BAB V

KESIMPULAN DAN SARAN

5.1 KESIMPULAN

Berdasarkan perhitungan dan analisis yang telah dilakukan menunjukkan bahwa kapasitas tangki eksisting tidak mencukupi untuk tekanan dan *flow rate* maksimal, yaitu sebesar 1050 psig dan 350 MMSCFD. Alternatif solusi yang mungkin untuk dilaksanakan di lapangan adalah dengan mengganti tangki lama dengan tangki yang didesain sesuai kapasitas. Struktur eksisting tidak mampu menanggung beban tangki baru, sehingga diperlukan rekontruksi struktur tersebut.

5.2 SARAN

1. Dalam pembuatan tangki lebih lanjut, perlu dikaji lebih dalam lagi mengenai tekanan maksimum dan *flow rate* maksimum gas yang akan dilewatkan pada tangki tersebut.
2. Perlu adanya *Operating Manual*, agar saat gas dialirkan dalam kondisi tekanan yang berbeda-beda, tangki masih dapat bekerja secara optimum.
3. Perlu dilakukan pengukuran secara detail di lapangan apabila akan dilakukan rekonstruksi. Selain itu jugaperlu dilakukan beberapa tinjauan agar solusi dari masalah tersebut efektif dan efisien.

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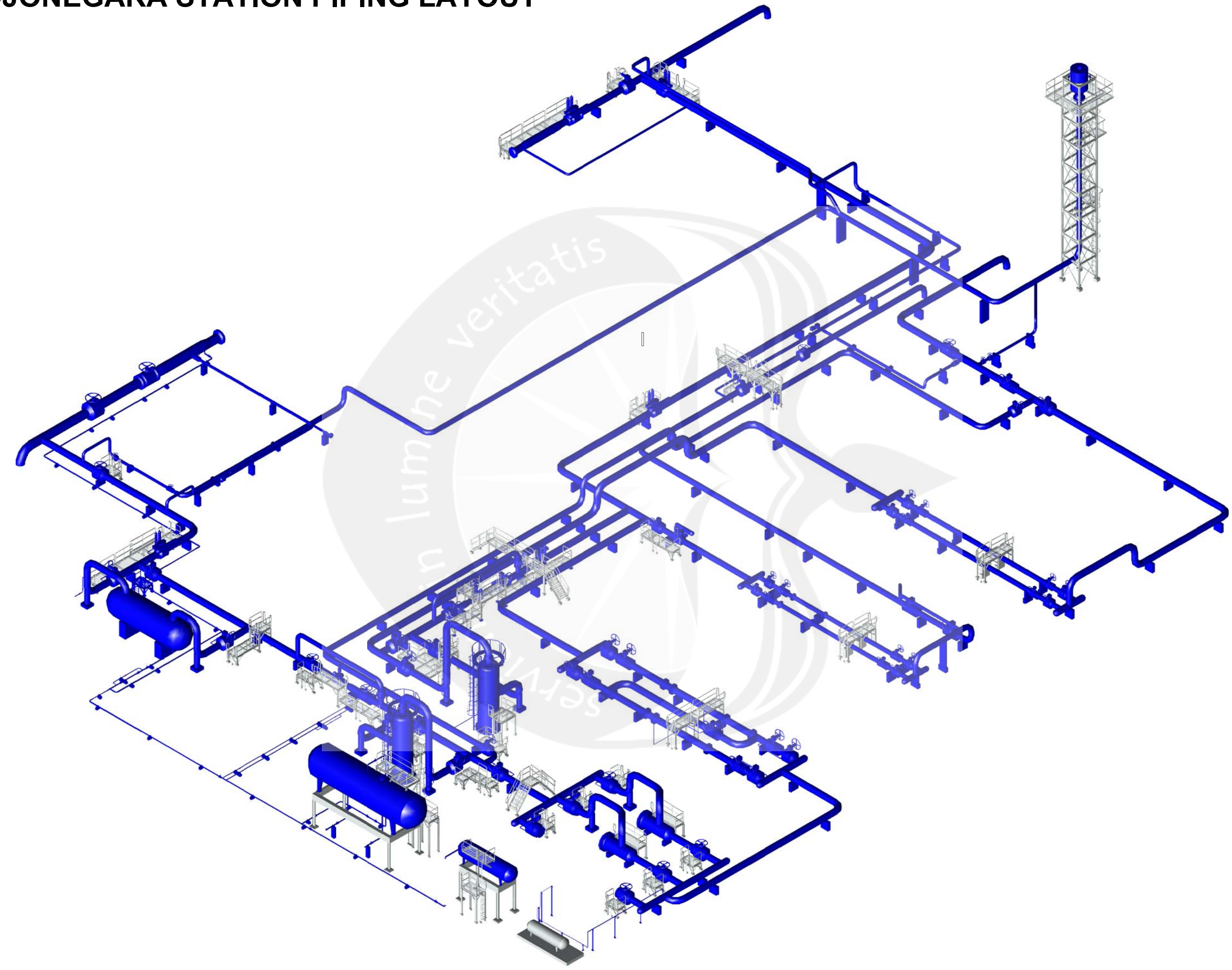
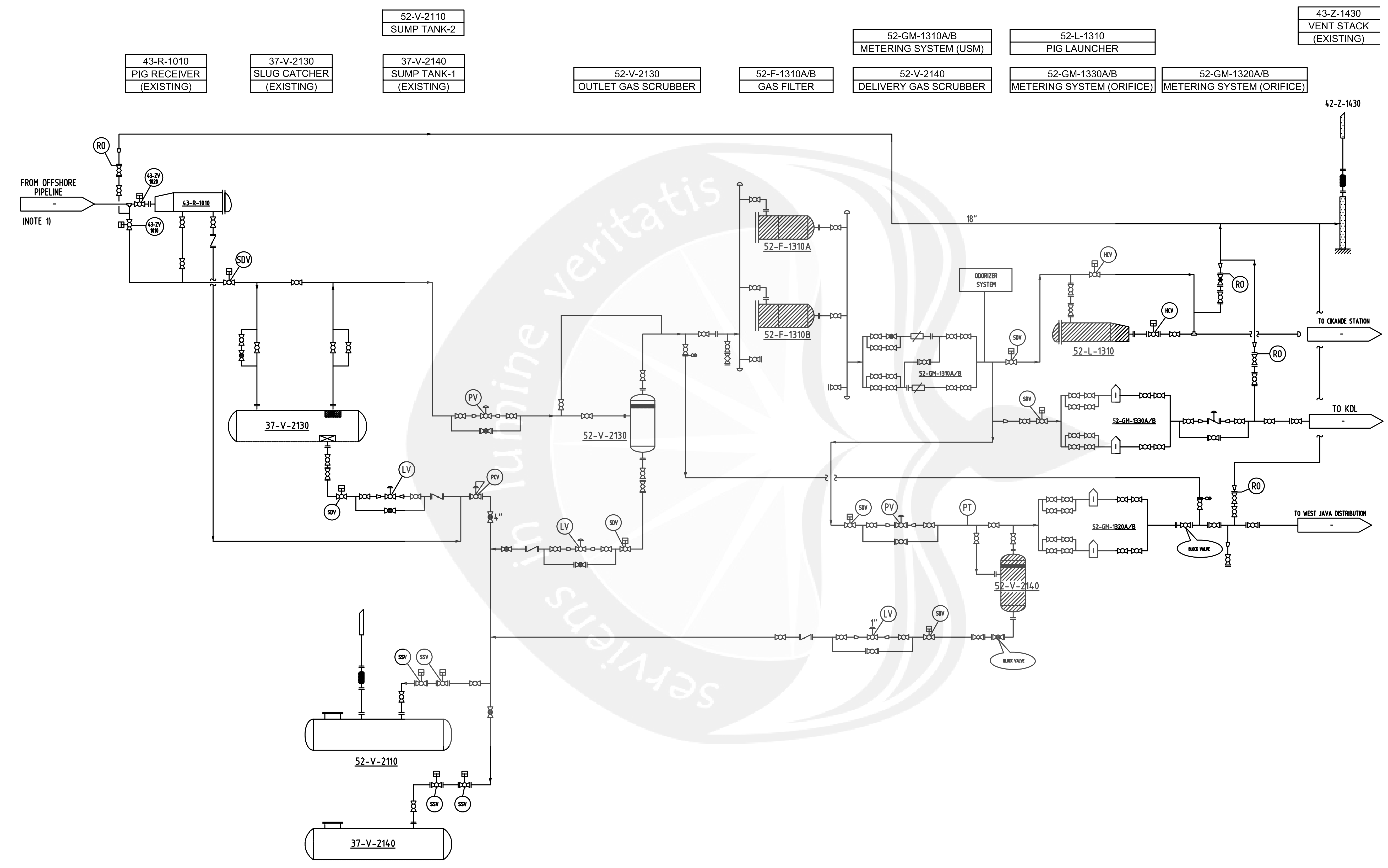
LAMPIRAN

