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> (collectively the "Project")

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E-24003	V-24002	C-24001	E-24005	V-24004	C-24002	E-24004	V-24001	E-24001	V-24006	E-24002	V-24005
CHEMICAL FEED COMPRESSOR 1ST STAGE COOLER	LP CHEMICAL FEED KNOCK OUT DRUM	CHEMICAL FEED COMPRESSOR	NITROGEN RECYCLE COMPRESSOR COOLER	NITROGEN RECYCLE COMPRESSOR KNOCKOUT DRUM	N2 RECYCLE COMPRESSOR	CHEMICAL FEED COMPRESSOR 2ND STAGE COOLER	HP CHEMICAL FEED KNOCK OUT DRUM	NATURAL GAS PREHEATER	NATURAL GAS PREHEATER CONDENSATE POT	BACK-UP H2 RICH GAS COOLER	HYDROGEN RICH GAS KNOCK OUT DRUM
Duty (MW) = 1.66	1600 mm ID x 2700 mm T/T	Cap. 65,000 m3(st)/hr Suct 473 kPa(ga) Disch 4802 kPa(ga) Driver 7950 kW	Duty (MW) = 0.224	914 mm OD x 2350 mm T/T	Cap. 15,198m3(st)/hr Pss 800 kPa (ga) Pds 1200 kPa (ga) Driver 335 kW	Duty (MW) = 4.64	1600 mm ID x 2700 mm T/T	Duty (MW) = 3.62	610 mm OD x 1250 mm T/T	Duty (MW) = 1.31	610 mm OD x 2100 mm T/FOF

I-24101/24201
HYDROGEN EDUCTOR

C1 FLOW CALCULATION TRAIN 2 242.001
C1 FLOW CALCULATION TRAIN 1 241.001
C1 FLOW CALCULATION TRAIN 1 241.001
C1 FLOW CALCULATION TRAIN 2 242.001

HP CHEMICAL FEED B. L.
LP NATURAL GAS 240.002
LP CHEMICAL FEED B. L.
HP NATURAL GAS B. L.
NITROGEN RECYCLE FROM V-24206 242.003
NITROGEN RECYCLE FROM V-24106 241.003
NITROGEN MAKE-UP B. L.

MIXED FEED TO E-24216 242.002
MIXED FEED TO E-24116 241.002
BACK-UP H2 RICH GAS TO TRAIN 1 PSA NNF 241.003
BACK-UP H2 RICH GAS TO TRAIN 2 PSA NNF 242.003
C1 FLOW CALCULATION TRAIN 2 242.001
C1 FLOW CALCULATION TRAIN 1 241.001
HYDROGEN RECYCLE 244.001
HYDROGEN RECYCLE 243.001
240.003 SL
240.003 SC

E-24003 E-24002 E-24001 E-24004 E-24005 E-24006
V-24001 V-24002 V-24004 V-24005 V-24006
C-24001 CASING 1 STAGE 1
C-24001 CASING 1 C-24001 CASING 2 STAGE 2
C-24002
I-24201 I-24101
240.004 CWR CWS 240.004

NOTES

1. COMPLETE ANALYSIS TO DETERMINE EQUIVALENT C1 IN CHEMICAL FEED.
2. CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.
   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100%. CO2 LEAN STREAM TO PSA.

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr)
  FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	12 DEC 21	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 OCT 25	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT
PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT CHEMICAL FEED COMPRESSION

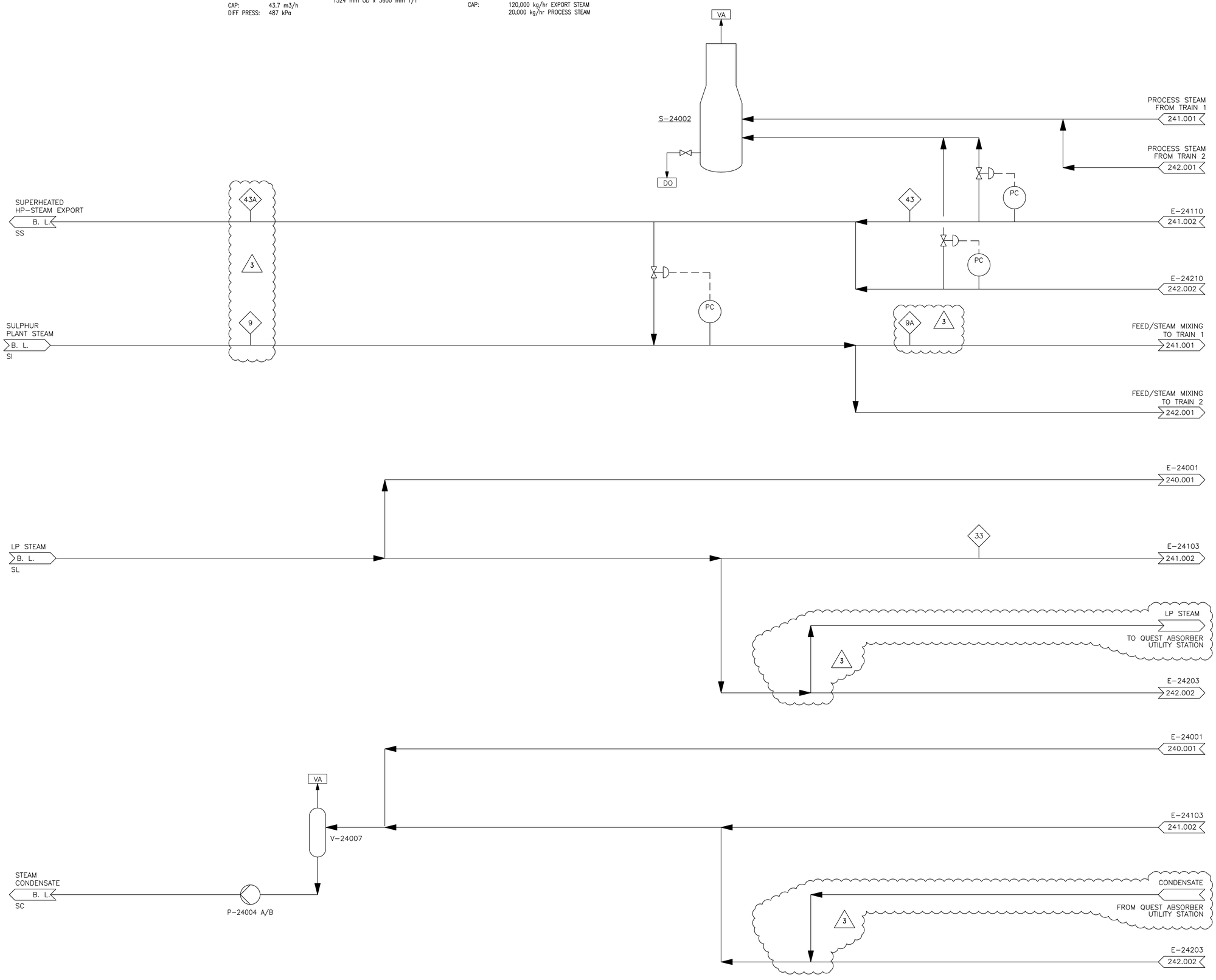
SCALE: NTS
TOE DWG. No.: 99049-0-DG-BB-00001.1
SHELL DWG NO.: 240.0001.000.040.001
REV. 3

FORMAT A1
0011-B8W

P-24004 A/B
STEAM CONDENSATE DRUM PUMPS
CAP: 43.7 m3/h
DIFF PRESS: 487 kPa

V-24007
STEAM CONDENSATE DRUM
1524 mm OD x 3600 mm T/T

S-24002
STEAM SILENCER
CAP: 120,000 kg/hr EXPORT STEAM
20,000 kg/hr PROCESS STEAM



NOTES

KEY PLAN

REFERENCE DRAWINGS

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2B	13 JAN 10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
2A	11 MAR 01	RE-ISSUED FOR DESIGN	GB	SM	MB	JI	CV	MD/SB
2	10 OCT 25	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
1A	10 AUG 26	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

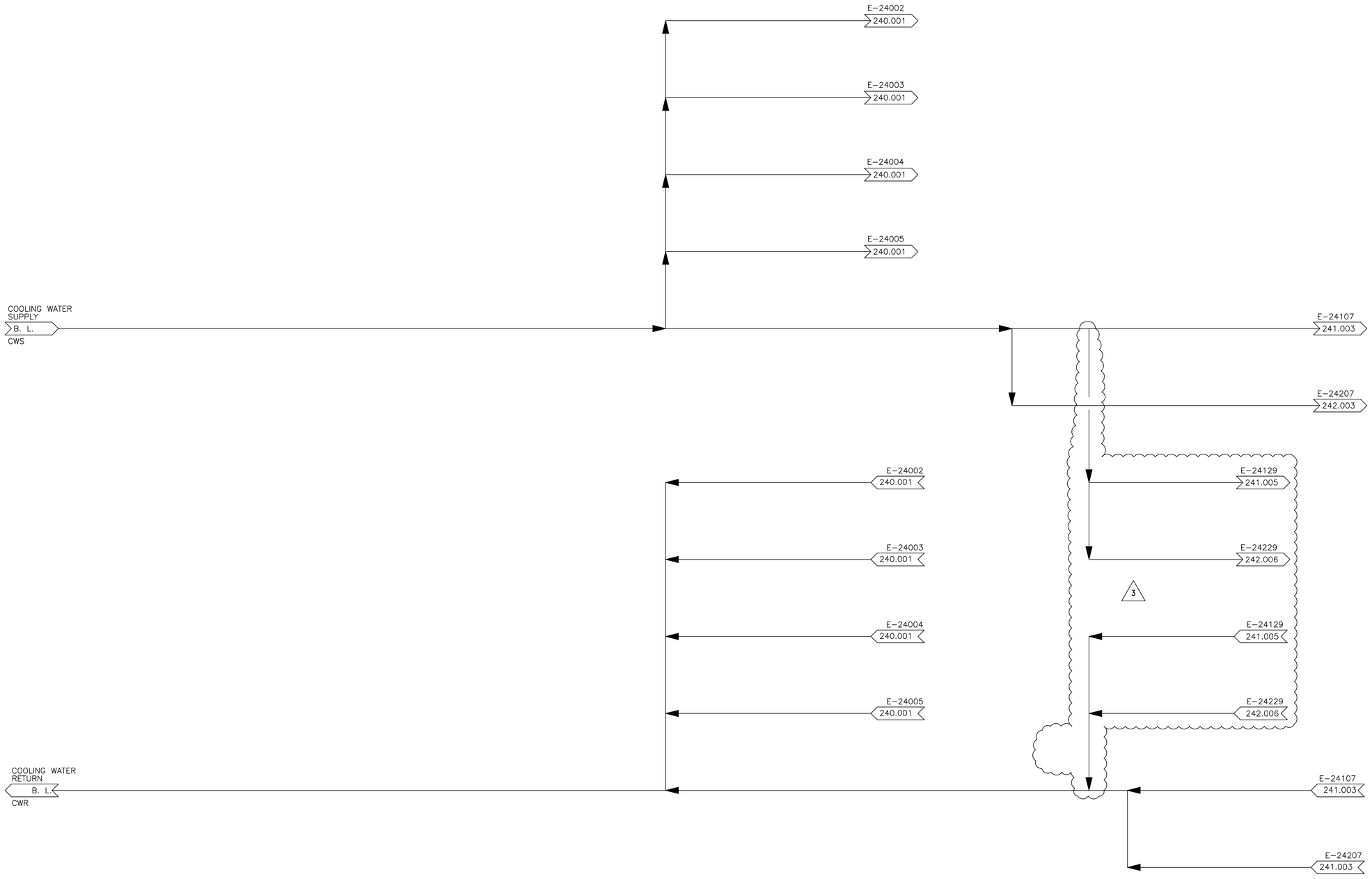
SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

UTILITY PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT STEAM AND CONDENSATE

SCALE: NTS
TOE DWG. No.: 99049-0-DG-BB-00003.1
SHELL DWG NO.: 240.0001.000.040.003
REV. 3

FORMAT A1
0031-ndy



NOTES

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2B	13 JAN 10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
2A	11 MAR 01	RE-ISSUED FOR DESIGN	GB	SM	MB	JI	CV	MD/SB
2	10 OCT 25	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

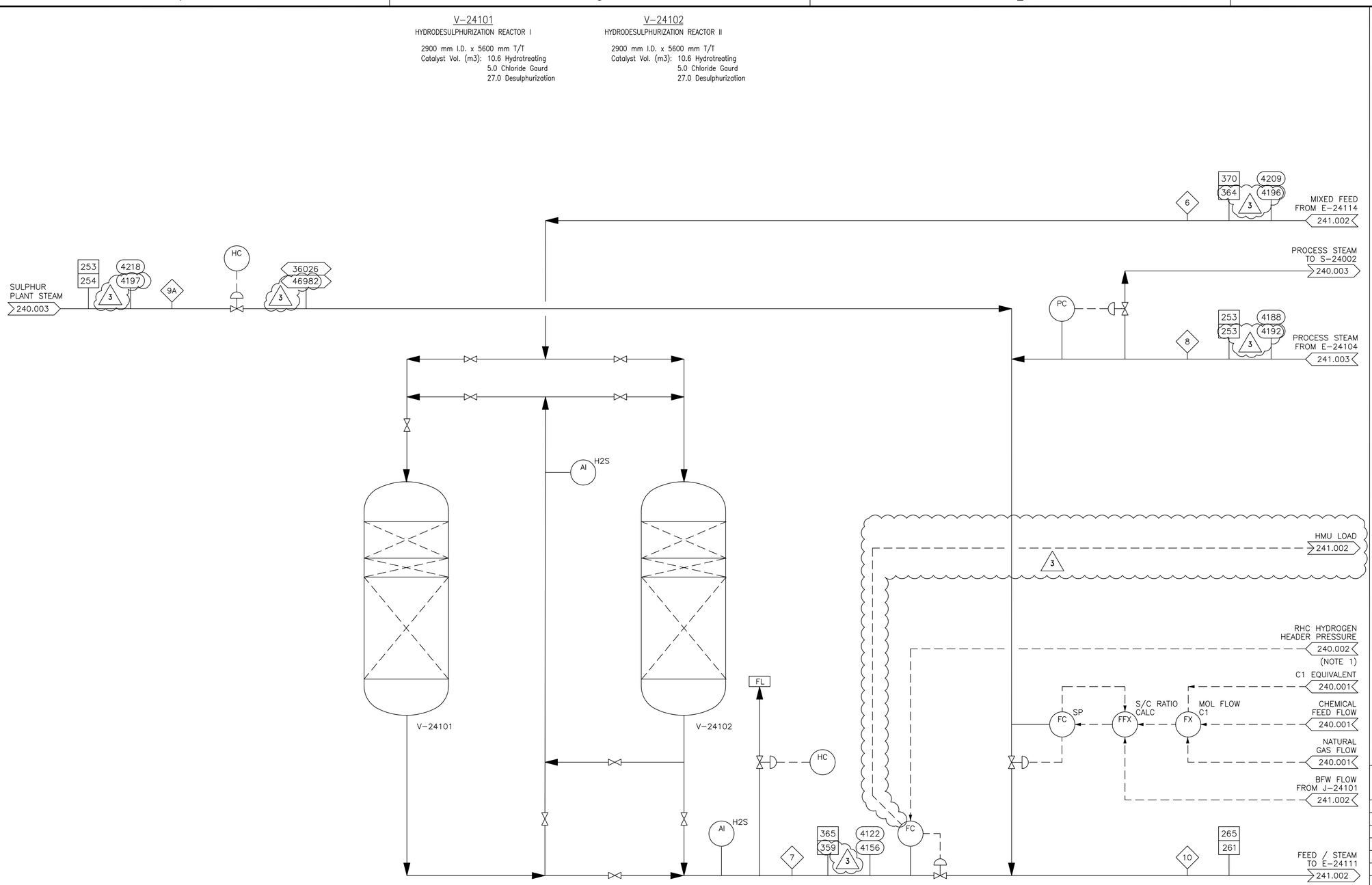
SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

UTILITY PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT COOLING WATER SUPPLY / RETURN

SCALE: NTS
TOE DWG. No.: 99049-0-DG-BB-00004.1
SHELL DWG NO.: 240.0001.000.040.004
REV. 3

FORMAT A1
0041-B8Z



NOTES

1. HYDROGEN HEADER PRESSURE AT RHC WILL AUTOMATICALLY ADJUST HMU PRODUCTION. HMU IS RESPONSIBLE FOR ADJUSTMENT OF EACH HMU TRAIN BASED ON RHC HYDROGEN PRESSURE.
2. CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.

