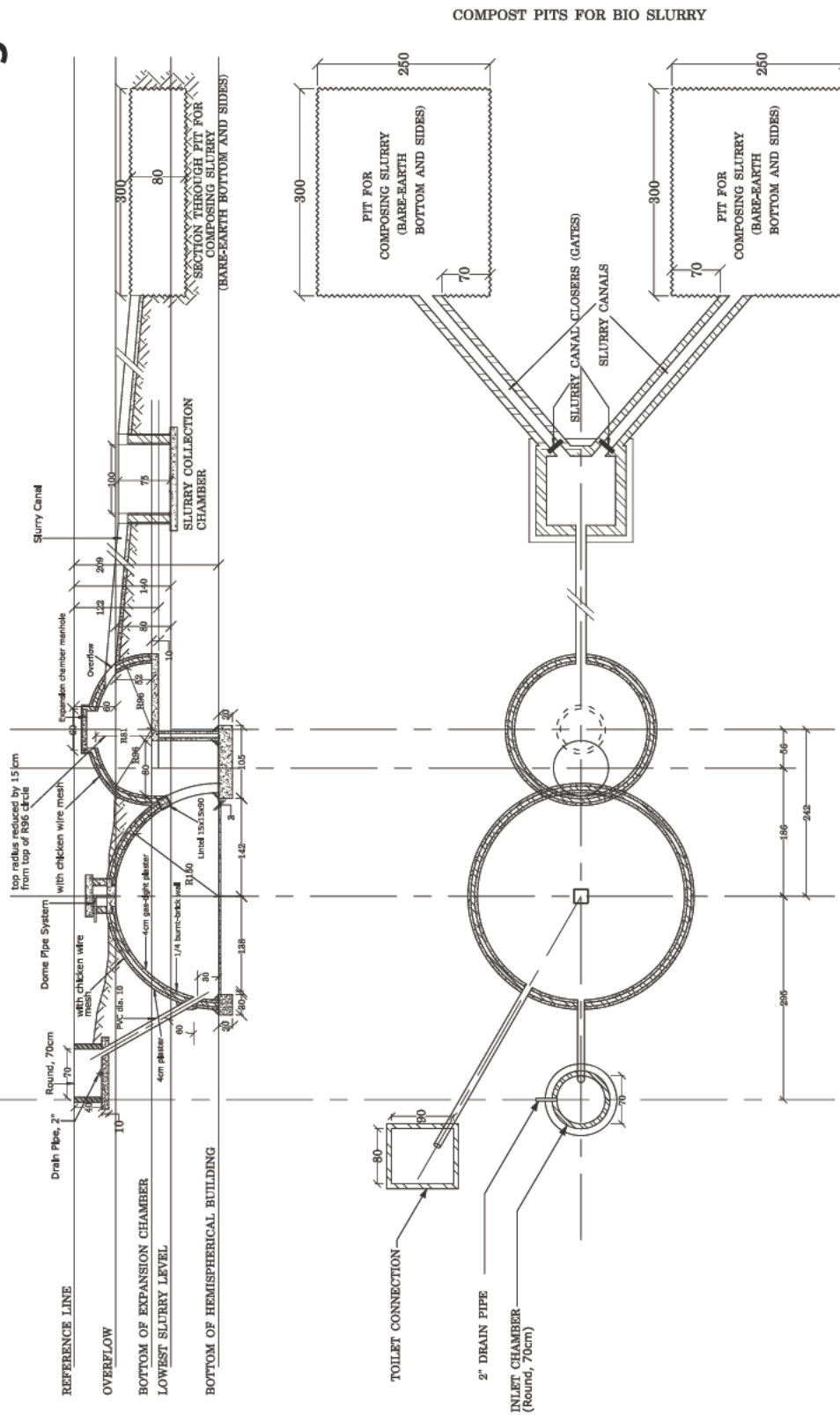


TD Biogas 4cu.m



UGANDA DOMESTIC BIOGAS PROGRAMME	
MODIFIED CAMARTEC FIXED DOME BGP, 4 CU.M	
VOLUME OF PLANT=4CU.M. VG=0.9CU.M	
MODEL: CAMARTEC	DWG NO.: 2012/BGP/4
DRAWN BY: G.OFUMBI	SCALE: TO FIT
CHECKED BY: F.HEGDE	DATE: MAR 2012