BOJONEGARA STATION PIPING LAYOUT




43-R-1010
PIG RECEIVER
(EXISTING)
37-V-2130
SLUG CATCHER
(EXISTING)
52-V-2110
SUMP TANK-2
37-V-2140
SUMP TANK-1
(EXISTING)
52-V-2130
OUTLET GAS SCRUBBER
52-F-1310A/B
GAS FILTER
52-GM-1310A/B
METERING SYSTEM (USM)
52-V-2140
DELIVERY GAS SCRUBBER
52-L-1310
PIG LAUNCHER
52-GM-1330A/B
METERING SYSTEM (ORIFICE)
52-GM-1320A/B
METERING SYSTEM (ORIFICE)
43-Z-1430
VENT STACK
(EXISTING)
42-Z-1430
FROM OFFSHORE PIPELINE
(NOTE 1)
43-R-1010
37-V-2130
52-V-2130
52-F-1310A
52-F-1310B
52-GM-1310A/B
ODORIZER SYSTEM
52-L-1310
52-GM-1330A/B
52-GM-1320A/B
52-V-2140
52-V-2110
37-V-2140
18"
4"
1"
TO CIKANDE STATION
TO KDL
TO WEST JAVA DISTRIBUTION
BLOCK VALVE
BLOCK VALVE
SDV
PV
LV
PCV
PT
HCV
RO
SSV

PLANT NORTH

TRUE NORTH 46°31

DRAWING LIMIT

SEE DETAIL "1"

SEE DETAIL "2"

GRADE EL.(+) 0.00
NOTE.3

3/4" GATE VALVE

LADDER

PLATFORM (NEW) (#7)
TOS EL.(+) 850

PLATFORM (NEW) (#26)
TOS EL.(+) 850

PLATFORM (NEW) (#13)
TOS EL.(+) 850

PLATFORM (NEW) (#6)
TOS EL.(+) 1900

PLATFORM
(EXISTING)

PLATFORM
TOS EL.(+) 850

2"-600#
52-GLV-1002

2"-600#
52-BV-1008

2"-600#
52-BV1005

2"-600#
52-GLV-1001

2"-BV

2"-600#
52-BV-1007

2"-600#
52-BV-1003

2"-600#
52-BV-1004

2"-600#NC
52-BV-1006

24"-PG-52-CC1-1001
EL.(+) 1150

24"-PG-52-CC1-1001
EL.(+) 4650

24"-PG-52-CC1-1301
EL.(+) 1150

4"-DC-52-CC1-2101
EL.(+) 328

4"-DC-52-CC1-2102
EL.(+) 328

4"-DC-52-BC1-2103
EL.(+) 328

4"-600#
52-BV-2102

4"-600#
52-CKV-2101

2"-600#NC
52-GLV-2101

4"x600#
52-BV-2101

4"x2" CONC.RED
(TYP.)

4"x1"SWAGE

4"x1"SWAGE

2"-600#
52-BV-1302

24"-600#
52-BV-1301

3/4" VENT.(TYP)

3/4" VENT.

PS-022-001

PS-022-002

PS-022-003

PS-022-004

PS-022-005

PS-022-006

PS-022-007

PS-022-008
(EXIST.)

PS-022-009
NEW

PS-022-010

PS-022-011

PS-022-012

SP
002-1

NEW EXIST.

USE EXIST.
FOUNDATION

SADDLE

TIE-IN
52-1003

TIE-IN
52-1004

TIE-IN
52-2102

37-V-2130 (EXIST.)
EL. 2400

24"
MH

(VALVES EXISTING)

37-LG 2130

37-LT 2130

52-LSLL 1301

52-LSHH 1301

52-PRV 2101B

52-PRV 2101A

52-ZSC 2101

52-LCV 2101

52-ZSO 2101

52-SDV 2101

52-ZSC 1007

52-ZSO 1007

52-ZSC 1001

52-ZSO 1001

52-PT 1002C

52-PT 1002B

52-PT 1002A

52-SDV 1001

52-TT 1001

52-TI 1001

52-PT 1001

52-PI 1001

52-ZSC 1301

52-ZSO 1301

PS (EXISTING)

PS (EXISTING)

EL. +328

EL.(+) 4650

EL.(+) 2674

COD.NO.:003B-52-L-DG-021-A1

COD.NO.: 003B-52-L-DG-023-A1 SHT.3 OF 12

10235 2320 300 1245 300 935 900 2032 1245 2308 180

632 250 200 200 450 300 300 450 200 200 200 200 150

927 520 750

435 9800 6000 5765

22000

2360 900 150 1245 780 1480 20

18500 5470 4575 2360

1000 1750 3345

750 2000 1000 2345

1353 292 1353

300# 600#

238 405 292 400 292 435 213 879 313 438 260 508 222 508 438 313 313 438 260 654 462 435 1000 650 1670 300 1245 300 835 1000

85

1100 585 4300

NO OBJECTION

This Notice of No Objection is given on the understanding that PT. Istana Karang Laut shall nonetheless remain entirely responsible for fully complying with the Employer's Requirements and that the completed Works are fit for purpose.

For-PGN :

THIS DRAWING

KEY PLAN

PLANT NORTH

37-V-2130

TIE IN 52-2102

NEW EXISTING

1000

(REF.1)

HOR. 3/4"

4"-DC-52-CC1-2102
EL.+ 328

TIE IN-52-2102

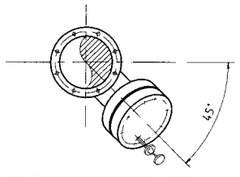
0 2000 4000
SCALE 1 : 50

HOLD ON THIS DWG.

(H3) FINAL VENDOR DATA FOR HOSE CONNECTION

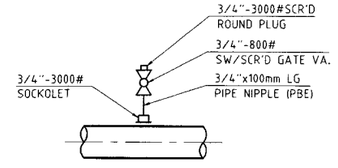
NOTE.

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE STATED
2. NITROGEN CONNECTION
3. GRADE EL.0.00 = MSL ±3.183 (LAT 3.783)



SECTION "A-A"

PLAN VIEW



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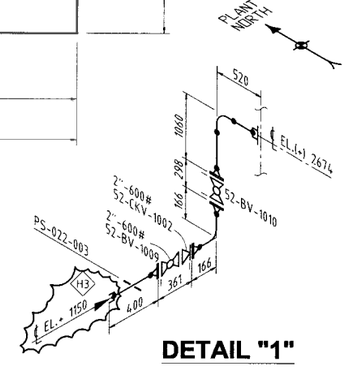

DETAIL "1"

REV. NO.	REVISION	DATE	CHK'D	EM	PM	PMC	PGN
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2	RE-ISSUED FOR CONSTRUCTION	05 NOV'07	JSH	DS/SM	GZL		
1	RE-ISSUED FOR CONSTRUCTION	14 SEP'07	JSH	DS/SM	GZL		
0	ISSUED FOR CONSTRUCTION	31 AUG'07	JSH	DS/SM	GZL		
C	RE-ISSUED FOR REVIEW	09 AUG'07	JSH	DS/SM	GZL		

IKL

SCALE 1 : 50 | DESIGNED : AS | DRAWN : AH | APP'D : GZL

PT. PERUSAHAAN GAS NEGARA (Persero) Tbk.