   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100%. CO2 LEAN STREAM TO PSA. (3)

REFERENCE

- (3) STREAM NUMBER
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr)
  FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	12 DEC 21	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT FEED GAS DESULPHURIZATION

SCALE: NTS
TOE DWG. No.: 99049-1-DG-BB-00001.1
SHELL DWG NO.: 241.0001.000.040.001
REV. 3

FORMAT A1
0011-B9B

J-24101
FEED/STEAM PREHEATER
SPRAY ATTEMPERATOR
Capacity: 14,000 kg/h

J-24102
STEAM SUPERHEATER
SPRAY ATTEMPERATOR I
Capacity: 8,000 kg/hr

J-24103
STEAM SUPERHEATER
SPRAY ATTEMPERATOR II
Capacity: 5,000 kg/h

V-24104
STEAM DRUM
BLOWDOWN DRUM
590 mm ID x 2550 mm T/T

P-24103 A/B
STEAM BLOWDOWN
DRUM PUMPS
Capacity: 3.0 m3/hr
Diff Press: 601 kPa

H-24102
CONVECTION BANK

COIL	DESIGNATION	Duty (MW)
E-24108	HP-STEAM GENERATOR	7.17 / 7.40
E-24109	FEED/STEAM PREHEATER II	13.51 / 13.20
E-24110	HP-STEAM SUPERHEATER III	3.48 / 3.53
E-24111	FEED/STEAM PREHEATER I	16.43 / 16.60
E-24112	HP-STEAM SUPERHEATER II	5.07 / 4.82
E-24113	HP-STEAM SUPERHEATER I	9.56 / 9.30
E-24114	FEED PREHEATER II	4.40 / 3.67
E-24115	PROC COND PARTIAL EVAPORATOR	32.90 / 30.75
E-24116	FEED PREHEATER I	2.27 / 2.84
E-24117	COMBUST AIR HEATER	13.85 / 13.28

V-24103
STEAM DRUM
2100 mm I.D. x 8900 mm T/T

E-24101
PROCESS GAS COOLER
Duty (MW): 54.15 / 57.13

H-24101
STEAM REFORMER
Absorbed Duty (MW): 97.44 / 101.87
NOTE 5

C-24102
INDUCED DRAFT
(FLUE GAS) FAN
Cap. 282,786 Nm3/hr
Diff 3.8 kPaN
Driver 935 kW

E-24103
COMBUSTION AIR PREHEATER
Duty (MW): 9.37 / 3.48 (NOTE 3)

C-24101
FORCED DRAFT
(COMBUSTION AIR) FAN
Cap. 208,038 Nm3/hr
Diff 4.6 kPa
Driver 675 kW

S-24103
STACK
4000 mm I.D. x 50 m

C-24103
FLUE GAS
RECIRCULATION FAN
Cap. 40,871 Nm3/hr
Diff 3.9 kPa
Driver 95 kW

S-24101
COMBUSTION AIR SILENCER

S-24104
FLUE GAS
SILENCER

SUPERHEATED HP STEAM EXPORT 240.003
MIXED FEED FROM C-24001 240.001
MIXED FEED TO V-24101 241.001
PSA OFF-GAS PRESSURE CONTROLLER 243.001
LP PSA OFF-GAS FROM S-24301 243.001
NATURAL GAS 240.002
BLOWDOWN 240.002
FEED/STEAM 241.001
STEAM/CARBON RATIO CONTROLLER 241.001
MASTER HMU LOAD CONTROLLER 241.001
CAPTURED CO2 FEEDFORWARD 241.003
MAKE-UP WATER FLOW CONTROLLER 241.003
BOILER FEED WATER FROM E-24105 241.003
PROCESS CONDENSATE FROM E-24102 241.003
PART. EVAPORATED PROCESS CONDENSATE TO V-24109 241.003
INJECTION BOILER FEED WATER 241.003
REFORMED GAS TO V-24105 241.003
SC 240.003
AIR INTAKE
NOTE 1
NOTE 4
NOTE 5

NOTES

1. PROCESS SIDE TEMPERATURE IS CONTROLLED, WITH CHANGES IN FLUE GAS TEMPERATURE USED TO INITIATE NATURAL GAS FLOW CHANGES TO MINIMIZE DEVIATIONS IN THE PROCESS TEMPERATURE.
2. FLOWS & DUTIES: CASE #2 / CASE #24.
   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.
   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100% CO2 LEAN STREAM TO PSA.
3. DUTY WINTER/SUMMER. FOR CASE #2.
4. FLOW CONTROL ON COMBUSTION AIR WITH TRIM FROM EXCESS O2 AT BURNER OUTLET.
5. FLUE GAS RECIRCULATION FAN CONTROLLED BY TOTAL CONVECTION SECTION FLOW WITH FEEDFORWARD FROM CO2 CAPTURED.

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr)
  FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

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REV	DATE	DESCRIPTION	DWN	CK	ENG	AP1	AP2	C.AP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	13 JAN 08	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 OCT 25	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP

SHELL CANADA LTD.
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM
HYDROGEN MANUFACTURING UNIT
STEAM REFORMING

SCALE: NTS
TOE DWG. No.: 99049-1-DG-BB-00002.1
SHELL DWG NO.: 241.0001.000.040.002
REV. 3

FORMAT A1
0021-BB-C

V-24105	V-24109	V-24111	E-24104	E-24105	E-24102	E-24106	P-24101 A/B	E-24107	V-24106	V-24107
HT-SHIFT CONVERTER	PROCESS STEAM SEPARATOR	PROCESS STEAM BLOWDOWN DRUM	PROCESS CONDENSATE EVAPORATOR	BFW PREHEATER	PROCESS CONDENSATE PREHEATER	AIR COOLER	PROCESS CONDENSATE PUMP	FINAL COOLER	PROCESS CONDENSATE SEPARATOR	PROCESS CONDENSATE FLASH DRUM
4000 mm ID x 3000 mm T/T Catalyst Vol. (m3): 59.1	1200 mm ID x 2050 mm T/T	590 mm ID x 2800 mm T/T	Duty (MW): 12.97 / 13.68	Duty (MW): 27.90 / 27.16	Duty (MW): 5.17 / 4.92	Duty (MW): 27.93 / 31.48	Cap. 70.5 m3/h diff. press. 1857 kPa	Duty (MW): 4.73 / 4.74	2250 mm ID x 5500 mm T/T	690 mm ID x 1100 mm T/T

BACK-UP H2 RICH GAS 240.001 — NNF

DOW HYDROGEN RICH GAS 240.002

PROCESS CONDENSATE TO E-24115 241.002

STEAM DRUM LC 241.002

BOILER FEED WATER TO V-24103 241.002

PROCESS STEAM 241.001

PART. EVAPORATED PROCESS COND FROM E-24115 241.002

STG CONDENSATE 240.002

BOILER FEED WATER TO SPRAY ATTEMPERATORS 241.002

BOILER FEED WATER MAKE-UP 240.002

REFORMED GAS FROM E-24101 241.002

H2 RAW GAS FLOW 241.005

H2 RAW GAS 241.005 TO V-24118

H2 RAW GAS 241.005 FROM V-24119

H2 RAW GAS TO S-24301 243.001

N2 RECYCLE TO C-24002 NNF 240.001

240.004 CWR / CWS 240.004

SPLIT RANGE

COND AI — pH AI — CH4 AI — CO AI

V-24109 — V-24105 — V-24111 — V-24106 — V-24107

E-24104 — E-24105 — E-24102 — E-24106 — E-24107

P-24101 A/B

FC — LC — LY — FX — PC — FT — TC — FL — M — NC

DO — DO NNF

NOTES

1. FLOWS & DUTIES: CASE #2 / CASE #24.

   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.

   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100% LOAD. CO2 LEAN STREAM TO PSA.

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CASE #2 (°C) / TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a) / PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr) / FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr) / Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	12 DEC 21	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 03	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

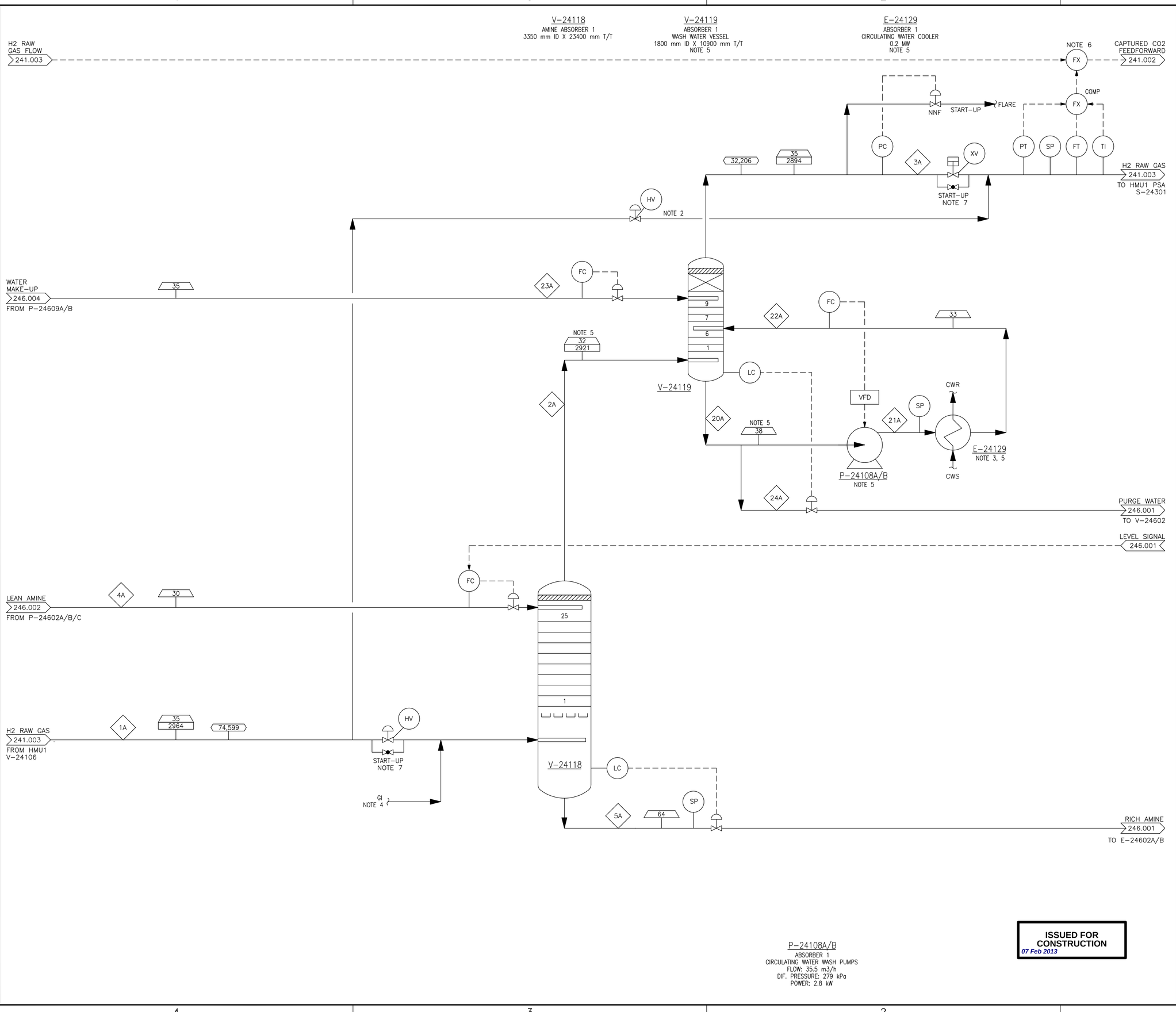
PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT CO-CONVERSION COOLING TRAIN

SCALE: NTS | TOE DWG. No.: 99049-1-DG-BB-00003.1

SHELL DWG NO.: 241.0001.000.040.003 | REV. 3

FORMAT A1

0861-1200



NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. FEED GAS BYPASS AROUND THE HMU1 CO2 CAPTURE TRAIN.
3. COOLING WATER SOURCE IS HMU1 COOLING WATER SYSTEM. SOURCE TEMPERATURE IS 25°C FOR DESIGN.
4. NITROGEN PURGE FOR START-UP.
5. WATER WASH SECTION IS DESIGNED FOR A HIGHER TREATED GAS TEMPERATURE OF 39°C FROM THE AMINE ABSORBER.
6. CAPTURED CO2 CALCULATED AND USED AS AN INPUT TO CONTROL THE FLUE GAS RECIRCULATION FAN (C-24103).
7. H2 RAW GAS BYPASS FOR SYSTEM PURGE AND PRESSURIZATION AT START-UP.