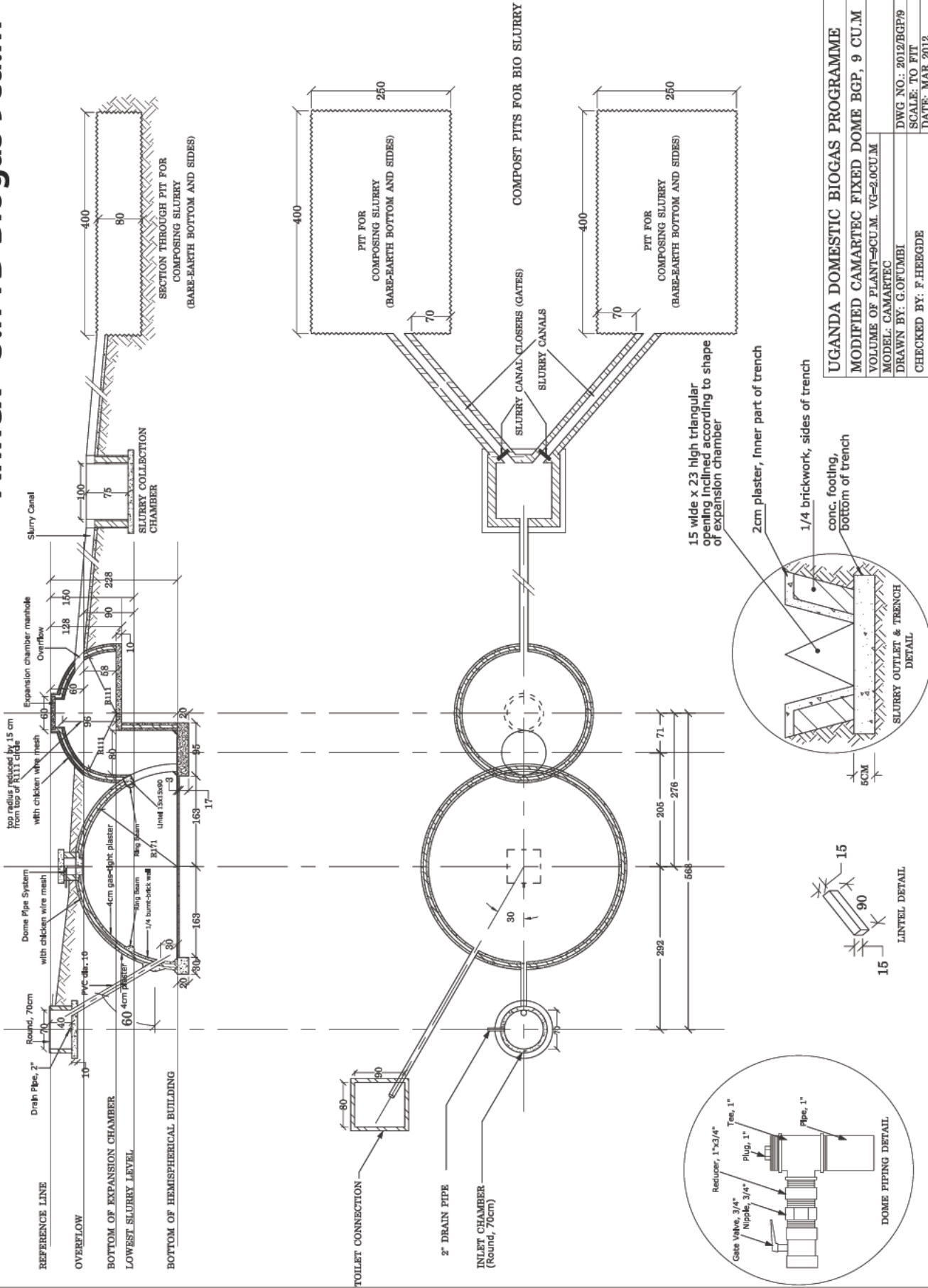
Annex - 3.m TD Biogas 6cu.m



COMPOST PITS FOR BIO SLURRY

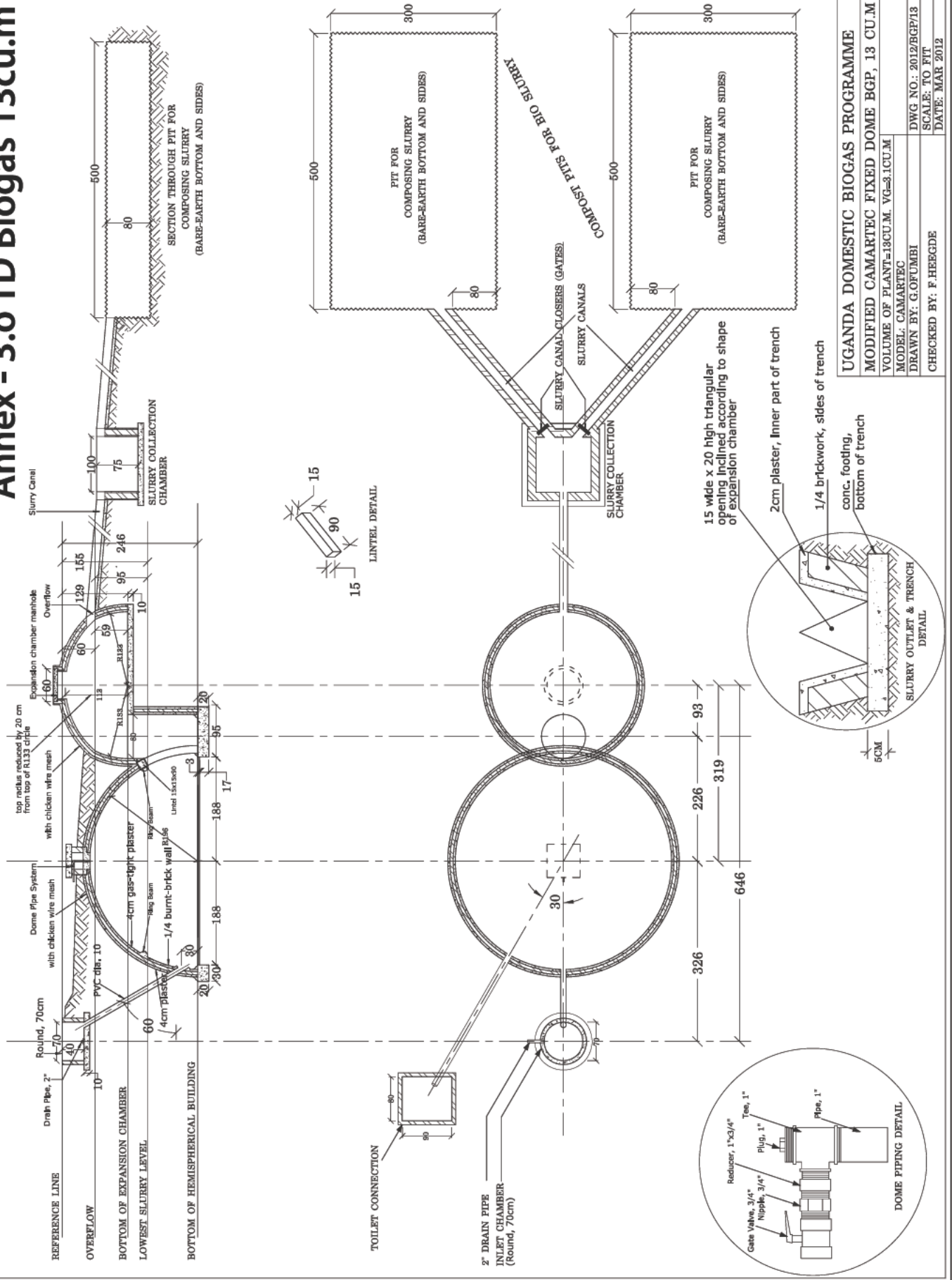
UGANDA DOMESTIC BIOGAS PROGRAMME	
MODIFIED CAMARTEC FIXED DOME BGP, 6 CU.M	
VOLUME OF PLANT=6CU.M. VG=1.4CU.M	
MODEL: CAMARTEC	
DWG NO.: 2012/BGP/6	SCALE: TO FIT
DRAWN BY: G.OFUMBI	DATE: MAR 2012
CHECKED BY: F.HEGDE	