In Association With

P.T. ISTANA KARANG LAUT

SOUTH SUMATRA – WEST JAVA GAS PIPELINE PROJECT
CONTRACT PACKAGE FOR BOJONEGARA STATION

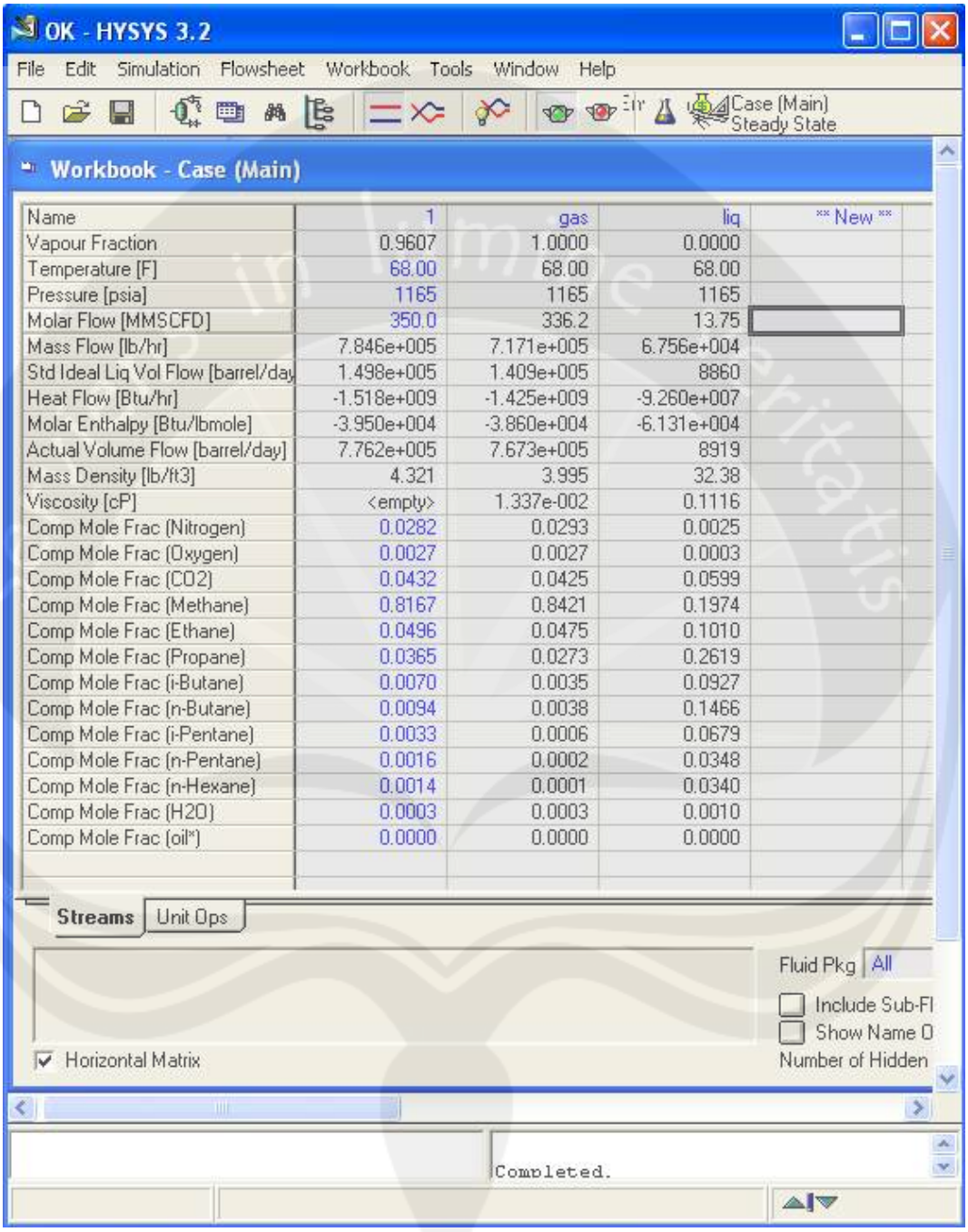
TITLE :

GENERAL ARRANGEMENT
SLUG CATCHER SYSTEM (EXISTING)
37-V-2130

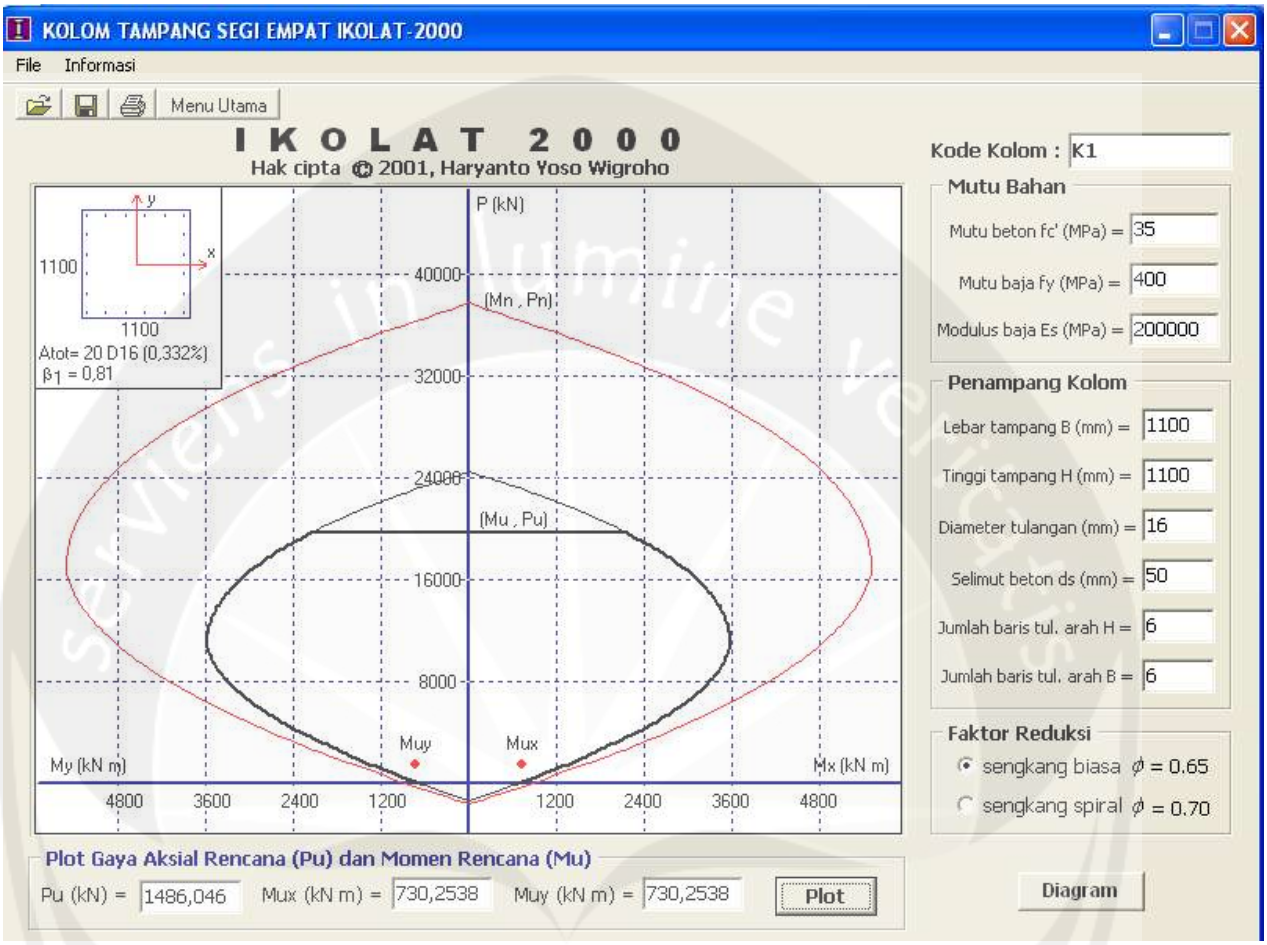
JOB. NO.	DRAWING NO.	REV.	SHEET
C-199/07	003B-52-L-DG-022-A1	3	2

003B-52-L-DG-022-A1-3.dwg

Lampiran 4 : Output *Hysys*



Lampiran 5 : Output IKOLAT untuk Pedestal



Lampiran 6 : *Design Specification for Civil and Structural* (Doc No.003B-52-SP-001-A4)

PT. PERUSAHAAN GAS NEGARA (Persero) Tbk.	JOE In Association With OGE CONNUSA	PT. ISTANA KARANG LAUT
DESIGN SPECIFICATION FOR CIVIL AND STRUCTURAL		
Document No. / **Rev.**	**CONTRACT PACKAGE FOR BOJONEGARA STATION**	**Page 3 of 33**
003B-52-S-SP-001-A4 / 3		

TABLE OF CONTENTS

ATTACHMENT:

1. **Soil Investigation Report**
   - Water Level observation
   - Soil Profile for Seismic Design
   - Strength Parameter
   - Settlement Analysis Result
   - Negative Skin Friction
   - Plates for allowable pile capacity

2. **UBC 1997**
   - Reduction to live loads
   - Wind Design
   - Earthquake Design
   - Tables

3. **ASCE 7 – 05**
   - Loading Combination
   - Reduction to live loads

4. **ACI 318 – 05**
   - Strength and Serviceability requirement

5. **SKBI-1.3.53, 1987**
   - Loading Requirement for Buildings

6. **Weather Data**
   - Average Wind Speed 2007- June 2010 at BMG Serang Station

Rangkuman Kapasitas Ijin *Pile*

5.4. Stability

All buildings, structures and or foundations shall be designed so that the safety factor shall not be less than the values mentioned below at any circumstances.

(1) Sliding
The ratio of resisting force due to friction to total shear cause by wind or earthquake load is not less than 1.5 and caused by permanent load is not less than 2.0

(2) Overturning
The ratio of resisting moment due to dead load to over turning moment cause by wind or earthquake load is not less than 1.5 and caused by permanent load is not less than 2.0

(3) Buoyancy
The ratio of total dead load of structure and soil weight above to total buoyancy is not less than 1.1

5.6. Soil Bearing Capacity

Based on the soil investigation report, shallow foundation is not recommended. Therefore soil bearing capacity will be ignored unless the structure integrity is not affected by the soil settlement.

5.7. Pile Bearing Capacity

For the heavy load and settlement sensitive structure/foundation, the piled foundation shall be used. The type of pile to be used shall conform to soil condition and also considering any plant environment condition.