LEGEND

- XXX — STREAM NUMBER
- XXX — TEMPERATURE, °C
- XXX — PRESSURE, kPag
- XX,XXX — FLOW, kg/h

P-24108A/B
ABSORBER 1
CIRCULATING WATER WASH PUMPS
FLOW: 35.5 m3/h
DIF. PRESSURE: 279 kPa
POWER: 2.8 kW

ISSUED FOR CONSTRUCTION
07 Feb 2013

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

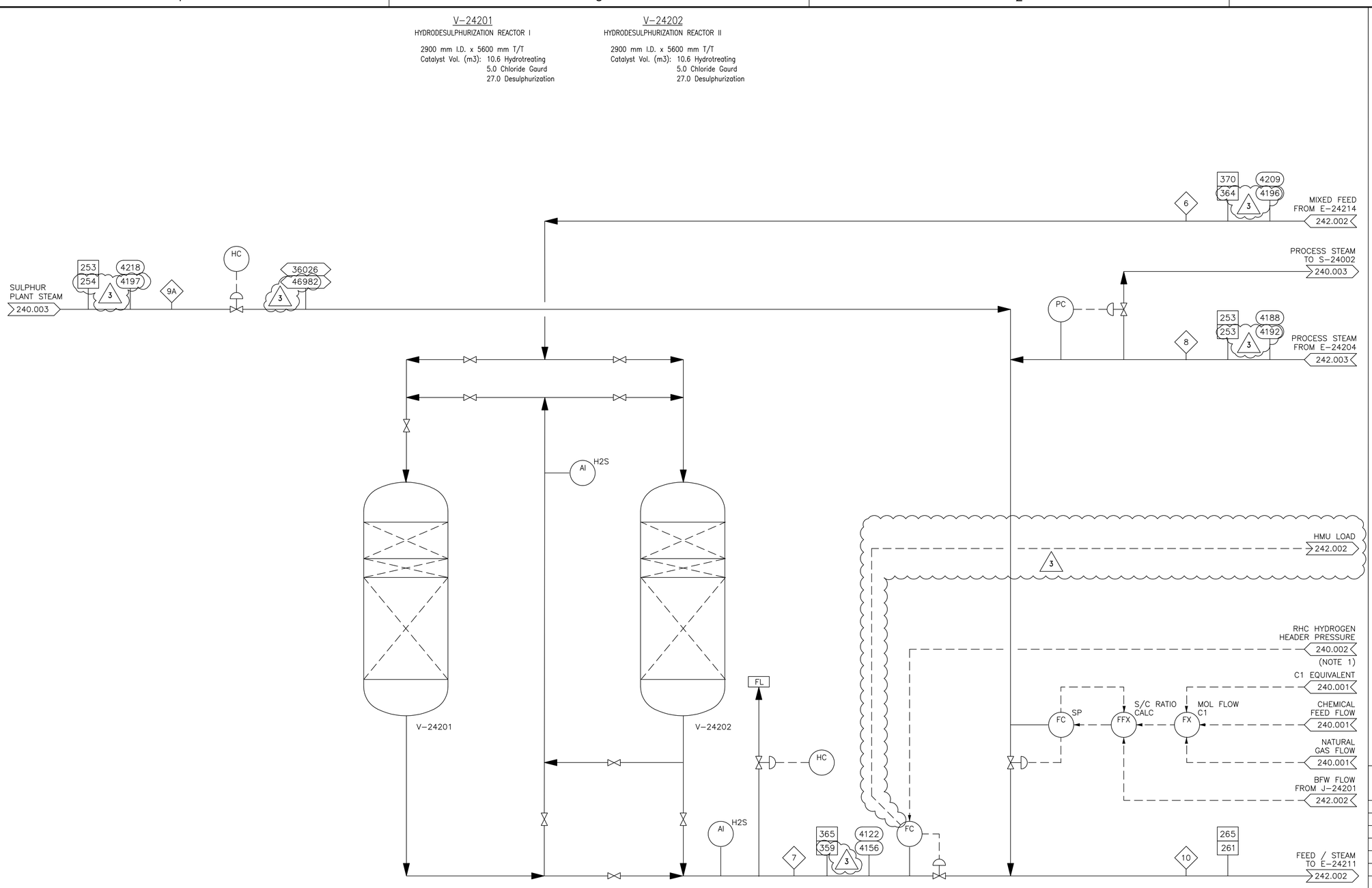
FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
HMU1 AMINE ABSORBER

SCALE: NONE | TOE DWG. No.:

SHELL DWG NO.: 241.0001.000.040.005 | REV. 1

FORMAT A1



NOTES

1. HYDROGEN HEADER PRESSURE AT RHC WILL AUTOMATICALLY ADJUST HMU PRODUCTION. HMU IS RESPONSIBLE FOR ADJUSTMENT OF EACH HMU TRAIN BASED ON RHC HYDROGEN PRESSURE.
2. CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.

   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100% LOAD. CO2 LEAN STREAM TO PSA.

   3

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr)
  FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	13 JAN 09	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT FEED GAS DESULPHURIZATION

SCALE: NTS
TOE DWG. No.: 99049-2-DG-BB-00001.1
SHELL DWG NO.: 242.0001.000.040.001
REV. 3

FORMAT A1
0011-F6E

J-24201
FEED/STEAM PREHEATER
SPRAY ATTEMPERATOR
Capacity: 14,000 kg/h

J-24202
STEAM SUPERHEATER
SPRAY ATTEMPERATOR I
Capacity: 8,000 kg/hr

J-24203
STEAM SUPERHEATER
SPRAY ATTEMPERATOR II
Capacity: 5,000 kg/h

V-24204
STEAM DRUM
BLOWDOWN DRUM
590 mm ID x 2550 mm T/T

P-24203 A/B
STEAM BLOWDOWN
DRUM PUMPS
Capacity: 3.0 m3/hr
Diff Press: 601 kPa

H-24202
CONVECTION BANK

COIL	DESIGNATION	Duty (MW)	
E-24208	HP-STEAM GENERATOR	7.17	7.40
E-24209	FEED/STEAM PREHEATER II	13.51	13.20
E-24210	HP-STEAM SUPERHEATER III	3.48	3.53
E-24211	FEED/STEAM PREHEATER I	16.43	16.60
E-24212	HP-STEAM SUPERHEATER II	5.07	4.82
E-24213	HP-STEAM SUPERHEATER I	9.56	9.30
E-24214	FEED PREHEATER II	4.40	3.67
E-24215	PROC COND PARTIAL EVAPORATOR	32.90	30.75
E-24216	FEED PREHEATER I	2.27	2.84
E-24217	COMBUST AIR HEATER	13.85	13.28

V-24203
STEAM DRUM
2100 mm I.D. x 8900 mm T/T

E-24201
PROCESS GAS COOLER
Duty (MW): 54.15 / 57.13

H-24201
STEAM REFORMER
Absorbed Duty (MW): 97.44 / 101.87
NOTE 5

C-24202
INDUCED DRAFT
(FLUE GAS) FAN
Cap. 282,786 Nm3/hr
Diff 3.8 kPa
Driver 935 kW

E-24203
COMBUSTION AIR PREHEATER
Duty (MW): 9.37 / 3.48 (NOTE 3)

C-24201
FORCED DRAFT
(COMBUSTION AIR) FAN
Cap. 208,038 Nm3/hr
Diff 4.6 kPa
Driver 675 kW

S-24203
STACK
4000 mm I.D. x 50 m

C-24203
FLUE GAS
RECIRCULATION FAN
Cap. 40,871 Nm3/hr
Diff 3.9 kPa
Driver 95 kW

S-24201
COMBUSTION AIR SILENCER

S-24204
FLUE GAS
SILENCER

SUPERHEATED HP STEAM EXPORT 240.003
MIXED FEED FROM C-24001 240.001
MIXED FEED TO V-24201 242.001
PSA OFF-GAS PRESSURE CONTROLLER 243.001
PSA OFF-GAS FROM S-24401 244.001
LP NATURAL GAS 240.002
BLOWDOWN 240.002
FEED/STEAM 242.001
STEAM/CARBON RATIO CONTROLLER 242.001
MASTER HMU LOAD CONTROLLER 242.001
CAPTURED CO2 FEEDFORWARD 242.006
MAKE-UP WATER FLOW CONTROLLER 242.003
BOILER FEED WATER FROM E-24205 242.003
PROCESS CONDENSATE FROM E-24202 242.003
PART. EVAPORATED PROCESS CONDENSATE TO V-24209 242.003
INJECTION BOILER FEED WATER 242.003
REFORMED GAS TO V-24205 242.003
SC 240.003
AIR INTAKE

NOTE 1
NOTE 4
NOTE 5

V-24203
V-24204
H-24201
H-24202
E-24201
E-24203
C-24201
C-24202
C-24203
P-24203 A/B
J-24201
J-24202
J-24203
E-24208
E-24209
E-24210
E-24211
E-24212
E-24213
E-24214
E-24215
E-24216
E-24217

NOTES

1. PROCESS SIDE TEMPERATURE IS CONTROLLED, WITH CHANGES IN FLUE GAS TEMPERATURE USED TO INITIATE NATURAL GAS FLOW CHANGES TO MINIMIZE DEVIATIONS IN THE PROCESS TEMPERATURE.
2. FLOWS & DUTIES: CASE #2 / CASE #24.
   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.
   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100% LOAD. CO2 LEAN STREAM TO PSA.
3. DUTY WINTER/SUMMER. FOR CASE #2.
4. FLOW CONTROL ON COMBUSTION AIR WITH TRIM FROM EXCESS O2 AT BURNER OUTLET.
5. FLUE GAS RECIRCULATION FAN CONTROLLED BY TOTAL CONVECTION SECTION FLOW WITH FEEDFORWARD FROM CO2 CAPTURED.

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/Hr)
  FLOW – CASE #24 (kg/Hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	13 JAN 09	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT
PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM
HYDROGEN MANUFACTURING UNIT
STEAM REFORMING

SCALE: NTS
TOE DWG. No.: 99049-2-DG-BB-00002.1
SHELL DWG NO.: 242.0001.000.040.002
REV. 3

FORMAT A1
0021-F66

V-24205	V-24209	V-24211	E-24204	E-24205	E-24202	E-24206	P-24201 A/B	E-24207	V-24206	V-24207
HT-SHIFT CONVERTER	PROCESS STEAM SEPARATOR	PROCESS STEAM BLOWDOWN DRUM	PROCESS CONDENSATE EVAPORATOR	BFW PREHEATER	PROCESS CONDENSATE PREHEATER	AIR COOLER	PROCESS CONDENSATE PUMP	FINAL COOLER	PROCESS CONDENSATE SEPARATOR	PROCESS CONDENSATE FLASH DRUM
4000 mm ID x 3000 mm T/T Catalyst Vol. (m3): 59.1	1200 mm ID x 2050 mm T/T	590 mm ID x 2800 mm T/T	Duty (MW): 12.97 / 13.68 (4)	Duty (MW): 27.90 / 27.16 (4)	Duty (MW): 5.17 / 4.92 (4)	Duty (MW): 27.93 / 31.48 (4)	Cap. 70.5 m3/h diff. press. 1857 kPa	Duty (MW): 4.73 / 4.74 (4)	2250 mm ID x 5500 mm T/T	690 mm ID x 1100 mm T/T

BACK-UP H2 RICH GAS 240.001 — NNF — 29

DOW HYDROGEN RICH GAS 240.002 — 20 — 40 — 5526 / 4794 (4) — 3190 — FC

PROCESS CONDENSATE TO E-24215 242.002 — 49 — 97 / 98 (4)

STEAM DRUM LC 242.002

BOILER FEED WATER TO V-24203 242.002 — 42 — 225 / 225 (4)

PROCESS STEAM 242.001 — 8 — 253 / 253 (4)

PART. EVAPORATED PROCESS COND FROM E-24215 242.002 — 50 — 253 / 253 (4)

V-24209

V-24205

E-24204 — E-24205 — E-24202 — E-24206 — E-24207

399 / 400 — 3214 / 3275 (4) — 14

273 / 273 (4) — 15

162 / 168 (4) — 16

154 / 160 (4) — 17

65 — 18

V-24206

LC — LC — LC — FC — M

SPLIT RANGE — LY — LY

240.004 CWR — 240.004 CWS

CO — AI

NC — NC

FT — TC — PC — FX

3020 / 3056 (4) — 19

1B — FL

19A — 3B

H2 RAW GAS FLOW 242.005 — 4

35 — 71379 / 76116 — 4 — H2 RAW GAS 242.006 TO V-24218

35 — 71379 / 32659 — 3020 / 2986 — H2 RAW GAS 242.006 FROM V-24219

21 — 35 / 35 (4) — H2 RAW GAS TO S-24401 244.001

STG CONDENSATE 240.002 — 54 — 35 — 47

COND AI — pH AI — 3247 / 3311 (4) — 340 — 44 — 55

P-24201 A/B — 48 — 35

BOILER FEED WATER TO SPRAY ATTEMPERATORS 242.002

BOILER FEED WATER MAKE-UP 240.002 — 121 — 41

51

AI CH4 — REFORMED GAS FROM E-24201 242.002 — 13

VA — 45 — V-24211 — 46 — DO

VA — V-24207 — NNF — 52 — DO NNF

30 — NNF — N2 RECYCLE TO C-24002 240.001

NOTES

1. FLOWS & DUTIES: CASE #2 / CASE #24.

   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.

   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100% LOAD. CO2 LEAN STREAM TO PSA. (4)

REFERENCE

- STREAM NUMBER (4)
- TEMPERATURE – CASE #2 (°C)
  TEMPERATURE – CASE #24 (°C)
- PRESSURE – CASE #2 (kPa-a)
  PRESSURE – CASE #24 (kPa-a)
- FLOW – CASE #2 (kg/hr)
  FLOW – CASE #24 (kg/hr)
- Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
4	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
3C	13 JAN 09	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
3B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	WD/SB
3A	11 MAR 03	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	WD/SB
3	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	WD/SB
2A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
2	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
1	01 MAY 31	IFC: ISSUED FOR CONSTRUCTION	LWM	EG	RAMC	MWP	–	DCL

DRAWING REVISION "0" AFFIXED WITH P.ENG. STAMP ON 00.10.16 AND STAMPED BY: ROBERT A. MACDONALD.

FULL SIZE VERSION OF THIS DRAWING STAMPED WITH PERMIT TO PRACTICE AT REV.0

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM HYDROGEN MANUFACTURING UNIT CO-CONVERSION COOLING TRAIN

SCALE: NTS | TOE DWG. No.: 99049-2-DG-BB-00003.1

SHELL DWG NO.: 242.0001.000.040.003 | REV. 4

FORMAT A1

0031-F6I

V-24218
AMINE ABSORBER 2
3350 mm ID X 23400 mm T/T

V-24219
ABSORBER 2
WASH WATER VESSEL
1800 mm ID X 10900 mm T/T
NOTE 5

E-24229
ABSORBER 2
CIRCULATING WATER COOLER
0.2 MW
NOTE 5

H2 RAW GAS FLOW
242.003

NOTE 6
CAPTURED CO2 FEEDFORWARD
242.002

COMP
FX
NNF
START-UP
FLARE
PC
PT
SP
FT
TI
3B
XV
32,206
35
2894
H2 RAW GAS
242.003
TO HMU2 PSA
S-24401
START-UP
NOTE 7

HV
NOTE 2

WATER MAKE-UP
246.004
FROM P-24609A/B
35
23B
FC
9
7
6
1
22B
33
NOTE 5
32
2921
V-24219
LC
2B
20B
NOTE 5
38
VFD
SP
21B
CWR
CWS
E-24229
NOTE 3, 5
P-24208A/B
NOTE 5
24B
PURGE WATER
246.001
TO V-24602

LEVEL SIGNAL
246.001

LEAN AMINE
246.002
FROM P-24602A/B/C
4B
30
FC
25
1

H2 RAW GAS
242.003
FROM HMU2
V-24206
1B
35
2964
74,599
HV
START-UP
NOTE 7
GI
NOTE 4
V-24218
LC
64
5B
SP
RICH AMINE
246.001
TO E-24602A/B

P-24208A/B
ABSORBER 2
CIRCULATING WATER WASH PUMP
FLOW: 35.5 m3/h
DIF. PRESSURE: 279 kPa
POWER: 2.8 kW

ISSUED FOR CONSTRUCTION
07 Feb 2013

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. FEED GAS BYPASS AROUND HMU2 CO2 CAPTURE TRAIN.
3. COOLING WATER SOURCE IS HMU2 COOLING WATER SYSTEM. SOURCE TEMPERATURE IS 25°C FOR DESIGN.
4. NITROGEN PURGE FOR START-UP.
5. WATER WASH SECTION IS DESIGNED FOR A HIGHER TREATED GAS TEMPERATURE OF 39°C FROM THE AMINE ABSORBER.
6. CAPTURED CO2 CALCULATED AND USED AS AN INPUT TO CONTROL THE FLUE GAS RECIRCULATION FAN (C-24203).
7. H2 RAW GAS BYPASS FOR SYSTEM PURGE AND PRESSURIZATION AT START-UP.