Annex - 3.n TD Biogas 9cu.m



UGANDA DOMESTIC BIOGAS PROGRAMME	
MODIFIED CAMARTEC FIXED DOME BGP, 9 CU.M	
VOLUME OF PLANT=9CU.M. VG=2.0CU.M	
MODEL: CAMARTEC	
DRAWN BY: G.OFUMBI	
DWG NO.: 2012/BGP/9	
SCALE: TO FIT	
DATE: MAR 2012	
CHECKED BY: F.HEEGDE	

Annex - 3.0 TD Biogas 13cu.m



UGANDA DOMESTIC BIOGAS PROGRAMME	
MODIFIED CAMARTEC FIXED DOME BGP, 13 CU.M	
VOLUME OF PLANT=13CU.M. VG=3.1CU.M	DWG NO.: 2012/BGP/13
MODEL: CAMARTEC	DRAWN BY: G.OFUMBI
CHECKED BY: F.HEEGDE	SCALE: TO FIT
	DATE: MAR 2012

Biogas Energy Calculation Example Diesel to Biogas

Power	35 kW 6 hrs/day
Energy	210 kWh/day

Conversion factor kWh to MJ	3.6
Net electric energy production	756 MJ/day

Efficiency diesel generator	30%
Gross energy consumption	2520 MJ/day

Calorific value diesel	46 MJ/kg
Density diesel	0.9 kg/ltrm ³
Calorific value diesel	41.4 MJ/ltr

Diesel consumption generator	18 ltrs/day
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Calorific value biogas	20 MJ/m ³
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Biogas consumption generator	37.8 m ³ /day
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Specific biogas production cow dung	0.04 m ³ /kg
Feeding requirement	945 kg dung

Biogas storage factor	82%
Biogas storage volume	31.1 m ³

Biogas Energy Calculation Example

Power installed/required	5 [kW]	
On-time	6 [hrs]	
Energy produced	108 [MJ]	
Calorific value biogas	23 [MJ/m ³]	
Biogas requirement	4.70 [m ³]	net
Efficiency conversion	25%	
Biogas requirement	18.78 [m ³]	gross
Specific biogas production dung	0.04 m ³ /kg	
Dung requirement	470 kg	
HRT	40	
Digester volume	37.57 [m ³]	