1. Based on the Soil Investigation Report, the estimated length of piles from ground surface and allowable capacities are as follows.

Table 5.8 Summary of Allowable Pile Capacity

Pile Type	Pile Dimension (mm)	Depth (m)	Allowable Capacity (ton)			
			Comp.	Tension	Neg.Fric	Lateral
Square	250 x 250	15	82,5	12	14,2	4,3
Spun	300	15	85	11,5	13,4	4,9
Spun	350	15	112,5	13,5	15,6	6,2
Spun	**400**	**15**	**142,5**	**15,4**	**17,9**	**7,6**

Note: Allowable Pile Capacity is taken from Soil investigation report. See Attachment.

Keterangan Mengenai Beban Angin

5.2.4 Equipment load ("E")

Equipment load means the weight of equipment. Equipment load can be taken from Piping stress analysis or Equipment Mechanical Data and shall consider the heaviest condition from Operation, Test, or Maintenance.

5.2.5 Impact load ("I")

Impact load means forces caused by a moving object such as crane, hoist and elevator. The load shall be taken accordance with SKBI-1.3.53. 1987 UDC 624.042 as follows :

- Vertically : $^1/_{10}$ of the maximum wheel load
- Horizontally, parallel with rail direction : $^1/_7$ of the maximum wheel load
- Horizontally, orthogonal with rail direction : $^1/_{15}$ of the maximum wheel load
- Elevator (at foundation) : 100% of max capacity (incl. self weight)

5.2.6 Wind load ("W")

Wind Load shall be calculated based on the equation from UBC 1997, chapter 16

P = Ce x Cq x qs x Iw

Ce = Combined height, exposure and gust factor coefficient as given in table 16-G UBC 1997

Cq = Pressure coefficient for the structure or portion of structure under consideration as given in table 16-H UBC 1997

Iw = Important factor as set forth in table 16-K UBC 1997

P = Design Wind pressure (kg/m2)

Qs = Wind stagnation pressure at standard height of 33 feet as set forth in table 16-F UBC 1997 (See Attachment)

Those parameter above shall consider items as follows :

(a) Standard wind velocity at the height of 9.0 m (33 feet) above ground level shall be 35 m/dtk (80 mph) refer to UBC 1997
(b) Wind stagnation pressure (qs) shall be 16.4 psf (80 kg/m2)
(c) Wind load based on terrain exposure "C"
(d) Important factor, I = 1 (for Building or Structure Outside Hazardous Area)
I = 1,15 (for Building or Structure Inside Hazardous Area)

Keterangan Mengenai Beban Gempa

PT. PERUSAHAAN GAS NEGARA (Persero) Tbk.	JOC In Association With OGE CONNUSA	PT. ISTANA KARANG LAUT
DESIGN SPECIFICATION FOR CIVIL AND STRUCTURAL		
Document No. 003B-52-S-SP-001-A4	Rev. 3	CONTRACT PACKAGE FOR BOJONEGARA STATION
		Page 23 of 33

5.2.7 Earthquake Load ("V")

Earth quake load for Building Structure shall be calculate accordance to formula given in UBC 1997, chapter 16.

Total lateral force or shear at the base :

$$V = \frac{Cv\, I}{RT} W$$

Total lateral force shall not more than :

$$V = \frac{2.5\, Ca\, I}{R} W$$

Total lateral force shall not less than :

$$V = 0.11\, Ca\, I\, W$$

Where,
- V : Total lateral load load or shear at the base.
- Ca : Basic seismic coefficient, table 16-Q UBC 1997
- Cv : Basic seismic coefficient, table 16-R UBC 1997
- I : Importance factor, table 16-K UBC 1997
- R : Numerical Coeffiicient that represent the ductile capacity of the structure that support the lateral load, table 16-N & table 16-P UBC 1997
- T : Vibration period of the structure.
- W : Total dead load, reduced load, piping and equipment load.

Those parameters above shall consider items as follows:

1. Seismic Risk Zone 4 (Z = 0.4)
2. Important factor I = 1 (for Building or Structure Outside Hazardous Area)
3. Important factor I = 1,25 (for Building or Structure Inside Hazardous Area)
4. Soil profile (Soft Soil Profile SE, UBC 1997 and Soil Investigation Report)
3
5. Vibration period of the structure, T shall be calculated based on following formula :

$$T = C_t (hn)^{3/4}$$

Where,
- C_t = 0.0835 for steel moment resisting frames
- C_t = 0.0731 for reinforced concrete moment resisting frames dan eccentrically braced frames
- C_t = 0.0488 for other structures
- hn = height of the structure (m)

Lanjutan Mengenai Beban Gempa

For Other Structure such as Pipe Support or Equipment foundation, Seismic load should be calculated according to UBC 97 Section 1634.5 for non-building structure.

V = 0,56 Ca I Wt

Where,

Ca = (refer to table 16-Q & 16 T UBC 97)

I = (refer to table 16-K UBC 97)

I = 1 (for Building or Structure Outside Hazardous Area)
I = 1,25 (for Building or Structure Inside Hazardous Area)

3

Z = (Zone 4)

Soil = S_E (Soft Soil)

Wt = Total self weight of structure

5.2.8 Piping load ("P")

Piping load means the weight of pipe, fittings, valves, insulation and the fluid contents of piping. Piping load shall be taken from pipe stress analysis result and consider the heaviest condition from Operation, Test or Maintenance.

5.2.9 Thermal force/Friction force ("T")

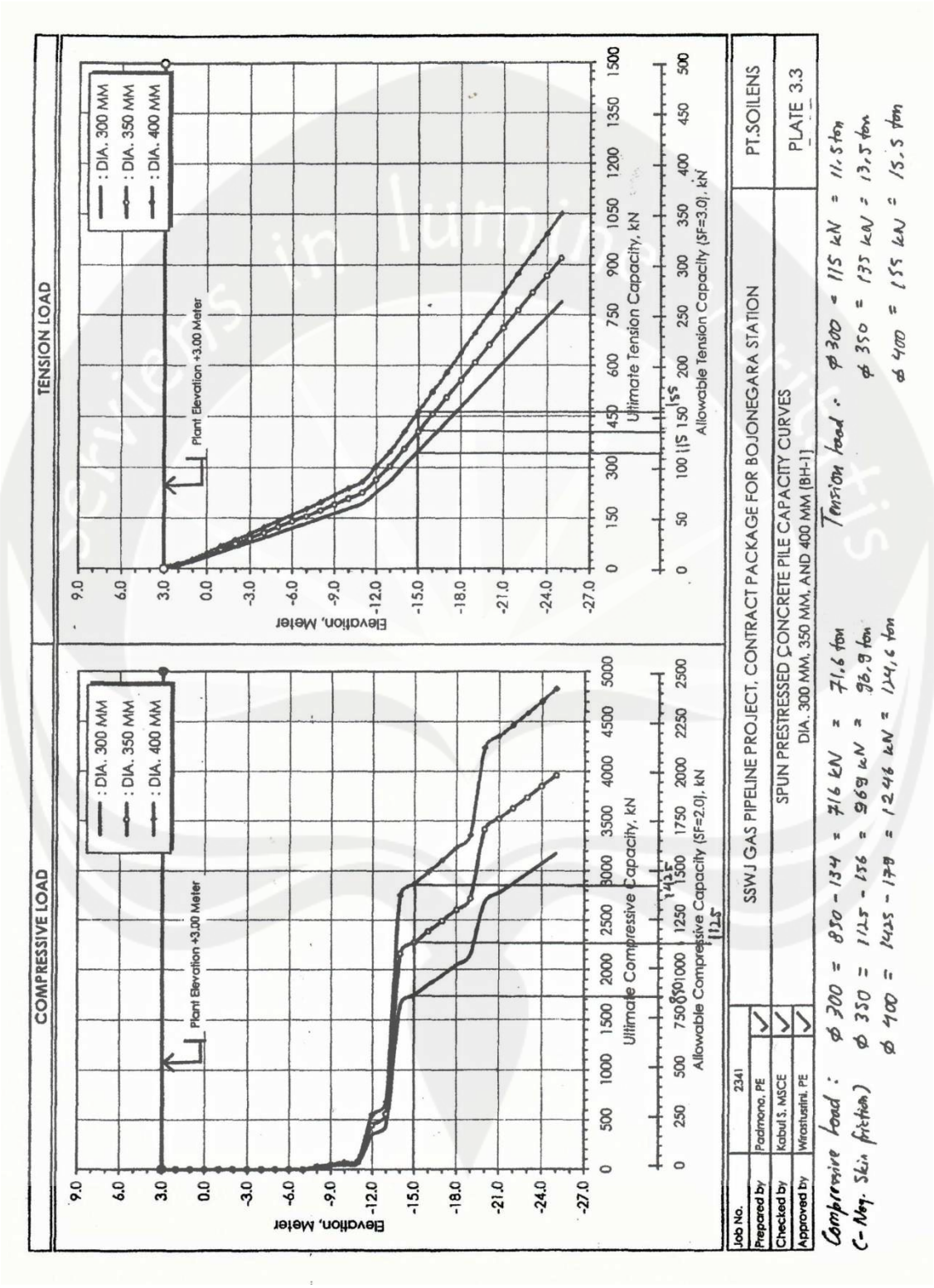
The magnitude and direction of thermal forces due to constraint of hot piping or equipment shall be calculated separately by piping or equipment engineer.