LEGEND

- XXX — STREAM NUMBER
- XXX — TEMPERATURE, °C
- XXX — PRESSURE, kPag
- XX,XXX — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

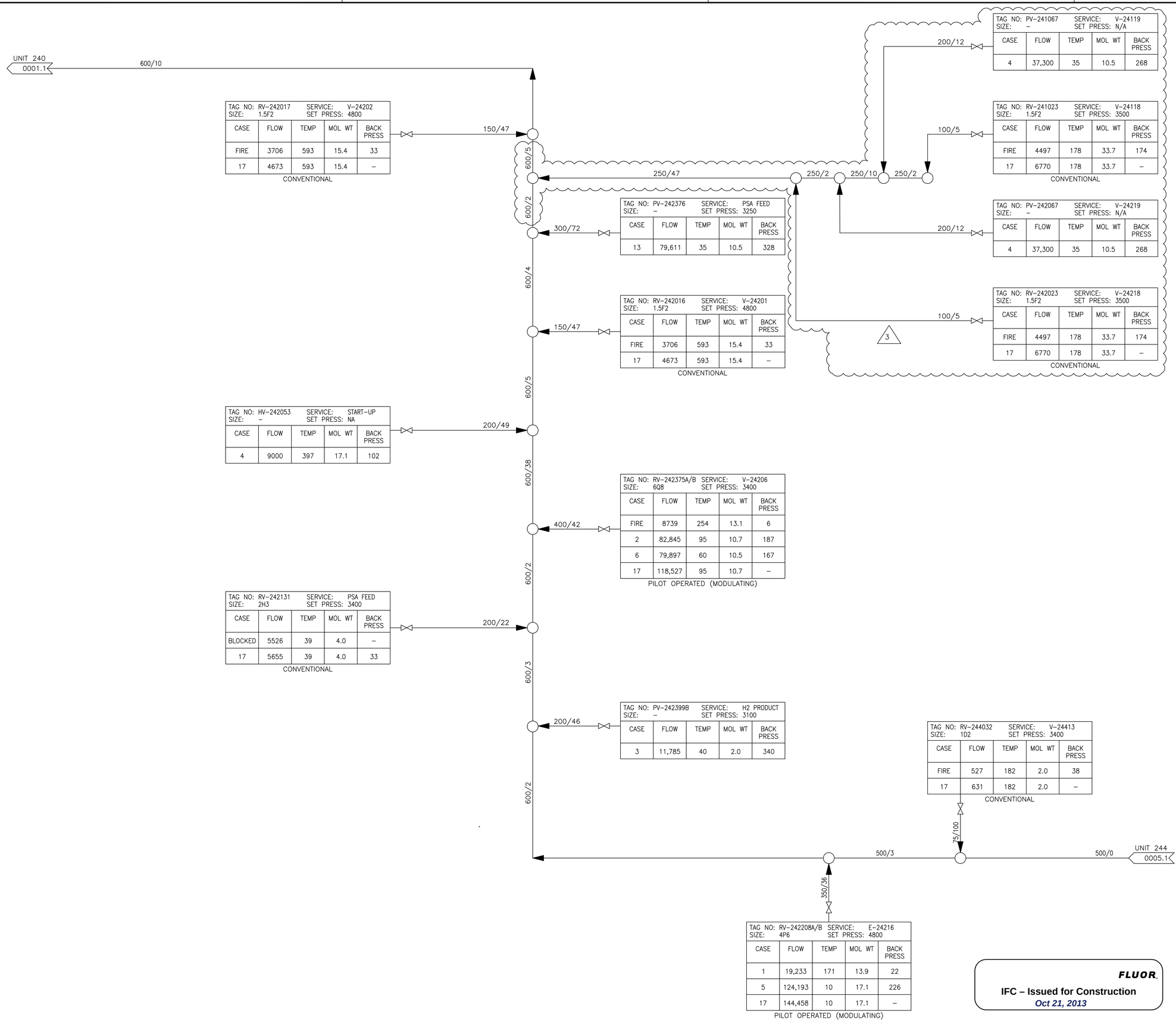
SHELL CANADA

FLUOR.

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
HMU2 AMINE ABSORBER

SCALE: NONE
TOE DWG. No.:
SHELL DWG NO.: 242.0001.000.040.006
REV. 1

FORMAT A1
DATESTAMP: FORMAT TBD



NOTES

CASES:

1. REFORMER TRIP (ONE TRAIN)
2. AIR COOLER FAILURE (ONE TRAIN)
3. 2HRDP + HMU (TWO TRAINS)
4. START–UP (ONE TRAIN)
5. NG PV FAILURE (ONE TRAIN)
6. STEAM MIXING VALVE FAILURE (ONE TRAIN)
7. H2 RICH GAS PV FAILURE
8. CHEM FEED COMP RECYCLE VALVE FAILURE
9. PSA UNIT – VALVE OUT OF SEQUENCE
10. FIRE – INLET AREA
11. FIRE – SYN GAS COOLNG TRAIN AREA
12. FIRE – PSA AREA
13. BLOCKED FLOW TO PSA (ONE TRAIN)
14. PSA UNIT – BLOCKED IN TAIL GAS
15. PSA UNIT – TAIL GAS VENT VALVE FAILURE
16. PSA UNIT – FEED BY–PASS VALVE FAILURE
17. RATED CAPACITY OF VALVE (FROM VALVE MANUFACTURER)

KEY PLAN

LINE CODE:
e.g. 150/53
150 – LINE DIAMETER (mm)
53 – LINE EQUIVALENT LENGTH (m) BETWEEN NODE POINTS

LEGEND
PRESSURE: kPa (ga)
TEMPERATURE: °C
FLOW: kg/h
NODE POINT

REFERENCE DRAWINGS

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE–ISSUED IFC ON NEXT HARD REV						
2A	13 JAN 14	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
1	02 OCT 03	AS–BUILT	RVM	EG	DEW	MWP		
0	01 JUL 26	IFD: ISSUED FOR DESIGN	LWM	EG	RAMC	MWP		DCL
B	01 JUN 19	IFR: ISSUED FOR REVIEW	LWM	EG	BTK			
A	00 AUG 02	IFR: ISSUED FOR REVIEW	LWM	RAMC	RAMC	–		–

FLUOR

IFC – Issued for Construction
Oct 21, 2013

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT
PARSONS . KRUPP UHDE . TRI OCEAN

RELIEF & DEPRESS FLOW DATA SUMMARY HYDROGEN MANUFACTURING UNIT UNIT 242

SCALE: NTS
TOE DWG. No.: 99049–2–DG–BG–00001.1
SHELL DWG NO.: 242.0001.000.043.001
REV. 3

FORMAT A1
pdp–1100

V-24313
H2 PRODUCT FILTER

V-24301-5
PSA ABSORBERS
NOTE 4

V-24306-10
PSA ABSORBERS
NOTE 4

3

S-24301
PSA UNIT

S-24302
SILENCER

S-24303
SILENCER

V-24311
PSA OFFGAS DRUMS

S-24301
NOTE 2,3

3

HYDROGEN TO
I-24101
240.001

NNF

V-24313

H2

AI

FL

PC

40
30

HYDROGEN
PRODUCT
240.002

22

PROD

EQ1/REP

EQ2/EQ3

EQ4/PP

V-24301 V-24302 V-24303 V-24304 V-24305 V-24306 V-24307 V-24308 V-24309 V-24310

3

FIC

35
28

23

H-24101
241.002

130

V-24311

21

35
36

3020
2986

3

H2 RAW GAS
241.003
FROM V-24106
OR V-24519

3

S-24302

S-24303

PC

FL

FEED BYPASS TO PURGE GAS

PC

PSA OFF-GAS
FLOW CONTROL
241.002

NOTES

1. FLOWS & DUTIES: CASE #2 / CASE #24.

   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.

   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100%. CO2 LEAN STREAM TO PSA.
2. MODIFICATIONS TO THE PSA UNIT TO BE DESIGNED BY AIR PRODUCTS.
3. LOGIC CHANGES REQUIRED FOR SWITCHING BETWEEN LEAN AND RICH CO2 CASES.
4. REPLACE PSA ABSORBENT. 3

REFERENCE

3

STREAM NUMBER

TEMPERATURE – CASE #2 (°C)
TEMPERATURE – CASE #24 (°C)

PRESSURE – CASE #2 (kPa-a)
PRESSURE – CASE #24 (kPa-a)

FLOW – CASE #2 (kg/Hr)
FLOW – CASE #24 (kg/Hr)

Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
3	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
2C	13 JAN 09	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
2B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
2A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
2	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
1A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
1	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
0	00 OCT 23	IFC: ISSUED FOR CONSTRUCTION	WZF	SW	SW	MWP	DLA	HRM

SHELL CANADA LTD.
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM
HYDROGEN MANUFACTURING UNIT
H2 PURIFICATION

SCALE: NTS
TOE DWG. No.: 99049-2-DG-BB-00003.1
SHELL DWG NO.: 243.0001.000.040.001
REV. 3

FORMAT A1

0031-F6i

V-24413
H2 PRODUCT FILTER

V-24401-5
PSA ABSORBERS
NOTE 4

V-24406-10
PSA ABSORBERS
NOTE 4

S-24401
PSA UNIT

S-24402
SILENCER

S-24403
SILENCER

V-24411
PSA OFFGAS DRUMS

S-24401
NOTE 2,3

HYDROGEN TO
I-24201
240.001

NNF

V-24413

H2 AI

FL

PC

40
30

HYDROGEN
PRODUCT
240.002

22

PROD

EQ1/REP

EQ2/EQ3

EQ4/PP

V-24401 V-24402 V-24403 V-24404 V-24405 V-24406 V-24407 V-24408 V-24409 V-24410

FIC

23

35
28

H-24201
242.002

130

V-24411

H2 RAW GAS
242.003
FROM V-24206
OR V-24219

21

35
36

3020
2986

S-24402

S-24403

PC

FL

FEED BYPASS TO PURGE GAS

PC

PSA OFF-GAS
FLOW CONTROL
242.002

NOTES

1. FLOWS & DUTIES: CASE #2 / CASE #24.
   CASE #2: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FGR OFFLINE. CO2 RICH STREAM TO PSA.
   CASE #24: H2 PRODUCTION WITH ADDITIONAL CHEMICAL FEED AND DOW GAS. FLUE GAS RECYCLE ONLINE AT 100%. CO2 LEAN STREAM TO PSA.
2. MODIFICATIONS TO THE PSA UNIT TO BE DESIGNED BY AIR PRODUCTS.
3. LOGIC CHANGES REQUIRED FOR SWITCHING BETWEEN LEAN AND RICH CO2 CASES.
4. REPLACE PSA ABSORBENT.

REFERENCE

STREAM NUMBER

TEMPERATURE – CASE #2 (°C)
TEMPERATURE – CASE #24 (°C)

PRESSURE – CASE #2 (kPa-a)
PRESSURE – CASE #24 (kPa-a)

FLOW – CASE #2 (kg/Hr)
FLOW – CASE #24 (kg/Hr)

Std. VOL. FLOW – CASE #2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #24 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUORS RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
4	13 SEP 30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
3C	12 DEC 21	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
3B	11 AUG 31	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM	JI	CV	MD/SB
3A	11 MAR 04	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS	JI	CV	MD/SB
3	10 NOV 03	ISSUED FOR QUEST DESIGN	JH	SM	BS	JI	CV	MD/SB
2A	10 AUG 24	ISSUED FOR QUEST COARSE HAZOP	JH					
2	02 SEP 20	AS-BUILT	LWM	MWP	AAI	MWP		HRM
1	01 MAY 31	IFC: ISSUED FOR CONSTRUCTION	LWM	EG	RAMC	MWP	–	DCL

DRAWING REVISION "0" AFFIXED WITH P.ENG. STAMP ON 00.10.16 AND STAMPED BY: ROBERT A. MACDONALD.

FULL SIZE VERSION OF THIS DRAWING STAMPED WITH PERMIT TO PRACTICE AT REV.0

SHELL CANADA LTD.
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT

PARSONS . KRUPP UHDE . TRI OCEAN

PROCESS FLOW DIAGRAM
HYDROGEN MANUFACTURING UNIT
H2 – PURIFICATION

SCALE: NTS
TOE DWG. No.: 99049-4-DG-BB-00001.1
SHELL DWG NO.: 244.0001.000.040.001
REV. 4

FORMAT A1

0011-F6L

E-24602A/B
LEAN / RICH
AMINE EXCHANGER
64.0 MW

E-24604A/B
LEAN AMINE
COOLER
41.5 MW

E-24605A/B
LEAN AMINE
TRIM COOLER
29.5 MW

E-24601A/B
STRIPPER OVERHEAD
CONDENSER
25.3 MW

V-24601
AMINE STRIPPER
6300 mm ID X 30400 mm T/T

V-24602
STRIPPER REFLUX
DRUM
3300 mm ID X 7300 mm T/T

E-24603A/B
STRIPPER
REBOILERS
96.1 MW
NOTE 4

V-24603A/B
STRIPPER REBOILER
CONDENSATE POTS
1500 mm ID x 4200 mm T/T
NOTE 4

PURGE WATER
241.005
FROM V-24119

PURGE WATER
242.006
FROM V-24219

WATER MAKE-UP
246.004
FROM E-24607A/B

KO LIQUIDS
247.001
FROM V-24702/
V-24703/V-24704

ANTI-FOAM
246.002
FROM S-24602
(P-24606)

LEAN AMINE
246.002
FROM P-24602A/B/C

RICH AMINE
241.005
FROM V-24118

RICH AMINE
242.006
FROM V-24218

RICH AMINE
441.005
FROM V-44118

LEAN AMINE
246.003
FROM P-24604/
P-24605

LEVEL SIGNAL
241.005

LEVEL SIGNAL
242.006

LEVEL SIGNAL
441.005

RECOVERED AMINE
246.003
FROM V-24605

CO2
247.001
TO V-24701

WASTE WATER
246.004
TO WWTP

P-24603A/B
NOTE 2

E-24601A/B

V-24602

E-24602A
TO E-24602B

FROM E-24602B

TO E-24602B/
E-24604B/
E-24605B/

V-24601

E-24603A
NOTE 4

P-24601A/B/C
NOTE 2,6

V-24603A
NOTE 3, 4

V-24603A
LEVEL SIGNAL
246.004

LP CONDENSATE
246.004
TO E-24606A

PRESSURE
SIGNAL
246.002

LP STEAM FROM
HEADER

TO E-24603B

LP STEAM HEADER
PRESSURE

TO E-24603B

TO E-24603B
STEAM CONTROL

E-24604A

E-24605A

FROM E-24602B/
E-24604B/
E-24605B/

LEAN AMINE
246.002
TO V-24604

P-24601A/B/C
LEAN AMINE PUMPS
FLOW: 755.3 m3/h NOTE 6
DIF. PRESSURE: 737 kPa
POWER: 155 kW

P-24603A/B
STRIPPER REFLUX PUMPS
FLOW: 45.7 m3/h
DIF. PRESSURE: 583 kPa
POWER: 7.5 kW

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 245.0001.000.046.001, FOR STREAM INFORMATION.
2. ALL AMINE PUMPS ARE CONTAINED WITHIN CURBED CONTAINMENT AREAS.
3. REBOILER CONDENSATE POT LEVEL TO BE SET TO ALLOW FLOODING OF STRIPPER REBOILER TUBES.
4. REBOILERS AND CONDENSATE POTS ARE 2 x 50%. ONE TRAIN IS SHOWN.
5. EQUIPMENT DRAINS ARE HARD-PIPED TO THE AMINE DRAIN DRUM.
6. 3 X 50% PUMPS FOR A TOTAL FLOW RATE OF 1511 m3/h.
7. CONTROL VALVES ARE 2 X 50%.
8. HMB FLOW RATE FOR STREAMS 7, 15 AND 16 REFLECT THE TOTAL AMINE FLOW.
9. STAGED CUTBACK FOR REDUCTION OF LP STEAM TO REBOILERS BASED ON LP STEAM HEADER PRESSURE.