Modified Camartec domestic biogas installation

13m³

Bill of Quantities and pricing

	qty	unit	rate	household	Company	Total
1 General bulk materials						
1.1	Sand	5.00 [m ³]	900	4,500		4,500
1.2	Gravel	4.00 [m ³]	54	216		216
1.3	Stones	3.00 [m ³]	900	2,700		2,700
1.4	Cement	28 [bags 50 kg]	390		10,920	10,920
1.5	Bricks	1,550 [piece]	9	13,950		13,950
1.6	Lime	5 [bags 50 kg]	420		2,100	2,100
1.7	Acrylic emulsion paint	2 [ltr]	210		420	420
1.8	Chicken wire (1 mtr wide)	75 [mtr]	90		6,750	6,750
1.9	Welded / square mesh	1 [pcs]	-			-
1.10	Round bar	2 [length]	390		780	780
1.11	PVC pipe 4"	1 [length]	420		420	420
1.12	HDPE 3.4"class 6	100 [mtr]	240		24,000	24,000
2 Biogas materials						
2.1	Dome pipe	1 [pcs]	600		600	600
2.2	Single biogas stove	1 [pcs]	900		900	900
2.3	Double biogas stove	[pcs]	-			-
2.4	Biogas lamp	1 [pcs]	-			-
2.5	Main gas valve	1 [pcs]	360		360	360
2.6	Stove tap	[pcs]	270			-
2.7	Lamp tap	1 [pcs]	-			-
2.8	Water trap	1 [pcs]	60		60	60
2.9	Pressure meter	1 [pcs]	60		60	60
2.10	Fitting material & sundry	1 [set price]	300		300	300
2.11	Repair & maintenace set	1 [set price]	180		180	180
3 Labour						
3.1	Unskilled labour	24 [persondays]	4			-
3.2	Skilled labour	12 [persondays]	8			-
3.3	Artisan	2 [persondays]	10			-
Euro = ZWM 8.24						
Total costs per category				Euro		
	Buidling material			21,366	45,390	66,756
	Biogas materials			-	2,460	2,460
	Company fees	40% of comp share in bldg materials			19,140	19,140
	Grand total				66,990	88,356
						10,723
Total costs per category productive biogas						
750	Buidling material		66,756			
	Biogas materials		8,640			
	Company fees	40%	30,158			
	Grand total		105,554			

Modified Camartec domestic biogas installation

4m³

Bill of Quantities and pricing

	qty	unit	rate	household	company	Total
1 General bulk materials						
1.1 Sand	2.2	[m3]	900	1,980		1,980
1.2 Gravel	1.2	[m3]	54	65		65
1.3 Stones	1	[m3]	900	900		900
1.4 Cement	12	[bags 50 kg]	390		4,680	4,680
1.5 Bricks	700	[piece]	9		6,300	6,300
1.6 Lime	2	[bags 50 kg]	420		840	840
1.7 Acrylic emulsion paint	1	[ltr]	210		210	210
1.8 Chicken wire (1 mtr wide)	30	[mtr]	90	2,700		2,700
1.9 Welded / square mesh	1	[pcs]	-			-
1.10 Round bar	1	[length]	390		390	390
1.11 PVC pipe 4"	1	[length]	420		420	420
1.12 HDPE 3.4" class 6	50	[mtr]	240		12,000	12,000
2 Biogas materials						
2.1 Dome pipe	1	[pcs]	600		600	600
2.2 Single biogas stove	1	[pcs]	900		900	900
2.3 Double biogas stove		[pcs]	-			-
2.4 Biogas lamp	1	[pcs]	-		-	-
2.5 Main gas valve	1	[pcs]	360		360	360
2.6 Stove tap	1	[pcs]	270		270	270
2.7 Lamp tap	1	[pcs]	-		-	-
2.8 Water trap	1	[pcs]	60		60	60
2.9 Pressure meter	1	[pcs]	60		60	60
2.10 Fitting material & sundry	1	[set price]	300		300	300
2.11 Repair & maintenace set	1	[set price]	180		180	180
3 Labour						
3.1 Unskilled labour	12	[persondays]	4	PM	PM	-
3.2 Skilled labour	6	[persondays]	8	PM	PM	-
3.3 Artisan	2	[persondays]	10	PM	PM	-
Total costs per category						
Buidling material				5,645	24,840	30,485
Biogas materials				-	2,730	2,730
Company fees		40% of comp share in bldg materials			11,028	11,028
Grand total					38,598	44,243