Reference: Concise Metals Handbook by J.R. davis ASM

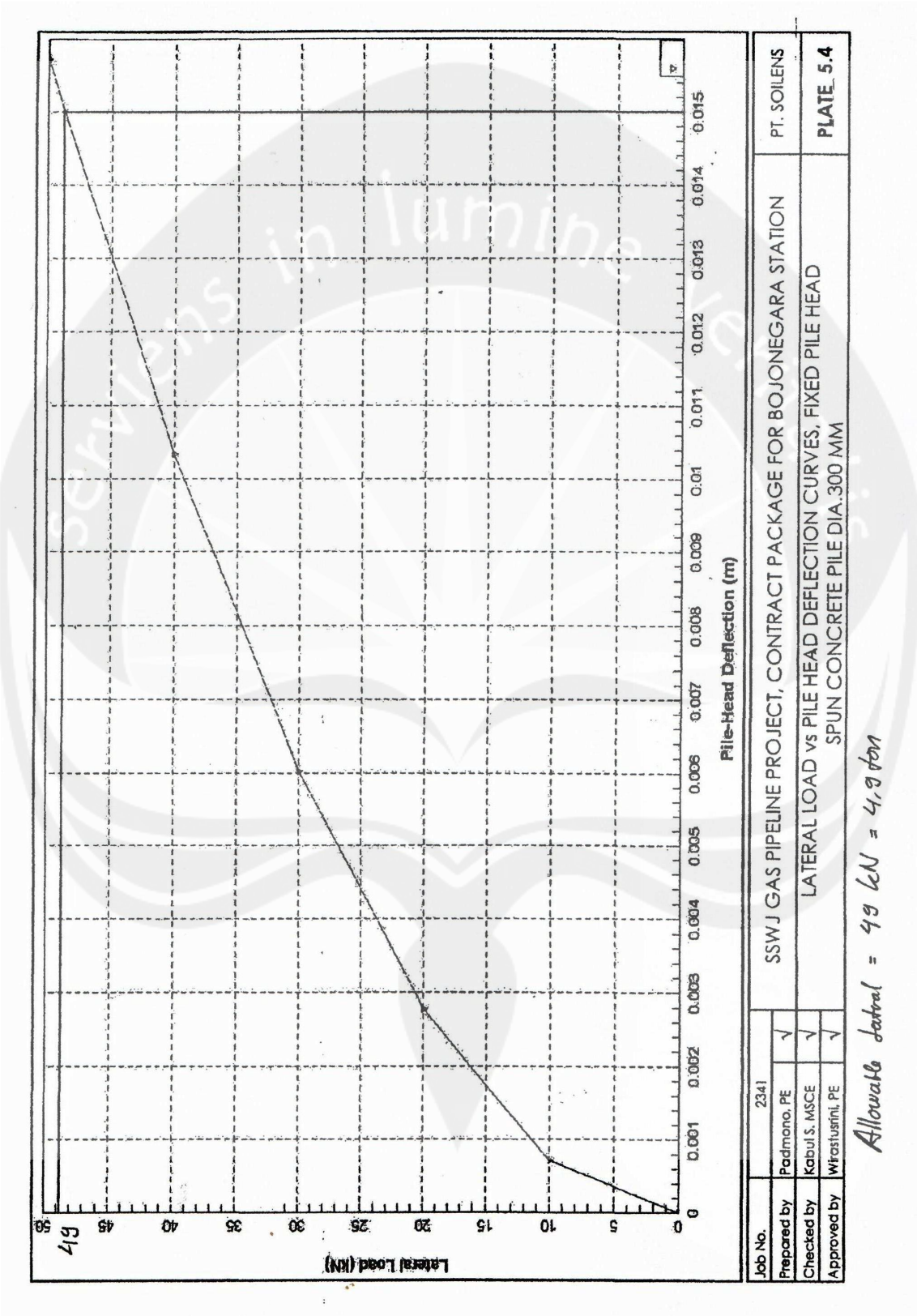
Friction factors, shall be as follows :

Concrete to soil	=	0.50
Steel to concrete	=	0.40
Steel to steel	=	0.30
Steel to lubricated bearing plate	=	0.10
Steel to teflon	=	0.04

Lampiran 7 : Grafik Kapasitas *Pile* (*Compressive Load* dan *Tension Load*)



Grafik Kapasitas *Pile* (*Lateral Load*)



Lampiran 8 : *Design Basis and Procedures for 32" South Sumatra-West Java Offshore Pipeline* (Doc No. 002-42-L-BD-1001)

2.3 General Parameters

The following general parameters will be adopted in the detailed design of the proposed 32" offshore gas transmission pipeline.

▪ Steel Density	:	7850 kg/m^3
▪ Young's Modulus of Elasticity of Steel	:	2.07 x 10^5 MPa
▪ Poisson's Ratio for Steel	:	0.3
▪ Linear Coefficient of Thermal Expansion of Steel	:	11.7 x 10^{-6} /°C

2.4 Operating Parameters

The pipeline system operating parameters are presented below:

▪ Design Pressure(1)	:	1150 psig (7,929 kPag)
▪ Maximum Allowable Operating Pressure (MAOP)(3)	:	1050 psig (7,239 kPag)
▪ Maximum Design Temperature(1)	:	120°F (48.9°C)
▪ Hydrotest Pressure (Offshore)(2)	:	1312.5 psi (9,049 kPa) (= 1.25 x MAOP)
▪ Flow Rate for Design(1)	:	275 MMSCFD
▪ Content Density(4)	:	50 kg/m^3 (3.12 pcf)

Lampiran 9 : *Operation and Maintenance Manual for Offshore Pipeline* (Doc No.002-40-G-MN-3301)

5. PROCESS DESIGN BASIS AND MATERIAL BALANCE

5.1. Process Design Basis

PT Perusahaan Gas Negara (PGN) Tbk. intends to provide the South Sumatra-West Java Gas pipeline distribution with a station for gas handling and metering. It is namely Bojonegara Station.

This natural gas handling facility at Bojonegara Station will receive the natural gas from South Sumatra to West Java through offshore pipeline, and then transfer and deliver it to the West Java distribution pipelines system for costumers in West Java area.

Bojonegara Station has several functions which are:

a. To receive 275 MMSCFD of natural gas from Labuhan Maringgai – Bojonegara Offshore Pipeline (In the future, this flow rate will be increased up to 350 MMSCFD (maximum) or more to supply natural gas to another customers in West Java area).
b. To control gas pressure, metering and transfer 110 MMSCFD of natural gas from Bojonegara Station to Serpong via Cikande and Bitung Stations.
c. To control gas pressure, metering and distribute 165 MMSCFD of natural gas from Bojonegara Station to West Java Distribution Pipeline.
d. To control gas flow, metering and deliver 75 MMSCFD of natural gas from Bojonegara Station to Krakatau Daya Listrik (KDL) at Cilegon industrial area through KDL's 20" pipeline
e. To control Odorize injection rate into variable gas flow rate until 350 MMSCFD (maximum) flow rate.
f. To provide all necessary interfaces with SCADA and Telecommunication Systems for the entire South Sumatra – West Java Gas Pipeline System.
g. To ensure that the completed gas transmission and distribution system will operate safely and efficiently without danger to the general public or the operational staff, and without being adversely affected by the environment;

h. To provide a safe facility that meets the capacity and quality requirements as defined in the Employer's Requirements and that is consistent with industrial standards;

i. To provide appropriate materials and equipment that will allow optimum operation of the facility at the given design conditions, whilst requiring a minimum of supervisory, operating and maintenance personnel; be cost-effective to maintain;

j. To function throughout the entirety of its specified design life in accordance with the requirements as may be more precisely defined elsewhere within the Employer's Requirements; and

k. To accommodate future changes and expansions with minimum operational disruption.

l. To protect the Station/Pipelines from overpressure and low pressure by Shutting Down related SDV.