LEGEND

- XXX (diamond) — STREAM NUMBER
- XXX (hexagon) — TEMPERATURE, °C
- XXX (rectangle) — PRESSURE, kPag
- XX,XXX (hexagon) — FLOW, kg/h

ISSUED FOR CONSTRUCTION
04 Jun 2013

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
2	13/05/24	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

FLUOR.

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
AMINE STRIPPER SYSTEM

SCALE: NONE
TOE DWG. No.:
SHELL DWG NO.: 246.0001.000.040.001
REV. 2

FORMAT A1

DATESTAMP: FORMAT TBD

V-24604
LEAN AMINE
FILTER
355 m3/h

TK-24602
ANTI-FOAM
INJECTION TANK
1 m3

S-24602
ANTI-FOAM
INJECTION PACKAGE

V-24608
LEAN AMINE
CARBON FILTER
75 m3/h

V-24609
LEAN AMINE
POST FILTER
75 m3/h

S-24602
NOTE 5

TK-24602
TOTE TANK

P-24606

VENDOR
FLUOR

ANTI-FOAM
246.001
TO V-24601

LEAN AMINE
246.001
START-UP
TO E-24602A/B

PRESSURE SIGNAL
246.001
TO P-24601A/B/C

LEAN AMINE
246.001
FROM E-24605A/B

LEAN AMINE
246.003
NNF
STARTUP
FROM P-24604

V-24604

V-24608

V-24609

P-24602A/B/C
NOTE 3,4

LEAN AMINE
242.006
TO V-24218

LEAN AMINE
241.005
TO V-24118

LEAN AMINE
441.005
TO V-44118

NNF
SHUTDOWN
LEAN AMINE
246.003
TO TK-24601

NNF

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. EQUIPMENT DRAINS ARE HARD-PIPED TO THE CLOSED AMINE DRAIN COLLECTION DRUM.
3. ALL AMINE PUMPS ARE CONTAINED WITHIN CURBED CONTAINMENT AREAS.
4. 3 X 50% PUMPS FOR A TOTAL OPERATING FLOW RATE OF 1418 m3/h.
5. TOTE TANK AND P-24606 ARE PART OF VENDOR PACKAGE S-24602.

LEGEND

- XXX (diamond) — STREAM NUMBER
- XXX (trapezoid) — TEMPERATURE, °C
- XXX (rectangle) — PRESSURE, kPag
- XX,XXX (hexagon) — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

P-24606
ANTI-FOAM
INJECTION PUMP
NOTE 5

P-24602A/B/C
LEAN AMINE
CHARGE PUMPS
FLOW: 709.2 m3/h NOTE 4
DIF. PRESSURE: 3603 kPa
POWER: 710 kW

ISSUED FOR CONSTRUCTION
07 Feb 2013

SHELL CANADA

FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
AMINE FILTRATION AND
ANTI-FOAM INJECTION

SCALE: NONE
TOE DWG. No.:
SHELL DWG NO.: 246.0001.000.040.002
REV. 1

FORMAT A1
DATESTAMP: FORMAT TBD

TK-24601
AMINE MAKE-UP TANK
5000 mm ID X 12500 mm H
WORKING CAPACITY: 196 m3

TK-24603
AMINE MAKE-UP TANK
5000 mm ID X 12500 mm H
WORKING CAPACITY: 196 m3

V-24606
AMINE DRAIN DRUM
2600 mm ID X 8100 mm T/T

V-24605
DRAINED AMINE FILTER
FLOW: 25 m3/h

S-24601
AMINE DRAIN DRUM SUMP

VENT
PC
NITROGEN
LI
MAKE-UP AMINE
NOTE 3
INTERMITTENT
XV
LEAN AMINE
246.002
FROM FILTRATION
NNF
SHUT DOWN
TK-24601
NOTES 4,11
TC
LP STEAM
CONDENSATE
TK-24603
NOTES 4,11
TC
LP STEAM
CONDENSATE
30
NNF
CONDENSATE
246.004
FROM P-24608A/B
SP
MIXING/PUMP MIN FLOW
FO
P-24605
NOTE 2,8
FC
INTERMITTENT
START-UP/
MAKE-UP AMINE
NNF
START-UP
246.001
TO V-24601
P-24604
NOTE 2
START-UP AMINE
NNF
START-UP
246.002
TO V-24604
NNF
PDI
V-24605
RECOVERED AMINE
246.001
TO V-24601
NNF
PC
NITROGEN
WASTE WATER
246.004
TO WWTP
271/471
INTERMITTENT
VENT
NOTE 5
M
LC
AMINE FROM DRAINS
NOTE 10
KO LIQUIDS/DRAINS
247.001
FROM COLLECTION
HEADER
V-24606
P-24607
NOTE 7, 9
S-24601
NOTE 6

P-24607
AMINE DRAIN PUMP
FLOW: 25 m3/h
DIF. PRESSURE: 641 kPa
POWER: 4.5 kW

P-24605
AMINE MAKE-UP PUMP
FLOW: 15 m3/h
DIF. PRESSURE: 300 kPa
POWER: 3.7 kW

P-24604
AMINE INVENTORY PUMP
FLOW: 60 m3/h
DIF. PRESSURE: 758 kPa
POWER: 30 KW

ISSUED FOR CONSTRUCTION
07 Feb 2013

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. ALL AMINE PUMPS ARE CONTAINED WITHIN CURBED CONTAINMENT AREAS.
3. TRUCK CONNECTION NEAR TANK.
4. AMINE MAKE-UP TANK NORMALLY CONTAINS UNDILUTED MDEA/DEDA, BUT WILL CONTAIN DILUTED AMINE SOLUTION DURING MAINTENANCE TURNAROUNDS.
5. CHECKER PLATE ON TOP OF SUMP.
6. LIQUID COLLECTION IN SUMP TO BE REMOVED BY VACUUM TRUCK.
7. DRUM TO BE ELECTRICALLY TRACED.
8. PUMP WILL HAVE A WAREHOUSE SPARE.
9. SUMP TO COMPLY WITH ERCB DIRECTIVE 55 CONTAINMENT REQUIREMENTS.
10. EQUIPMENT DRAINS ARE HARD-PIPED TO THE CLOSED AMINE DRAIN COLLECTION DRUM.
11. ALL LIQUID NOZZLES ON TANKS ARE LOCATED BELOW LLL.
12. TANKS TK-24601 AND TK-24602 OPERATE AS ONE STORAGE FACILITY AND MUST BE ISOLATED TOGETHER. TANKS CANNOT OPERATE INDEPENDENTLY.

LEGEND

XXX — STREAM NUMBER
XXX — TEMPERATURE, °C
XXX — PRESSURE, kPag
XX,XXX — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

FLUOR.

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
AMINE STORAGE AND DRAIN COLLECTION

SCALE: NONE
TOE DWG. No.:
SHELL DWG NO.: 246.0001.000.040.003
REV. 1

FORMAT A1
DATESTAMP: FORMAT TBD

S-24603
CO2 VENT STACK
EXIT TIP 500 mm ID
TOTAL HEIGHT 50000 mm
NOTE 7

V-24607
CONDENSATE FLASH DRUM
3000 mm ID x 6300 mm T/T

E-24607
CONDENSATE COOLER
DUTY = 0.7 MW

E-24606A/B
LP CONDENSATE / DEMIN WATER EXCHANGER
DUTY: 13.5 MW

LP CONDENSATE
246.001
FROM V-24603A

102A

HV

VFD

FC

LEVEL SIGNAL
251.001
FROM V-25102

DEMIN WATER
251.001
FROM DEAERATOR FEED SYSTEM FV-251001

108

22

P-24610A/B
NOTE 3

84

DEMIN WATER
251.001
TO V-25102

E-24606A

VENT

74

LC FROM V-24603B

PC

SP

SP

102B

LP CONDENSATE FROM V-24603B

LV SIGNAL
246.001
FROM V-24603A

NITROGEN

E-24606B

LP CONDENSATE

V-24607

35

HP CONDENSATE
248.001
FROM V-24805

104

LC

23A

WATER MAKE-UP
241.005
TO V-24119

FC

35

23B

WATER MAKE-UP
242.006
TO V-24219

START-UP

TC

FX

P-24609A/B

106

NOTE 8

AC

pH
COND

FC

CWR

FO

INTERMITTENT

WATER MAKE-UP
246.001
TO V-24602

E-24607A/B

2

P-24608A/B
NOTE 2

CWS

NOTE 6

FI

105

FI

74

AV

RECOVERED CLEAN CONDENSATE
251.001
TO RCC SYSTEM (TK-25101)

NC

AV

NOTE 8

NNF

109

POTENTIALLY OILY CONDENSATE
TO WWTP UNIT 271

CO2 VENT
247.002
FROM C-24701H & PIPELINE

HP VENT

NNF

WASTE WATER
246.003
FROM P-24607

CO2 VENT
247.001
FROM V-24701

LP VENT

27

WASTE WATER
246.001
FROM P-24603A/B

CO2 VENT
247.002
FROM C-24701F

S-24603

LI

NOTE 5

START-UP

CONDENSATE
246.003
TO TK-24601/03

NNF

AMINE DRAIN SYSTEM

XV

COOLING WATER SUPPLY
252.002
FROM COOLING TOWER

107

25

P-24611A/B
NOTE 4

STROMWATER COLLECTION INSIDE CURBED UNIT 246 AREA

P-24612

STORMWATER TO HMU 1/2 QUEST ABSORBER AREA MH-006

AMINE DRAIN SYSTEM

UNIT 247/248
COOLING WATER USERS
E-24701, E-24702, E-24703
E-24704, E-24705
& E-24804

UNIT 246
COOLING WATER USERS
E-24601, E-24604, E-24605
& E-24607

AI

pH

43

COOLING WATER RETURN
252.002
UTILITY PLANT/COGEN

P-24612
STORM WATER PUMP
FLOW: 10 m3/h
DIF. PRESSURE: 152 kPa
POWER: 0.4 kW

P-24608A/B
RECOVERED CLEAN CONDENSATE PUMPS
FLOW: 183 m3/h
DIF. PRESSURE: 602 kPa
POWER: 37 kW
NOTE 2

P-24609A/B
WATER MAKE-UP PUMPS
FLOW: 9.9 m3/h
DIF. PRESSURE: 2933 kPa
POWER: 15 kW

P-24610A/B
DEMIN WATER SUPPLY PUMPS
FLOW: 92.5 m3/h
DIF. PRESSURE: 503 kPa
POWER: 55 kW
NOTE 3

P-24611A/B
COOLING WATER BOOSTER PUMPS
FLOW: 3118 m3/h HOLD
DIF. PRESSURE: 214 kPa
POWER: 280 kW
NOTE 4

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. 2 x 100% PUMPS FOR TOTAL FLOW RATE OF 183 m3/h.
3. 2 X 50% PUMPS FOR TOTAL DESIGN FLOW RATE OF 185 m3/h.
4. 2 X 50% PUMPS FOR TOTAL DESIGN FLOW RATE OF 6236 m3/h.
5. START-UP PIPING REQUIRED FOR INITIAL AMINE FILL AND DILUTION WITH CONDENSATE.
6. TO MEASURE THE QUEST CCS UNIT CAPACITY DURING INITIAL START-UP, AS PROPOSED TO THE GOVERNMENT. OF ALBERTA.
7. CO2 VENT STACK HAS A 900 mm BASE DIAMETER WHICH IS PROVIDED FOR PIPING CONNECTIONS, A MAIN RISER STACK WHICH IS 600 mm DIAMETER AND A 500 mm TIP DIAMETER WHICH IS 2.4 m LONG.
8. RECOVERED CONDENSATE ANALYSER (pH & COND.) LOCATED IN UNIT 246 WITH SWITCHING VALVES LOCATED AT UNIT 251 SOUTHWEST OF RCC TANK TK-25101. WASTE WATER LINE FROM QUEST AND RE-ROUTED QUEST POC COMBINE ON NEW PIPERACK FOR DELIVERY TO POC TIE-IN ON MAIN UTILITY PIPERACK (TO UNIT 271).

ISSUED FOR CONSTRUCTION
04 Jun 2013

LEGEND

- XXX (diamond) — STREAM NUMBER
- XXX (trapezoid) — TEMPERATURE, °C
- XXX (rectangle) — PRESSURE, kPag
- XX,XXX (hexagon) — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
2	13/05/24	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

FLUOR.

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
UTILITIES SYSTEM

SCALE: NONE | TOE DWG. No.:

SHELL DWG NO.: 246.0001.000.040.004 | REV. 2

FORMAT A1

ISSUED FOR DESIGN

SHELL CANADA ENERGY
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT
FLUOR.