Modified Camartec domestic biogas installation

6m³

Bill of Quantities and pricing

	qty	unit	rate	household	company	Programme
1 General bulk materials						
1.1 Sand	3.00	[m3]	900	2,700		2,700
1.2 Gravel	2.00	[m3]	54	108		108
1.3 Stones	1.25	[m3]	900	1,125		1,125
1.4 Cement	15	[bags 50 kg]	390		5,850	5,850
1.5 Bricks	850	[piece]	9	7,650		7,650
1.6 Lime	2	[bags 50 kg]	420		840	840
1.7 Acrylic emulsion paint	1	[ltr]	210		210	210
1.8 Chicken wire (1 mtr wide)	35	[mtr]	90		3,150	3,150
1.9 Welded / square mesh	1	[pcs]	-			-
1.10 Round bar	1	[length]	390		390	390
1.11 PVC pipe 4"	1	[length]	420		420	420
1.12 HDPE 3.4" class 6	100	[mtr]	240		24,000	24,000
2 Biogas materials						
2.1 Dome pipe	1	[pcs]	600		600	600
2.2 Single biogas stove		[pcs]	900		-	-
2.3 Double biogas stove	1	[pcs]	-		-	-
2.4 Biogas lamp	1	[pcs]	-		-	-
2.5 Main gas valve	1	[pcs]	360		360	360
2.6 Stove tap		[pcs]	270		-	-
2.7 Lamp tap	1	[pcs]	-		-	-
2.8 Water trap	1	[pcs]	60		60	60
2.9 Pressure meter	1	[pcs]	60		60	60
2.10 Fitting material & sundry	1	[set price]	300		300	300
2.11 Repair & maintenance set	1	[set price]	180		180	180
3 Labour						
3.1 Unskilled labour	16	[persondays]	4	PM	PM	-
3.2 Skilled labour	8	[persondays]	8	PM	PM	-
3.3 Artisan	2	[persondays]	10	PM	PM	-
Total costs per category						
Buidling material				11,583	34,860	46,443
Biogas materials				-	1,560	1,560
Company fees		40% of comp share in bldg materials			14,568	14,568
Grand total					50,988	62,571

Modified Camartec domestic biogas installation

9m³

Bill of Quantities and pricing

	qty	unit	rate	household	company	Programme
1 General bulk materials						
1.1 Sand	4.00	[m3]	900	3,600		3,600
1.2 Gravel	3.00	[m3]	54	162		162
1.3 Stones	2.00	[m3]	900	1,800		1,800
1.4 Cement	20	[bags 50 kg]	390		7,800	7,800
1.5 Bricks	1,150	[piece]	9	10,350		10,350
1.6 Lime	4	[bags 50 kg]	420		1,680	1,680
1.7 Acrylic emulsion paint	2	[ltr]	210		420	420
1.8 Chicken wire (1 mtr wide)	55	[mtr]	90		4,950	4,950
1.9 Welded / square mesh	1	[pcs]	-			-
1.10 Round bar	2	[length]	390		780	780
1.11 PVC pipe 4"	1	[length]	420		420	420
1.12 HDPE 3.4" class 6	100	[mtr]	240		24,000	24,000
2 Biogas materials						
2.1 Dome pipe	1	[pcs]	600		600	600
2.2 Single biogas stove		[pcs]	900		-	-
2.3 Double biogas stove	1	[pcs]	-		-	-
2.4 Biogas lamp	1	[pcs]	-		-	-
2.5 Main gas valve	1	[pcs]	360		360	360
2.6 Stove tap		[pcs]	270		-	-
2.7 Lamp tap	1	[pcs]	-		-	-
2.8 Water trap	1	[pcs]	60		60	60
2.9 Pressure meter	1	[pcs]	60		60	60
2.10 Fitting material & sundry	1	[set price]	300		300	300
2.11 Repair & maintenance set	1	[set price]	180		180	180
3 Labour						
3.1 Unskilled labour	20	[persondays]	4	PM	PM	- 75
3.2 Skilled labour	10	[persondays]	8	PM	PM	- 75
3.3 Artisan	2	[persondays]	10	PM	PM	- 20
Total costs per category						
Buidling material				15,912	40,050	55,962
Biogas materials				-	1,560	1,560
Company fees		40% of comp share in bldg materials			16,644	16,644
Grand total					58,254	74,166