For detail information, See Document No. 003B-52-P-BD-001-A4 for Process Design Basis

Lampiran 10: *Calculation Sheet for Slug Catcher Foundation (Bojonegara Station)* (SJ2-F-52-CA-702-A4)

PT. PERUSAHAAN GAS NEGARA (Persero) Tbk.	JOE In Association With OGC CONNUSA	REKAYASA
CALCULATION SHEET FOR SLUG CATCHER FOUNDATION (BOJONEGARA STATION)		
Document No.	Rev.	CONTRACT NO.: 001800.PK/24/UT/2006
SJ2-F-52-S-CA-702-A4	0	Page 4 of 38

1. GENERAL

1.1 OUTLINE OF STRUCTURE

Project : SSWJ Phase II - Onshore/Station Facilities
Client : PT. Perusahaan Gas Negara (Persero)
Location : Bojonegara
Equipment : Slug Catcher 37-V-2130
Foundation type : Pile foundation

1.2 DESIGN PHILOSOPHY

1.2.1. Unit of measurement

Unit of measurement in design shall be in metric system.

1.2.2. Used of Computer Software used in design analysis, as folow :

-Math Cad
-MS-Excel

1.3 CODE AND STANDARD

1.3.1. General codes and standard

-SKBI-1.3.53, 1987. UDC : 624.042
Indonesian Loading Code for Building
-SKBI-1.3.53, 1987. UDC : 699.841
Earthquake Resistant Code for Building in Indonesia
-ACI 318-95
Building code for Structural Concrete

1.3.2. Spesific Codes and Standard

-SJ2-F-00-S-SP-201-A4
Design Spesification for Civil and Structural

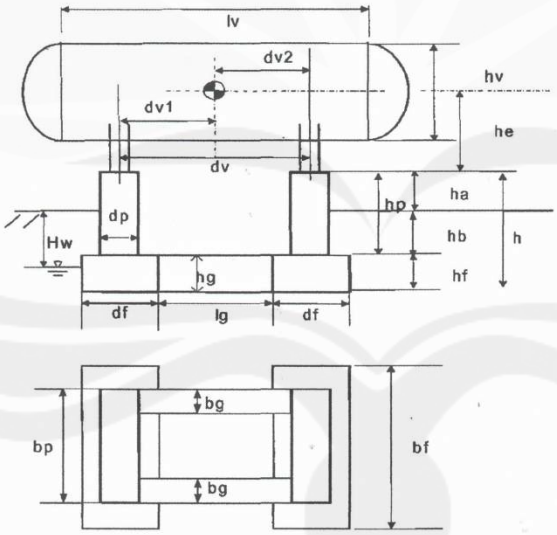
1.4 USED MATERIAL AND ALLOWABLE STRESS

Compressive concrete strength :	$fc := 210 \cdot kg \cdot cm^{-2}$
Yield steel strength :	$fy := 3200 \cdot kg \cdot cm^{-2}$
Specific gravity of reinf. concrete :	$\gamma c := 2400 \cdot kg \cdot m^{-3}$
Specific gravity of steel :	$\gamma s := 7850 \cdot kg \cdot m^{-3}$
Specific gravity of soil (refer to Soil Investigation Report) :	$\gamma soil := 1800 \cdot kg \cdot m^{-3}$
Specific gravity of water :	$\gamma water := 1000 \cdot kg \cdot m^{-3}$

1.5 OTHER REQUIREMENT DATA

Ground water table (refer to Soil Investigation Report) :	2.0 m below ground

2. LAYOUT



PT. PERUSAHAAN GAS NEGARA (Persero) Tbk.	JOE In Association With OGE ENGINEER	REKAYASA
CALCULATION SHEET FOR SLUG CATCHER FOUNDATION (BOJONEGARA STATION)		
Document No. / SJ2-F-52-S-CA-702-A4 / Rev. 0	CONTRACT NO.: 001800.PK/24/UT/2006	Page 6 of 38

3. PRELIMINARY

3.1. DIMENSION

Bearing plate of equipment :		dw := 0.26·m
		lw := 1.250·m
Estimated pedestal size due to dimension required from :		
-Base plate of equipment :	bp := lw + 100·mm	bp = 1.35 m
	dp := dw + 100·mm	dp = 0.36 m
For practical used :		bp := 1.50·m
		dp := 0.50·m
Estimated Footing Dimension :		df := 0.8m
		bf := 3.5m
Diameter of equipment :		hv := 1.981·m
Vertical distance from COG vessel to bot. of baseplate :		he := 1.250m
Length of equipment :		lv := 7.111·m
Distance between pedestal to pedestal :		dv := 4.271·m
Height of footing:		hf := 0.40·m
Height of pedestal above ground :		ha := 1.15·m
Height of pedestal below ground :		hb := 0.20·m
Height of pedestal:	hp := hb + ha	hp = 1.35 m
Height of foundation :	h := hf + hp	h = 1.75 m
Length of grade beam :	lg := dv – df	lg = 3.471 m
Width of grade beam:		bg := 0.3·m
Height of grade beam:		hg := 0.40·m

3.2. WEIGHT ESTIMATION

Weight of pedestal :	Wp := 2·bp·dp·hp·γc	Wp = 4.86 tonne
Weight of footing :	Wf := 2·bf·df·hf·γc	Wf = 5.376 tonne
Weight of grade beam :	Wg := 2·lg·bg·hf·γc	Wg = 1.999 tonne
Total concrete weight :	Wc := Wp + Wf + Wg	Wc = 12.235 tonne

Soil weight above footing :

$$Wsoil := [2\cdot(bf\cdot df - bp\cdot dp)\cdot hb + lg\cdot bg\cdot(hb + hf - hg)]\cdot \gamma soil$$

Wsoil = 1.851 tonne

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Document No. / SJ2-F-52-S-CA-702-A4 / Rev. 0	CONTRACT NO.: 001800.PK/24/UT/2006	Page 7 of 28

4. LOADING DATA

4.1 EQUIPMENT (E)

Erection Weight / E(E) :		EE := 33.1·tonne
Operation Weight / E(O) :		EO := 47.4·tonne
Test Weight / E(T) :		ET := 57.0·tonne
Tube bundle Weight / E(B) : Not to be Considered		EB := 0·tonne

4.2 FOUNDATION (Dead Load) (D)

D := Wc + Wsoil D = 14.086 tonne

4.3 SEISMIC LOAD (Tranversal Direction) due to EO (V)

Lateral force :		He := 11.9·tonne
Moment at base plate :		Me := 15·tonne·m
Moment at bottom found. :	Meb := Me + He·h	Meb = 35.825 tonne·m

4.4 SEISMIC LOAD (Tranversal Direction) due to EE (V)

Lateral force :	Hee := 0.15EE	Hee = 4.965 tonne
Moment at base plate :	Mee := Hee·he	Mee = 6.206 tonne·m
Moment at bottom found. :	Meeb := Mee + Hee·h	Meeb = 14.895 tonne·m

4.5 WIND LOAD (Tranversal Direction) (W)

Lateral force :		Hw := 0.8·tonne
Moment at base plate :		Mw := 1·tonne·m
Moment at bottom found. :	Mwb := Mw + Hw·h	Mwb = 2.4 tonne·m

4.6 THERMAL LOAD (Longitudinal Direction) (T)

Coefficient of friction :		Uo := 0.3
Lateral force :	Ht := Uo·EO	Ht = 14.22 tonne
Moment at bottom found. :	Mtb := Ht·h	Mtb = 24.885 tonne·m

4.7 TUBE BUNDLE PULLING LOAD (B)

Lateral force :	Hb := Uo·100%·EB	Hb = 0 tonne
Moment at bottom found. :	Mbb := Hb·he + Hb·h	Mbb = 0 tonne·m

4.8 BOUYANCY EFFECT (Ww)

Depth of water table from ground :		hw := 1.0·m
Foundation volumn below water table :		
Vw := (2·bf·df + lg·bg)·(hb + hf − hw)		Vw := 0·m³
Bouyancy effect :	Ww := γwater·Vw	Ww = 0 tonne

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Document No. SJ2-F-52-S-CA-702-A4 / Rev. 0	CONTRACT NO.: 001800.PK/24/UT/2006	Page 8 of 38

5. DESIGN ANALYSIS

5.1 CHECK OF PILE CAPACITY

5.1.1 Axial Bearing Capacity

for PC Pile dia. 300 mm : 17 ton ujth .