BATTERY LIMIT INTERFACE TABLE
QUEST CAPTURE INTERFACE
UNIT 246

246.0006.000.067.001

Rev 0

REV	DATE	DESCRIPTION	BY	CHK	APP	APP	CLNT APP
0	15-Aug-11	Issued for Basic Design Engineering Package	MRAB	KH/MG	JI		
B	3-Mar-11	Issued For PHA II Review	MRAB				
A	8-Nov-10	Issued for Information	MRAB				

	Fluid Description	Pipe CL el	Northing	Easting	Conn. Type	In / Out	Phase	P&ID Number	Sch.	Line Size	Fluid Code	Line Number	Matl. Class	Insulation Type / Mat'l	Thickness	Tracing	Const. Class	Severity Rating	Mass Flow				Pressure		Temperature		Properties		Design Code		Notes	Rev
																			Minimum	Normal	Maximum	Design	Normal	Maximum	Normal	Max	Viscosity	Density / (MW)	Press	Temp		
		m	m	m						(NPS)					mm	Type / °C			kg/h	kg/h	kg/h	kg/h	kPa(ga)	kPa(ga)	°C	°C	mPa-s	kg/m³	kPa(ga)	°C		
Unit 246	**Quest - Process Lines to HMU 1 / 2 - West Side of Unit 246**																														
ISBL OSBL	Lean Amine to HMU1/2				BW	OUT	L	246.011		16	P	246080	DAG	H /	xx	ET / 10				849,758	849,758	849,758	3769		30		5.46	1,040	6000	90	2 m/s velocity limit for CS pipe	C
ISBL OSBL	Rich Amine from HMU1/2				BW	IN	V/L	246.001		10	P	242064	DJE	H /	xx	ET / 10				934,642	934,642	934,642	2001		64		4.11	1,102	3500	95	Upper bound 5m/s velocity limit for SS pipe. Properties are for liquid fraction	C
ISBL OSBL	Wash Water Makeup to HMU 1/2				BW	OUT	L	246.022		2	SCH	246003	SAG	H /	xx	ET / 10				9,018	9,018	9,018	2920		35		0.74	994	4650	60		C
ISBL OSBL	Wash Water Purge				BW	IN	L	246.006		3	P	241076	PJE	H /	xx	ET / 10				9,126	9,126	9,126	76		38		0.68	994	3500	60	Includes CO2 rich waters, Line number to reflect origin point	C
ISBL OSBL	Anti Foam Injection					OUT	L	246.014		3/4	KP	246005	PJG	H /	xx	ET / 10				42		85	3800		15		168.00	1,016	4000	50	Small bore Injection piping to be supported Based on injection rate to meet 200 ppmw into Lean Amine	C
ISBL OSBL	Potentially Oily Storm Water Sewer (POSWS)				BW	OUT	L	246.035		2	WW	246001	UAB	H /	xx	ET / 10			0	0	10,000	10,000	350		5 - 15		1.50	1,000	700	50		C
Unit 246	**Quest - Process Lines to Pipeline Scope area - North West Side of Unit 246**																														
ISBL OSBL	CO2 to Pipeline				BW	OUT	Dense Phase	247.014		8	GC	247059	PJL(C)							148,496	148,496	148,496	9000	13900	43		0.029	402.0	14790	60	U/G piping temperature constraint to be checked, ~~check 16NPS as part of future~~	C
~~ISBL~~ ~~OSBL~~	~~Pipeline Vent~~				~~BW~~	~~IN~~	~~V~~	~~247.014~~		~~2~~	~~VA~~	~~247011~~	~~PJB(C)~~							~~NNF~~			~~1500~~		~~77~~						~~HOLD - destination in Quest Capture unit not defined and metallurgy effect not known~~	~~C~~
Unit 246	**Quest - Underground Utilities Lines - North Side of Unit 246**																														
~~ISBL~~ ~~OSBL~~	~~Potable Water~~					~~IN~~	~~L~~			~~2~~ ~~2~~	~~WD~~ ~~WD~~	~~246xxx~~ ~~282xxx~~	~~UJB~~ ~~UHX~~	~~H / ~~	~~xx~~	~~ET 10~~				~~NNF~~		~~14,990~~	~~750~~		~~95~~		~~0.30~~	~~962.2~~	~~1400~~	~~130~~	Underground is the current supply point. ~~Need to consider~~ using standalone water storage for safety shower / eye wash stations	C
OSBL	Firewater					IN	L	258.004		12	FW	258xxx	UHY							NNF		250,000	900		5		1.52	1,000.4	1100	27	1 of 2 Tie-Ins - Underground	C
ISBL OSBL	Firewater					IN	L	258.004		12	FW	258xxx	UHY							NNF		250,000	900		5		1.52	1,000.4	1100	27	2 of 2 Tie Ins - Underground	C
Unit 246	**Quest - Process & Utilities Lines - North Side of Unit 246**																														
ISBL OSBL	Lean Amine to HMU3				BW	OUT	L	246.101		14 14	P P	246081 285155	DAG DAG	H /	xx	ET / 10 ET / 10				625,733	625,733	625,733	3769		30		5.46	1,040	6000	90	2 m/s velocity limit for CS pipe	C
ISBL OSBL	Rich Amine from HMU3				BW	IN	V/L	246.101		10 10	P P	246002 285156	DJE DJE	H /	xx	ET / 10 ET / 10				689,658	689,658	689,658	2870		64		4.11	1,103	3500	95	Upper bound 5m/s velocity limit for SS pipe. Properties are for liquid fraction	C
ISBL OSBL	DWR Demin Water Return				BW	OUT	L	246.101		6 6	WI WI	246007 285003	UJD UJD	H /	xx	ET / 10 ET / 10				184,890	203,400	203,400	416		84		0.49	985.2	xxx TBD	125	Requires re-rate of existing spec to allow DT to be increased to match new operating temperature,	C
ISBL OSBL	RCC Recovered Clean Condensate				BW	OUT	L	246.101		6 6	SC SC	246008 285210	SAB SAB	H /	xx	ET / 10 ET / 10				153,894	161,718	161,718	350		74		0.30	975.6	1400	130	need to check pressure profile	C
ISBL OSBL	LT RHC H P Steam				BW	IN	V	246.101		2 2	SS SS	248001 285058	SAG SAG	H / H /	xx xx					589	850	850	4350		257		0.02	(18.0)	5170	415	used for TEG Regeneration	C
ISBL OSBL	SL L P Steam				BW	IN	V	246.101		36 36	SL SL	246001 285145	SAB SAB	H / H /	xx xx					166,300	166,300	170,326	335		160		0.01	(18.0)	500	250	includes utility stations	C
ISBL OSBL	AU Utility Air				BW	IN	V	246.101		2 2	AU AU	246001 285148	ULB ULB							NNF	250	250	700		45		0.02	(29.0)	1200	70		C
ISBL OSBL	WU Utility Water				BW	IN	L	246.101		2 2	WU WU	246001 285041	UAB UAB	H / H /	xx xx	ET / 10 ET / 10				NNF	11,000	11,000	250		35		0.72	994.1	1650	122		C
ISBL OSBL	AI Instrument Air				BW	IN	V	246.101		3 3	AI AI	246001 285150	ULB ULB							131	164	164	700		45		0.02	(29.0)	1200	70		C
ISBL OSBL	Waste Water				BW	OUT	L	246.101		4 4	WP WP	246002 285034	PJB PJB	H / H /	xx xx	ET / 10 ET / 10				12,000	12,000	12,000	250		40		0.72	992.3	1650	122	Includes CO2 rich waters, tie-in to POC, HOLD on Line Size	C
ISBL OSBL	GI Nitrogen				BW	IN	V	246.101		2 2	GI GI	246001 285068	ULB ULB							~~94~~	486	486	900		5	45	0.02	(28.0)	1500	70	N2 Stripping gas at 285 kg/h to TEG (change from 170 kg/h) + blanketing requirements	C
ISBL OSBL	DWS Demin Water Supply				BW	IN	L	246.101		6 6	WI WI	246001 285002	UJB UJB	H / H /	xx xx	ET / 10 ET / 10				184,890	203,400	203,400	416		22		0.95	997.9	1700	70		C
Unit 246	**Quest - Underground Utilities Lines - East Side of Unit 246**																														
ISBL OSBL	CWR Cooling Water Return				BW	OUT	L	246.025		30 30	CWR CWR	246018 282015	UAB UAB							5,700,134	5,832,003	6,079,878	340		42		0.63	991.5	1200	58	Line is Underground outside of Unit 246	C
ISBL OSBL	CWS Cooling Water Supply				BW	IN	L	246.024		30 30	CWS CWS	246001 282015	UAB UAB							5,700,134	5,832,003	6,079,878	420		25		0.89	997.2	800	58	Line is Underground outside of Unit 246	C

V-24701	E-24701	V-24702	E-24702	V-24703	E-24703	V-24704	E-24704
COMPRESSOR SUCTION KO DRUM 3500 mm ID X 3400 mm T/T	COMPRESSOR 1ST STAGE COOLER 2.7 MW	COMPRESSOR 2ND STAGE KO DRUM 2800 mm ID X 3000 mm T/T	COMPRESSOR 2ND STAGE COOLER 2.4 MW	COMPRESSOR 3RD STAGE KO DRUM 2500 mm ID X 2600 mm T/T	COMPRESSOR 3RD STAGE COOLER 3.0 MW	COMPRESSOR 4TH STAGE KO DRUM 2100 mm ID X 3300 mm T/T	COMPRESSOR 4TH STAGE COOLER 2.2 MW

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. LIQUID COLLECTION BOOT.

COMPRESSOR CONTROLLER
PERFORMANCE CONTROLLER
ANTI-SURGE CONTROL
6TH STAGE BLOW-OFF CONTROL
8TH STAGE BLOW-OFF CONTROL

PRESSURE SIGNAL 247.002 FROM 8TH STAGE
SIGNAL 247.002 TO 8TH STAGE BLOW-OFF
SIGNAL 247.002 TO 6TH STAGE BLOW-OFF
SIGNAL 247.002 TO ANTI-SURGE
TEMPERATURE SIGNAL 247.002 FROM 8TH STAGE

ANTI SURGE SPILL BACK 247.002 FROM C-24701H

FLASHED CO2 248.001 FROM V-24803
CO2 VENT 246.004 TO S-24603
CO2 246.001 FROM V-24602
KO LIQUIDS 246.003 TO V-24606
KO LIQUIDS 246.001 TO V-24602
TO TRENCH

CWR / CWS

E-24701 — 99 / 176
E-24702 — 42 / 164 — 90 / 361
E-24703 — 42 / 345 — 107 / 815
E-24704 — 42 / 795 — 92 / 1467

C-24701A
C-24701B
C-24701C
C-24701D

V-24701
V-24702
V-24703
V-24704

CO2 247.002 TO V-24705
KO LIQUID 247.002 FROM V-24705/ V-24706
KO LIQUID 247.002 FROM V-24707

LEGEND

- XXX — STREAM NUMBER
- XXX — TEMPERATURE, °C
- XXX — PRESSURE, kPag
- XX,XXX — FLOW, kg/h

C-24701A-H
CO2 COMPRESSOR
FLOW: 84255 STD. m3/h
POWER: 16 MW

ISSUED FOR CONSTRUCTION
07 Feb 2013

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

FLUOR.

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
CO2 COMPRESSION (SHEET 1)

SCALE: NONE | TOE DWG. No.:
SHELL DWG NO.: 247.0001.000.040.001 | REV. 1

FORMAT A1

V-24705	E-24705	V-24706	E-24706	V-24707	V-24708
COMPRESSOR 5TH STAGE KO DRUM 1900 mm ID X 2200 mm T/T	COMPRESSOR 5TH STAGE COOLER 2.4 MW	COMPRESSOR 6TH STAGE KO DRUM 1700 mm ID X 2000 mm T/T	COMPRESSOR 6TH STAGE COOLER 1.9 MW	TEG INLET SCRUBBER 959 mm ID X 3300 mm T/F	COMPRESSOR 7TH STAGE KO DRUM 959 mm ID X 3400 mm T/F

PRESS SIGNAL 247.001 TO COMP ANTI-SURGE CONTROL

TEMP SIGNAL 247.001 TO COMP ANTI-SURGE CONTROL

SIGNAL 247.001 FROM 8TH STAGE BLOW-OFF CONTROL

CO2 VENT 246.004 TO S-24603

SIGNAL 247.001 FROM ANTI-SURGE CONTROL

ANTI SURGE SPILL BACK 247.001 TO V-24701

SIGNAL 247.001 FROM 6TH STAGE BLOW-OFF CONTROL

CO2 VENT 246.004 TO S-24603

NNF

CO2 VENT 247.003 FROM PIPELINE

CWR

CWS

42 1432 | 97 2689 | E-24705 | TI | PI | C-24701E

42 2646 | 76 3912 | PI | TC | E-24706 | VFD | TI | PI | C-24701F

38 3172 | 86 6461 | PI | H2O AI | H2O H2 CO2 C1 AI | SP | FI | TI | PI | C-24701G

121 9200 | PI | TT | PT | TI | C-24701H

CO2 247.003 TO E-24707A/B

50 | 52 | 53

CO2 247.001 FROM E-24704

V-24705 | LC | 49

V-24706 | LC | 51

36 3797 | V-24707 | LC | 53

V-24708 | LC | 54

36 3797 | 53 | CO2 248.001 TO V-24801

39 | CO2 248.001 FROM V-24801

KO LIQUID 247.001 TO V-24704

KO LIQUID 247.001 TO V-24704

55 | 36

NNF | KO TEG 248.001 TO V-24803

C-24701A-H
CO2 COMPRESSOR
FLOW: 84255 STD. m3/h
POWER: 16 MW

ISSUED FOR CONSTRUCTION
07 Feb 2013

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.

LEGEND

- XXX — STREAM NUMBER
- XXX — TEMPERATURE, °C
- XXX — PRESSURE, kPag
- XX,XXX — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
CO2 COMPRESSION (SHEET 2)

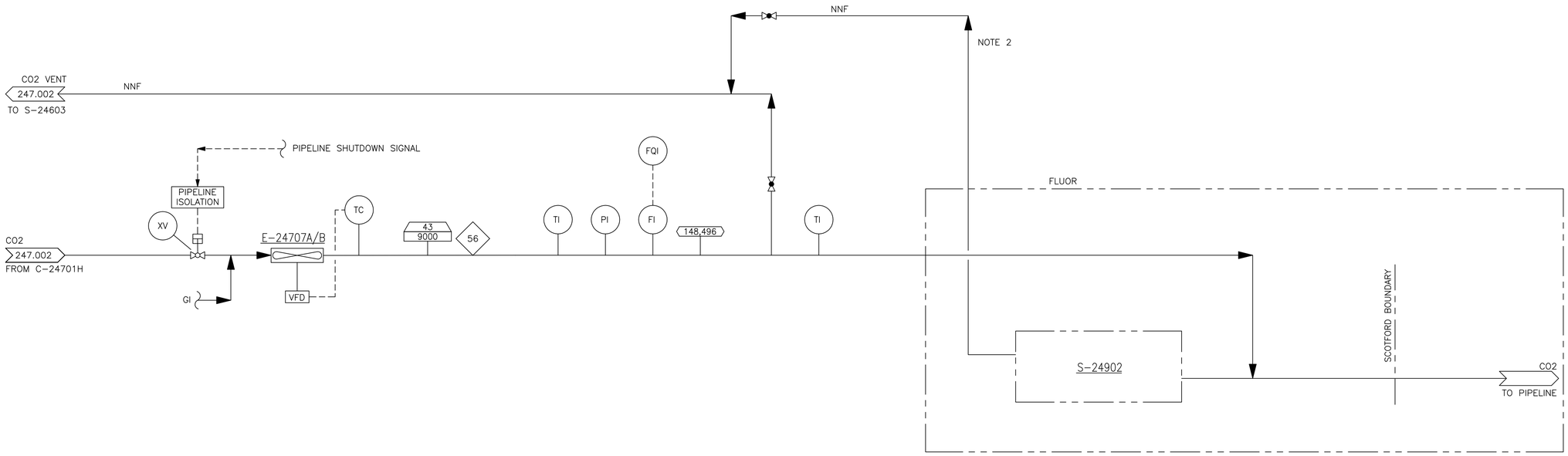
SCALE: NONE | TOE DWG. No.:

SHELL DWG NO.: 247.0001.000.040.002 | REV. 1

FORMAT A1

E-24707A/B
CO2 COMPRESSOR AFTERCOOLER
7.1 MW

S-24902
PIPELINE PIG LAUNCHER



NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. PIG LAUNCH VENT.