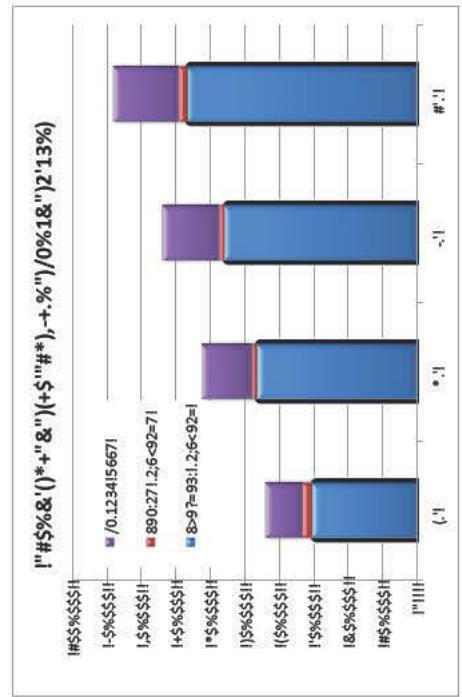
density bulk
Truck
Lorry

1.65 ton/m³
7.5 ton
30 ton

All prices in local currency

1 General bulk materials		Unit price	Average					Used for calves
	Unit	A	B	C	D	E		
1.1	Sand	7,500	36,364	28,282.83	36,363.64	24,242.42	31,313	150
1.2	Gravel	100,000	40,404	32,323	20,202	24,242	29,293	9
1.3	Stones		4,848	4,040		12,121	7,003	150
1.4	Cement	65,000	58,000	62,000	65,000	58,000	61,600	65
1.5	Bricks	300	250	250	750	650	440	1,50
1.6	Lime				25,000	75,000	25,000	70
1.7	Acrylic emulsion paint					27,000		35
1.8	Chicken wire (1 mtr wide)		20,000	10,000	10,000	11,500	12,875	15
1.9	Welded / square mesh					350,000		
1.10	Round bar		30,000		65,000	120,000	71,667	65
1.11	PVC pipe 4"	20,000			75,000	70,000	55,000	70
1.12	GS pipe 3/4"		130,000	135,000	90,000	139,000	123,500	120
1.13	GS pipe 1/2"		60,000	80,000	85,000	97,000	80,500	90
1.14	HDPE pipe 3/4" class 6	7,000				7,500	7,250	40
2 Biogas materials		Unit price						
	Unit							
2.1	Dome pipe							100
2.2	Single biogas / LPG stove	150000						150
2.3	Double biogas / LPG stove							
2.4	Biogas lamp	75000						75
2.5	Ball valve 3/4"	45000			35,000	45,000		60
2.6	Ball valve 1/2"	45000			30,000	35,000		45
2.7	Water trap							10
2.8	Pressure meter	35000						10
2.9	Fitting material & sundry							50
2.10	Repair & maintenance set							30
3 Labour		Unit price						
	Unit							
3.1	Unskilled labour	10000		16,000				30
3.2	Skilled labour	25000		30,000				60
3.3	Artisan level labour	50000						80
4 Company services & fees		Unit price						
	Unit							
4.1	Construction fee							600
4.2	Annual maintenance fee							700
							800	

	4m ³		6m ³		9m ³		13m ³	
	hh	comp	hh	comp	hh	comp	hh	comp
Building material	5,645	24,840	11,583	34,860	15,912	40,050	21,366	45,390
Biogas materials	-	2,730	-	1,560	-	1,560	-	2,460
Company fees	-	11,028	-	14,568	-	16,644	-	19,140
Totals	5,645	38,598	11,583	50,988	15,912	58,254	21,366	66,990
	13%		19%		21%		24%	
		30,485		46,443		55,962		66,756
		2,730		1,560		1,560		2,460
		11,028		14,568		16,644		19,140
		44,243		62,571		74,166		88,356



	4m ³	6m ³	9m ³	13m ³
Building material	30,485	46,443	55,962	66,756
Biogas materials	2,730	1,560	1,560	2,460
Company fees	11,028	14,568	16,644	19,140
Totals	44,243	62,571	74,166	88,356

Simple pay back	
Charcoal consumption	1 bag 50 kg/month
Charcoal price	1,000 KES
Annual charcoal exp	12,000 KES
Firewood consumption	2 cart/month
Firewood price	800 KES/cart
Annual firewood expenses	19,200
Tot fuel exp	31,200 KES