All. single pile bearing capacity due to the supporting strength of the soil (data from Soil Investigati Report for Bojonegara Station, July 2006, borehole no. BH PB-4) :

Qcall := 26.5tonne

Qtall := 3.25tonne

Total vertical load : V := max((EE EO ET)) + D

Estimated number of pile : $\Sigma n := \left(\frac{V}{Qcall}\right)$ $\Sigma n = 2.682$

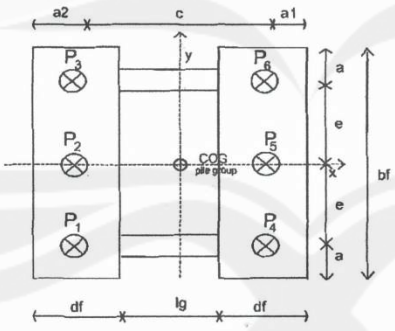
For practical used : $\Sigma n := 6$

Diamater of pile : Dia := 300·mm

Minimum distance to edge of foundation : 1.2·Dia = 0.36 m

Minimum distance between pile : 3·Dia = 0.9 m

Maximum distance between pile : 8·hf = 3.2 m



Data :

c := lg + df	c = 4.271 m
a := 0.40·m	a = 0.4 m
a1 := 0.50·m	a1 = 0.5 m
a2 := df − a	a2 = 0.4 m
e := 0.5(bf − 2·a)	e = 1.35 m

Lampiran 11 : *Data Sheet for Slug Catcher* (Doc No. SJ2-F-00-M-DS-003-A4)

PT. PERUSAHAAN GAS NEGARA (PERSERO)

PENSPEN-PETROTECHINDO UTAMA

PT. REKAYASA INDUSTRI

SOUTH SUMATERA WEST JAVA PHASE II
PIPELINE ONSHORE
CONTRACT NO. 001800.PK/24/AJT/2006

Horizontal Slug Catcher

Doc No. SJ2-F-00-M-DS-003-A4 | Rev. D
Job No.: 05-1604 | Sht 7 of 10
Tag No.: 37-V-2130

Rev. No.	Date	Description	By	CHK'D	APP'D	PMC	PGN
0	04/04/06	Approved for Construction	AC				
A	28/02/06	Preliminary Issue	FR	KR	SGH/DA		
			REKAYASA				

General Information

Applicable To: ☐ Proposal ☒ Purchase ☐ As Built ☒ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.

For	PT Perusahaan Gas Negara (Persero)	Unit Tag Number(s)	37-V-2130
Site	Labuhan Maringgai	No. Required	1
Service	Pipeline Slug Catcher	Serial Number	
Vendor			

Process Data

SITE AND SERVICE CONDITIONS

Ambient Temperature	95°F (max.), 78.4°F (min.)
Elevation/Barometric Pressure	14.696 psia
Relative Humidity	81.5-90 percent - tropical climate
Black Bulb Temperature	176°F (max.)
Solar Radiation	300 BTU/hr-ft² (max.)
Area Classification	Class I, Division 2, Group D (min.)
Wind Velocity	3 m/s (max.)
Seismic Zone	Zone 3 per UBC

FLUID DATA

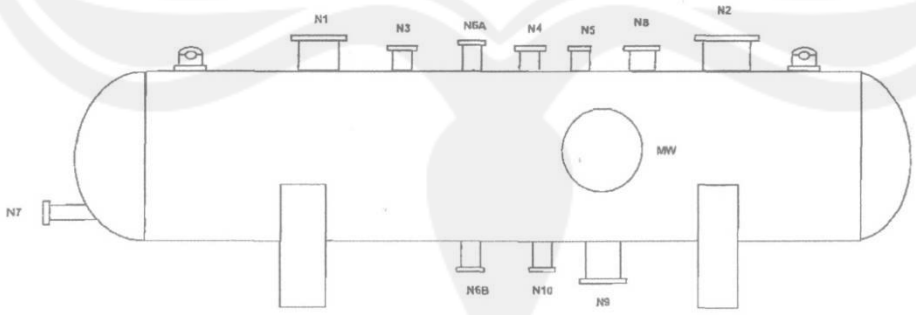
Fluid	Natural gas with condensates and carryovers
Fluid State	Single Phase (norm), two phase (during pigging)
Flowrate (Design)	159.7 MMSCFD
Gas Specific Gravity at Base	0.706
Gas Molecular Weight	20.46
Gas Cp/Cv	1.405
Gas Operating Viscosity	0.0124 cP
Liquid Density	39.146 lb/ft³
Liquid Molecular Weight	80.88
Liquid N.B.P	
Liquid Operating Viscosity	-
Base Pressure	14.696 psia

GAS COMPOSITION/SPECIFICATION :

Typical Gas Composition at Pagar Dewa during Upset Condition

CO_2	4.324
H_2S	-
Nitrogen	2.82
Methane	81.666
Ethane	4.983
Propane	3.656
i - Butane	0.697
n - Butane	0.942
i - Pentane	0.329
n - Pentane	0.18
Hexane	-
Heptane Plus	-
n-Octane	0.14
H_2O	0.015
TOTAL	100

ID : 1981 mm (Note 4)
LENGTH : 7011 mm S/S (Note 4)



Slug Catcher_SJ2-F-00-M-DS-003-A4_Rev.0

PT. PERUSAHAAN GAS NEGARA (PERSERO)

PENSPEN-PETROTECHINDO UTAMA

PT. REKAYASA INDUSTRI

SOUTH SUMATERA WEST JAVA PHASE II
PIPELINE ONSHORE
CONTRACT NO. 001800.PK/24/UT/2006

Horizontal Slug Catcher

Doc No.	Rev.
SJ2-F-00-M-DS-003-A4	0
Job No.: 06-1604	Sht 8 of 10
Tag No.: 37-V-2130	

Rev. No.	Date	Description	By	CHK'D	APP'D	PMC	PGN
0	04/04/06	Approved for Construction	AZ	VW	SGH/DA		
A	28/02/06	Preliminary Issue	FR	KR	SGH/DA		
			REKAYASA				

GENERAL INFORMATION

Applicable To: ☐ Proposal ☒ Purchase ☐ As Built ☒ Seller shall complete Data Sheet with information not otherwise provided by Buyer.

For: PT. Perusahaan Gas Negara (Persero)
Site: Labuhan Maringgai
Service: Pipeline Slug Catcher
Vendor:

Unit Tag Number(s): 37-V-2130
No. Required: 1
Serial Number:

DESIGN & FABRICATION DATA

Contruction to be in accordance with the latest adition of the ASME Code & Addenda

Code Symbol	U	Required	Yes
Design Pressure	1150	PSIG @	150 °F
Operating Pressure (Normal/min)	1060/950	PSIG @	95-100 °F
MDMT	-20 °F		
Stress Relieve	Yes	Radiograph	100%
Joint Eff :Shell	1	Heads	1
Corr. Allowance: Shell	0.0625"	Heads	0.0625"
Min. Thickness : Shell	2.40" (Note 4)	Heads	2.32" Note 4(Ellipsoidal)
Material ASTM : Shell	SA-516-70	Heads	SA-516-70
Flanges	(Note 5)	Pipe	(Note 5)
Studs	SA-193-B7	Nuts	SA-194-2H
Internals	SA-36	Saddles	SA-36
Wire mesh type demisters	316 Stainless Steel (Note 6)		
Inlet Deflector	SA-36		
Vortex Breaker	SA-36		
Gaskets	304 SS w/non Asbestos Filler (center ring + inner ring)		
Nozz. Proj.	230mm	M.W. Proj.	300 mm Dim TOL 3 mm
Saddles	Yes	Lugs	Yes
Hinges	No	Davits	Yes Req'd for Manholes
Insulation Thk.	None	Insulation Rings	None
Ladder Clips	Yes	Platform Clips	Yes
Paint	As per project spec. Painting Doc.No. SJ2-F-00-M-SP-008-A4		
Internal coating	Yes		

Approximate Weight in Lbs

Shipping (Note 3) Erection (Note 3)
Operatir (Note 3) Hydrotest (Note 3)

NOZZLE SCHEDULE :

MK	NO.	SIZE	RATING	TYPE	SERVICE
MW	1	24"	600#	RFWN	Manway
N10	1	4"	600#	RFWN	Drain
N9	1	4"	600#	RFWN	Liquid Outlet
N8	1	2"	600#	RFWN	PSV
N7	1	4"	600#	RFWN	Washout
N6 A/B	2	2"	600#	RFWN	Briddle/LG/LT
N5	1	3/4"	3000#	NPT	PI
N4	1	3/4"	3000#	NPT	PT
N3	1	4"	600#	RFWN	Vent
N2	1	24"	600#	RFWN	Gas Outlet
N1	1	24"	600#	RFWN	Gas Inlet

All gage glass, level controls, alarms, etc. having two connections are to be set with jig

Notes. :

ADDITIONAL DATA

1. Unit shall be in accordance with Project Specification - Slug Catcher (Doc. no. SJ2-F-00-M-DS-005-A4)
2. Design Refer to ASME Sect. VIII Div. 1
3. Vendor to complete
4. Vendor to clarify
5. Refer to project specification General pipe, Valves and Fittings Doc. No. SJ2-F-00-M-SP-002-A4
6. Vendor to confirm the suitability of demister type with the gas composition
7. All material shall have the carbon equivalent not exceed 0.4 percent
8. The carbon content base on the product analysis shall not exceed 0.23 percent.

Lampiran 12 : Tabel 16-F *Wind Stagnation Pressure (qs)*

TABLE 16-F—WIND STAGNATION PRESSURE (q_s) AT STANDARD HE[illegible] OF 33 FEET (10 058 mm)

Basic wind speed (mph)[1] (× 1.61 for km/h)	70	80	90	100	110	120	130
Pressure q_s (psf) (× 0.0479 for kN/m^2)	12.6	16.4	20.8	25.6	31.0	36.9	43.3

[1]Wind speed from Section 1618.

Lampiran 13 : Tabel 16-G *Combined Height,Exposure and Gust Factor Coefficient*

TABLE 16-G—COMBINED HEIGHT, EXPOSURE AND GUST FACTO[illegible]EFFICIENT (C_e)[1]

HEIGHT ABOVE AVERAGE LEVEL OF ADJOINING GROUND (feet) × 304.8 for mm	EXPOSURE D	EXPOSURE C	EXPOSURE B
0-15	1.39	1.[illegible]	0.62
20	1.45	1.[illegible]	0.67
25	1.50	1.[illegible]	0.72
30	1.54	1.[illegible]	0.76
40	1.62	1.[illegible]	0.84
60	1.73	1.[illegible]	0.95
80	1.81	1.[illegible]	1.04
100	1.88	1.[illegible]	1.13
120	1.93	1.[illegible]	1.20
160	2.02	1.[illegible]	1.31
200	2.10	1.[illegible]	1.42
300	2.23	2.[illegible]	1.63
400	2.34	2.[illegible]	1.80

[1]Values for intermediate heights above 15 feet (4572 mm) may be interpolated.

Lampiran 14 : Tabel 16-H *Pressure Coefficient*

TABLE 16-H—PRESSURE COEFFICIENTS (C_q)

STRUCTURE OR PART THEREOF	DESCRIPTION	C_q FACTOR
1. Primary frames and systems	Method 1 (Normal force method)	
	Walls:	
	Windward wall	0.8 inward
	Leeward wall	0.5 outward
	Roofs[1]:	
	Wind perpendicular to ridge	
	Leeward roof or flat roof	0.7 outward
	Windward roof	
	less than 2:12 (16.7%)	0.7 outward
	Slope 2:12 (16.7%) to less than 9:12 (75%)	0.9 outward or 0.3 inward
	Slope 9:12 (75%) to 12:12 (100%)	0.4 inward
	Slope > 12:12 (100%)	0.7 inward
	Wind parallel to ridge and flat roofs	0.7 outward
	Method 2 (Projected area method)	
	On vertical projected area	
	Structures 40 feet (12 192 mm) or less in height	1.3 horizontal any direction
	Structures over 40 feet (12 192 mm) in height	1.4 horizontal any direction
	On horizontal projected area[1]	0.7 upward
2. Elements and components not in areas of discontinuity[2]	Wall elements	
	All structures	1.2 inward
	Enclosed and unenclosed structures	1.2 outward
	Partially enclosed structures	1.6 outward
	Parapets walls	1.3 inward or outward
	Roof elements[3]	
	Enclosed and unenclosed structures	
	Slope < 7:12 (58.3%)	1.3 outward
	Slope 7:12 (58.3%) to 12:12 (100%)	1.3 outward or inward
	Partially enclosed structures	
	Slope < 2:12 (16.7%)	1.7 outward
	Slope 2:12 (16.7%) to 7:12 (58.3%)	1.6 outward or 0.8 inward
	Slope > 7:12 (58.3%) to 12:12 (100%)	1.7 outward or inward
3. Elements and components in areas of discontinuities[2,4,5]	Wall corners[6]	1.5 outward or 1.2 inward
	Roof eaves, rakes or ridges without overhangs[6]	
	Slope < 2:12 (16.7%)	2.3 upward
	Slope 2:12 (16.7%) to 7:12 (58.3%)	2.6 outward
	Slope > 7:12 (58.3%) to 12:12 (100%)	1.6 outward
	For slopes less than 2:12 (16.7%)	
	Overhangs at roof eaves, rakes or ridges, and canopies	0.5 added to values above
4. Chimneys, tanks and solid towers	Square or rectangular	1.4 any direction
	Hexagonal or octagonal	1.1 any direction
	Round or elliptical	0.8 any direction
5. Open-frame towers[7,8]	Square and rectangular	
	Diagonal	4.0
	Normal	3.6
	Triangular	3.2
6. Tower accessories (such as ladders, conduit, lights and elevators)	Cylindrical members	
	2 inches (51 mm) or less in diameter	1.0
	Over 2 inches (51 mm) in diameter	0.8
	Flat or angular members	1.3
7. Signs, flagpoles, lightpoles, minor structures[8]		1.4 any direction

[1]For one story or the top story of multistory partially enclosed structures, an additional value of 0.5 shall be added to the outward C_q. The most critical combination shall be used for design. For definition of partially enclosed structures, see Section 1616.

[2]C_q values listed are for 10-square-foot (0.93 m^2) tributary areas. For tributary areas of 100 square feet (9.29 m^2), the value of 0.3 may be subtracted from C_q, except for areas at discontinuities with slopes less than 7 units vertical in 12 units horizontal (58.3% slope) where the value of 0.8 may be subtracted from C_q. Interpolation may be used for tributary areas between 10 and 100 square feet (0.93 m^2 and 9.29 m^2). For tributary areas greater than 1,000 square feet (92.9 m^2), use primary frame values.

[3]For slopes greater than 12 units vertical in 12 units horizontal (100% slope), use wall element values.

[4]Local pressures shall apply over a distance from the discontinuity of 10 feet (3048 mm) or 0.1 times the least width of the structure, whichever is smaller.

[5]Discontinuities at wall corners or roof ridges are defined as discontinuous breaks in the surface where the included interior angle measures 170 degrees or less.

[6]Load is to be applied on either side of discontinuity but not simultaneously on both sides.

[7]Wind pressures shall be applied to the total normal projected area of all elements on one face. The forces shall be assumed to act parallel to the wind direction.

[8]Factors for cylindrical elements are two thirds of those for flat or angular elements.

Lampiran 15 : Tabel 16-K *Occupancy Category*

TABLE 16-K—OCCUPANCY CATEGORY

OCCUPANCY CATEGORY	OCCUPANCY OR FUNCTIONS OF STRUCTURE	SEISMIC IMPORTANCE FACTOR, I	SEISMIC IMPORTANCE[1] FACTOR, I_p	WIND IMPORTANCE FACTOR, I_w
1. Essential facilities[2]	Group I, Division 1 Occupancies having surgery and emergency treatment areas Fire and police stations Garages and shelters for emergency vehicles and emergency aircraft Structures and shelters in emergency-preparedness centers Aviation control towers Structures and equipment in government communication centers and other facilities required for emergency response Standby power-generating equipment for Category 1 facilities Tanks or other structures containing housing or supporting water or other fire-suppression material or equipment required for the protection of Category 1, 2 or 3 structures	1.25	1.50	1.15
2. Hazardous facilities	Group H, Divisions 1, 2, 6 and 7 Occupancies and structures therein housing or supporting toxic or explosive chemicals or substances Nonbuilding structures housing, supporting or containing quantities of toxic or explosive substances that, if contained within a building, would cause that building to be classified as a Group H, Division 1, 2 or 7 Occupancy	1.25	1.50	1.15
3. Special occupancy structures[3]	Group A, Divisions 1, 2 and 2.1 Occupancies Buildings housing Group E, Divisions 1 and 3 Occupancies with a capacity greater than 300 students Buildings housing Group B Occupancies used for college or adult education with a capacity greater than 500 students Group I, Divisions 1 and 2 Occupancies with 50 or more resident incapacitated patients, but not included in Category 1 Group I, Division 3 Occupancies All structures with an occupancy greater than 5,000 persons Structures and equipment in power-generating stations, and other public utility facilities not included in Category 1 or Category 2 above, and required for continued operation	1.00	1.00	1.00
4. Standard occupancy structures[3]	All structures housing occupancies or having functions not listed in Category 1, 2 or 3 and Group U Occupancy towers	1.00	1.00	1.00
5. Miscellaneous structures	Group U Occupancies except for towers	1.00	1.00	1.00

[1]The limitation of I_p for panel connections in Section 1633.2.4 shall be 1.0 for the entire connector.
[2]Structural observation requirements are given in Section 1702.
[3]For anchorage of machinery and equipment required for life-safety systems, the value of I_p shall be taken as 1.5.

2–30

Lampiran 16 : Tabel 16-Q *Seismic Coefficient*

TABLE 16-Q—SEISMIC COEFFICIENT C_a

SOIL PROFILE TYPE	SEISMIC ZONE FACTOR, Z				
	$Z = 0.075$	$Z = 0.15$	$Z = 0.2$	$Z = 0.3$	$Z = 0.4$
S_A	0.06	0.12	0.16	0.24	$0.32N_a$
S_B	0.08	0.15	0.20	0.30	$0.40N_a$
S_C	0.09	0.18	0.24	0.33	$0.40N_a$
S_D	0.12	0.22	0.28	0.36	$0.44N_a$
S_E	0.19	0.30	0.34	0.36	$0.36N_a$
S_F	See Footnote 1				

[1]Site-specific geotechnical investigation and dynamic site response analysis shall be performed to determine seismic coefficients for Soil Profile Type S_F.