LEGEND

- XXX — STREAM NUMBER
- XXX — TEMPERATURE, °C
- XXX — PRESSURE, kPag
- XX,XXX — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

ISSUED FOR CONSTRUCTION
07 Feb 2013

SHELL CANADA

FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
CO2 METERING STATION & PIG LAUNCHER

SCALE: NONE | TOE DWG. No.:
SHELL DWG NO.: 247.0001.000.040.003 | REV. 1

FORMAT A1

S-24802
TEG MAKE-UP PACKAGE

V-24801
TEG ABSORBER
1500 mm ID X 10200 mm T/T

E-24804A-E
LEAN TEG COOLER
0.19 MW

V-24804A/B
LEAN TEG FILTER
4.8 m3/h

V-24803
TEG FLASH DRUM
2000 mm ID X 5000 mm T/T

E-24803
LEAN/RICH TEG EXCHANGER
0.46 MW

E-24801
TEG STRIPPER CONDENSER
0.069 MW
NOTE 3

V-24802
TEG STRIPPER
STILL: 560 mm ID X 4740 mm T/T
STRIPPER: 560 mm ID X 2850 mm T/T
NOTE 3

E-24802
TEG STRIPPER REBOILER
0.28 MW
NOTE 3

V-24806
TEG SURGE DRUM
1300 mm ID X 3900 mm T/T
NOTE 3

V-24805
TEG STRIPPER REBOILER
CONDENSATE POT
600 mm ID X 1800 mm T/T

TK-24801
TEG MAKE-UP TANK
2 m3

TK-24802
TEG DRAIN TANK
1 m3

V-24807
LEAN TEG CARBON FILTER
1.2 m3/h

V-24808
LEAN TEG POST FILTER
1.2 m3/h

S-24801
TEG REGENERATION PACKAGE

FLASHED CO2
247.001
TO V-24701

CO2
247.002
TO V-24708

247.002
FROM V-24707

NNF

KO TEG
247.002
FROM V-24708

LOW TEMP HP STEAM

HP CONDENSATE
246-004
TO V-24607

NITROGEN STRIPPING GAS

TEG DRAINS

TOTE TANK
TK-24801

TOTE TANK
TK-24802

P-24802
P-24801A/B
NOTE 2

VENDOR
FLUOR

S-24802
NOTE 4

S-24801
NOTE 3

VENDOR
FLUOR

P-24802
TEG MAKE-UP PUMP
FLOW: 0.64 m3/h
DIF. PRESSURE: 350 kPa
POWER: 1 kW
NOTE 4

P-24801A/B
LEAN TEG PUMPS
FLOW: 4.8 m3/h
DIF. PRESSURE: 5824 kPa
POWER: 10 kW

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. THE LEAN TEG PUMPS (P-24801A/B) ARE POSITIVE DISPLACEMENT PUMPS WITH SUCTION STABILIZERS AND DISCHARGE DAMPENERS.
3. EQUIPMENT ITEMS V-24802, V-24806, E-24801, AND E-24802 ARE PART OF VENDOR PACKAGE S-24801.
4. TOTE TANK AND P-24802 ARE PART OF VENDOR PACKAGE S-24802.

LEGEND

XXX — STREAM NUMBER
XXX — TEMPERATURE, °C
XXX — PRESSURE, kPag
XX,XXX — FLOW, kg/h

ISSUED FOR CONSTRUCTION
04 Jun 2013

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
2	13/05/24	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

SHELL CANADA

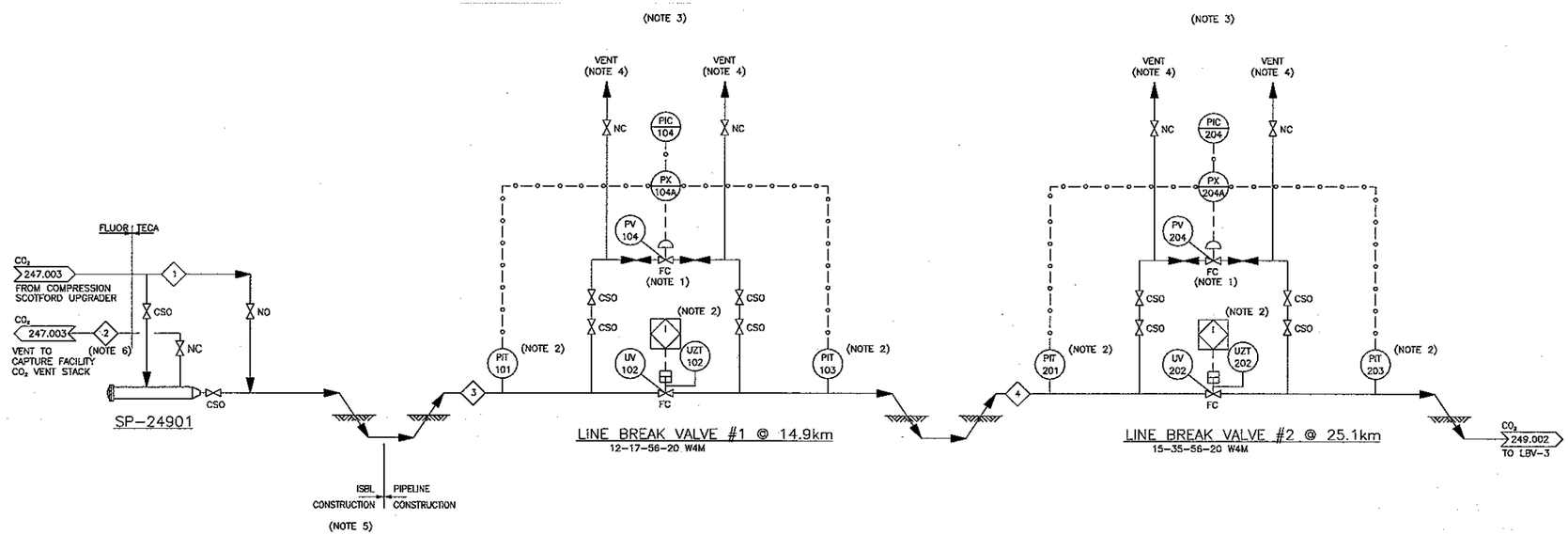
FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
CO2 DEHYDRATION

SCALE: NONE
TOE DWG. No.:
SHELL DWG NO.: 248.0001.000.040.001
REV. 2

FORMAT A1

SP-24901
PIG LAUNCHER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)



NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
3. ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
4. ALL VENTS TO SAFE LOCATION.
5. ISBL CONSTRUCTION TO OCCUR BEFORE PIPELINE CONSTRUCTION. PIPE TO BE CAPPED AND MARKED FOR PIPELINE TIE-IN.
6. DATA PROVIDED IS AFTER DEPRESSURIZING PIG LAUNCHER TO 2000 kPag.

KEY PLAN

REFERENCE DRAWINGS
1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND
XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No.	CAD FILE
09223-0-DG-BB-00001.01	00101-125W

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
0	12 NOV 09	ISSUED FOR CONSTRUCTION	DM	MJM	KVM			
1	12 SEP 20	ISSUED FOR CLIENT REVIEW	DM	MJM	KVM			
H	12 SEP 19	ISSUED FOR INTERNAL REVIEW	DM	MJM	KVM			

PROFESSIONAL ENGINEER ALBERTA K. V. MADHUSUDAN 13 NOV 2011
TOYO ENGINEERING CANADA LTD. APEGGA PERMIT P2034

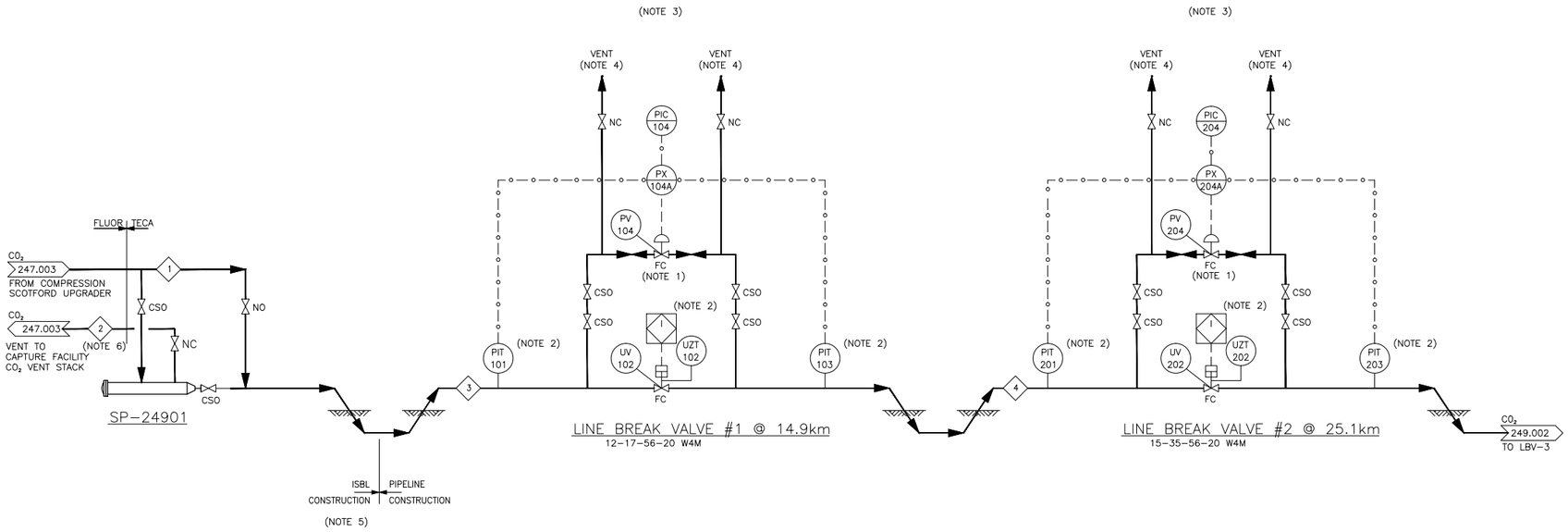
SHELL CANADA

QUEST CCS PROJECT
LINE BREAK VALVES #1 & #2
PROCESS FLOW DIAGRAM

SCALE: NTS
SHELL DWG NO.: 249.0000.000.040.001 REV. 0

1 UPDATED ON 11/07/12 AT 15:10 by DMerlin

SP-24901
PIG LAUNCHER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)



NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
3. ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
4. ALL VENTS TO SAFE LOCATION.
5. ISBL CONSTRUCTION TO OCCUR BEFORE PIPELINE CONSTRUCTION. PIPE TO BE CAPPED AND MARKED FOR PIPELINE TIE-IN.
6. DATA PROVIDED IS AFTER DEPRESSURIZING PIG LAUNCHER TO 2000 kPag.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No. 09223-0-DG-BB-00001.01 | CAD FILE 00101-125W

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
0	12 NOV 09	ISSUED FOR CONSTRUCTION	DIM	MJM	KVM	GJJ		
I	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
H	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

TOYO ENGINEERING CANADA LTD.
APEGGA PERMIT P2034

SHELL CANADA

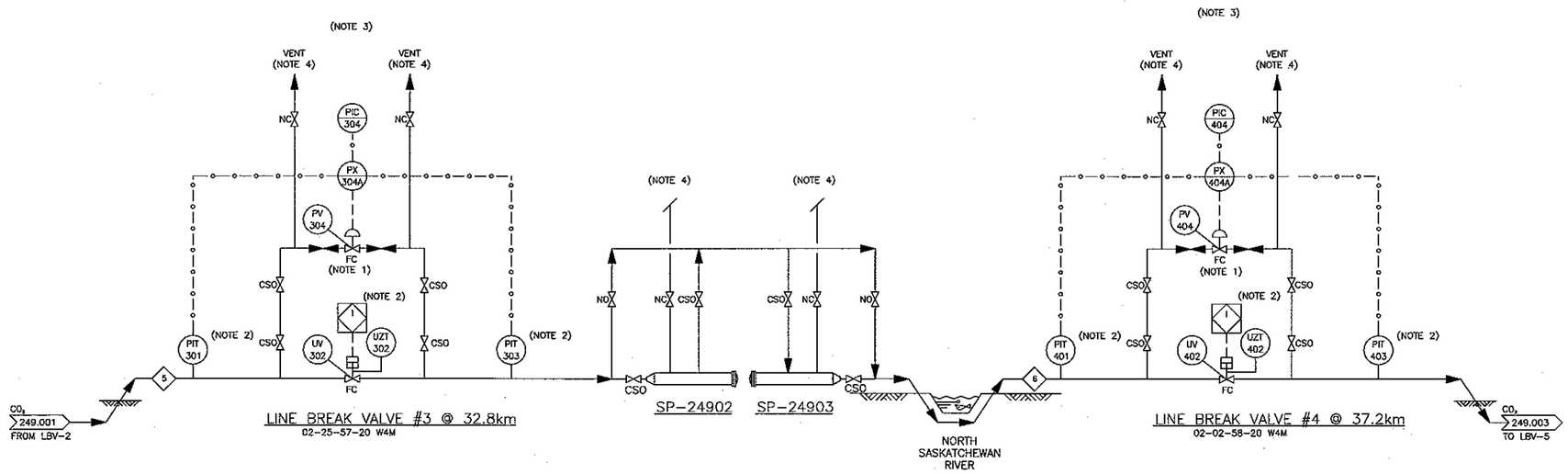
QUEST CCS PROJECT
LINE BREAK VALVES #1 & #2
PROCESS FLOW DIAGRAM

SCALE: NTS
SHELL DWG NO.: 249.0000.000.040.001 REV. 0

1 UPDATED ON 11/07/12 AT 15:10 by DMerlin

SP-24902
PIG RECEIVER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)

SP-24903
PIG LAUNCHER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)



NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
3. ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
4. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No. 09223-0-DG-BB-00002.01 | CAD FILE 00201-125Z

0	12 NOV 09	ISSUED FOR CONSTRUCTION	DIM	MJM	KVM			
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			
ISSUED DATE		DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP

PROFESSIONAL ENGINEER K. V. MADHUSUDAN ALBERTA

TOYO ENGINEERING CANADA LTD. APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVES #3 & #4
PROCESS FLOW DIAGRAM

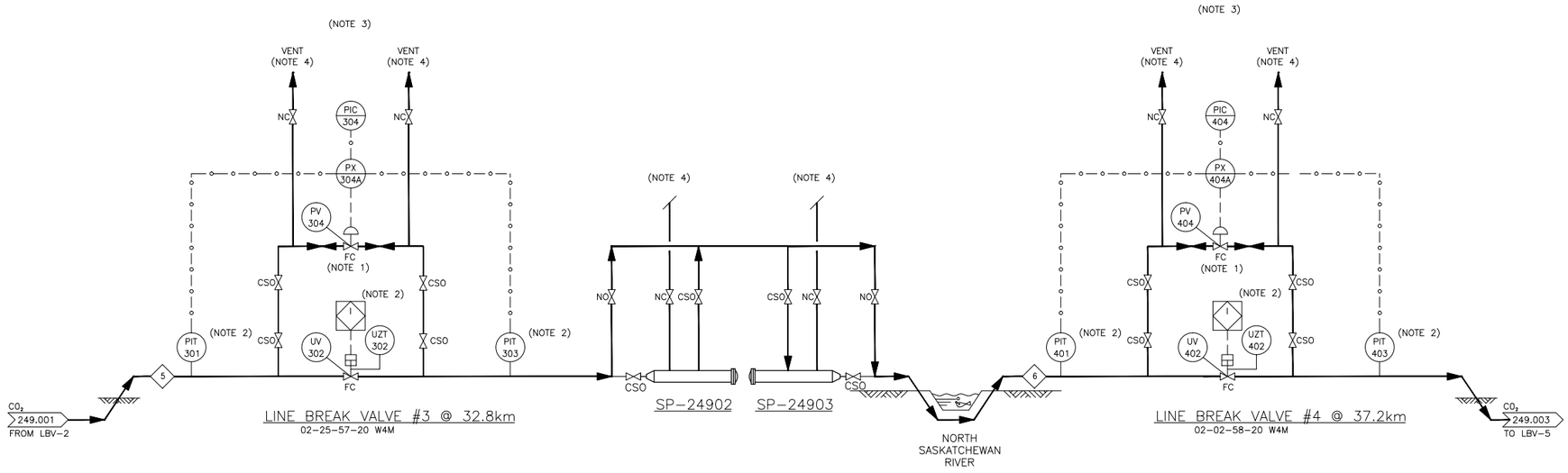
SCALE: NTS

SHELL DWG NO.: 249.0000.000.040.002 REV. 0

1 UPDATED ON 11/07/12 AT 14:45 by DMerlin

SP-24902
PIG RECEIVER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)

SP-24903
PIG LAUNCHER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)



NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
3. ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
4. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No.	CAD FILE
09223-0-DG-BB-00002.01	00201-125Z

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
O	12 NOV 09	ISSUED FOR CONSTRUCTION	DIM	MJM	KVM	GJJ		
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

TOYO ENGINEERING CANADA LTD.
APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVES #3 & #4
PROCESS FLOW DIAGRAM

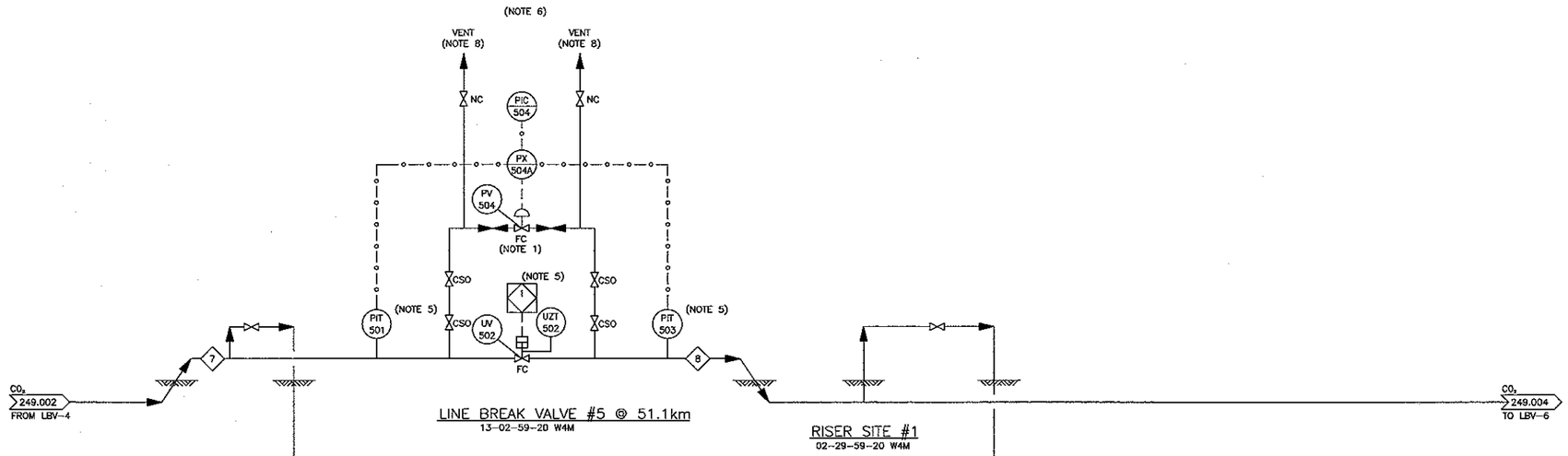
SCALE: NTS

SHELL DWG NO.: 249.0000.000.040.002 REV. 0

1 UPDATED ON 11/07/12 AT 14:45 by DMerlin

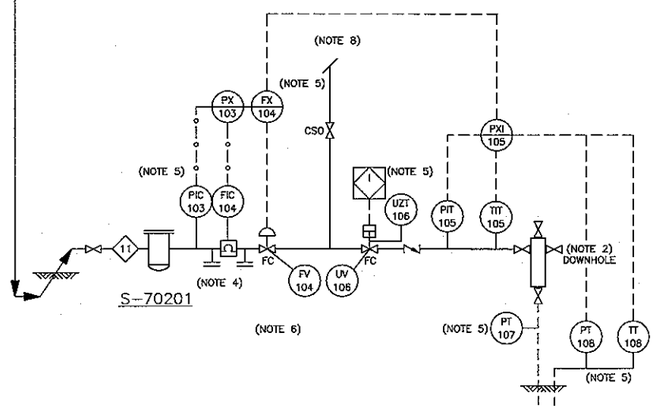
S-70201
WELLSITE #1 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS

S-70202
WELLSITE #2 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS

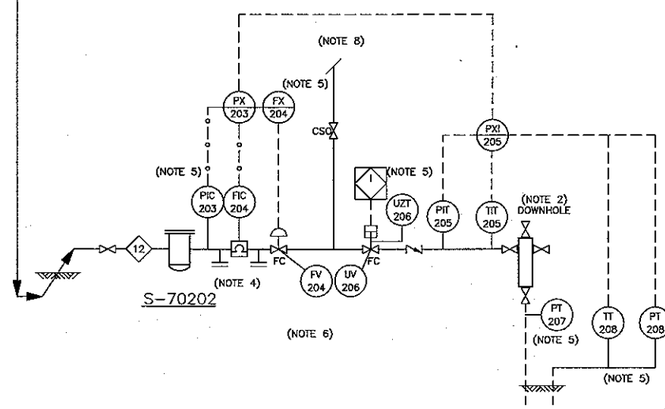


LINE BREAK VALVE #5 @ 51.1km
13-02-59-20 W4M

RISER SITE #1
02-29-59-20 W4M



WELLSITE #1
07-11-59-20 W4M



WELLSITE #2
08-19-59-20 W4M

NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. MULTI-SENSOR.
3. DELETED.
4. METER PROVER TAPS.
5. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
6. ALL WELLSITE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #702 AND ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
7. DELETED.
8. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No. 09223-0-DG-BB-00003.01 | CAD FILE 00301-1261

REV	DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP.
0	12 NOV 09	ISSUED FOR CONSTRUCTION	DM	MJM	KVM			
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

PROFESSIONAL ENGINEER ALBERTA K. V. MADHUSUDAN 13 NOV 2012

TOYO ENGINEERING CANADA LTD. APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVE #5, RISER SITE #1
WELLSITES #1 & #2
PROCESS FLOW DIAGRAM

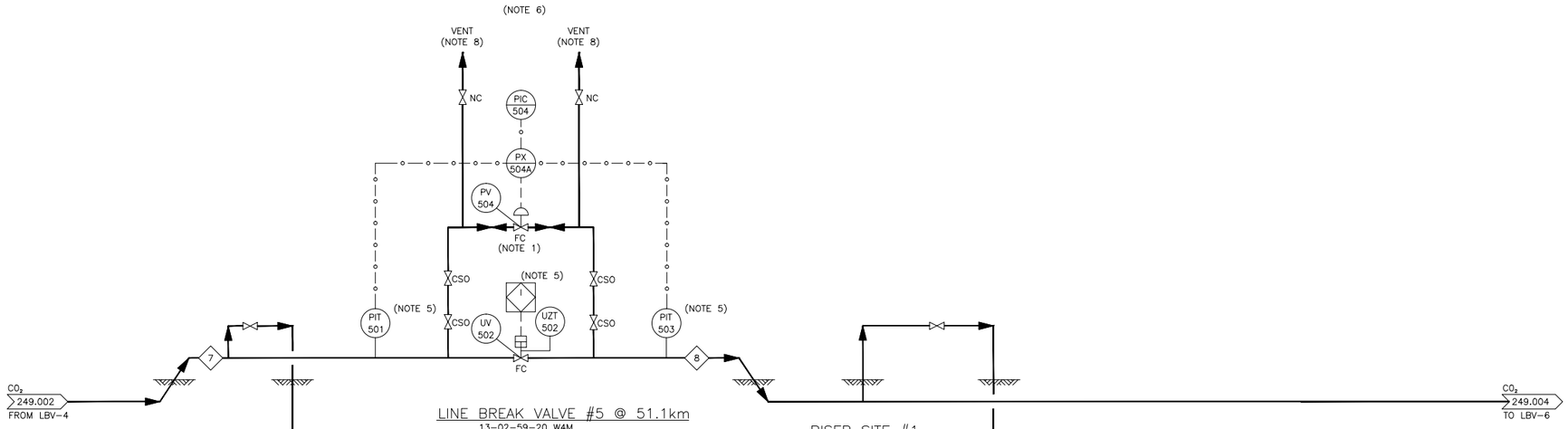
SCALE: NTS

SHELL DWG NO.: 249.0000.000.040.003 REV. 0

1 UPDATED ON 11/07/12 AT 15:06 by DMerlin

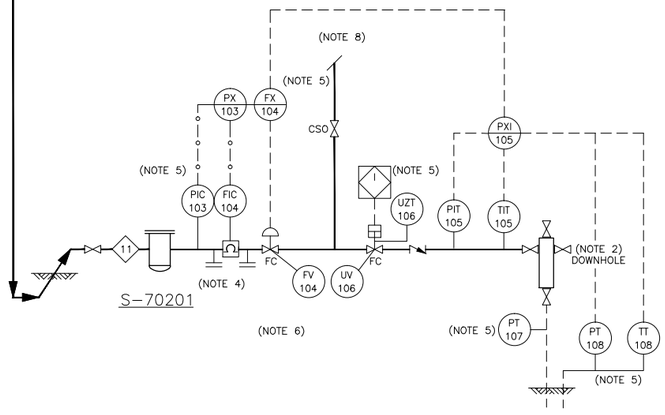
S-70201
WELLSITE #1 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS

S-70202
WELLSITE #2 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS

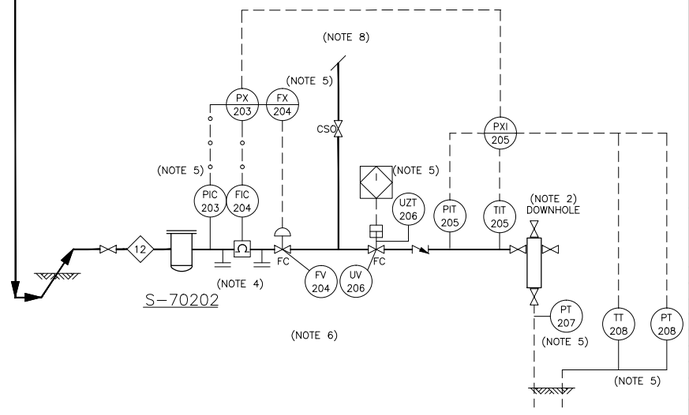


LINE BREAK VALVE #5 @ 51.1km
13-02-59-20 W4M

RISER SITE #1
02-29-59-20 W4M



WELLSITE #1
07-11-59-20 W4M



WELLSITE #2
08-19-59-20 W4M

NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. MULTI-SENSOR.
3. DELETED.
4. METER PROVER TAPS.
5. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
6. ALL WELLSITE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #702 AND ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
7. DELETED.
8. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No. 09223-0-DG-BB-00003.01 | CAD FILE 00301-1261

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
O	12 NOV 09	ISSUED FOR CONSTRUCTION	DIM	MJM	KVM	GJJ		
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

TOYO ENGINEERING CANADA LTD.
APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVE #5, RISER SITE #1
WELLSITES #1 & #2
PROCESS FLOW DIAGRAM

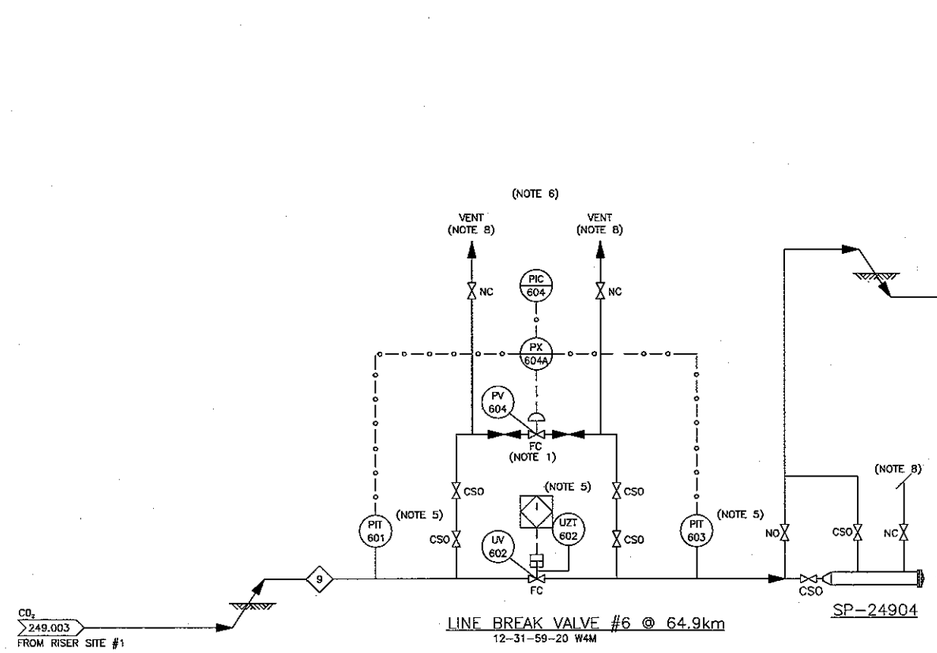
SCALE: NTS

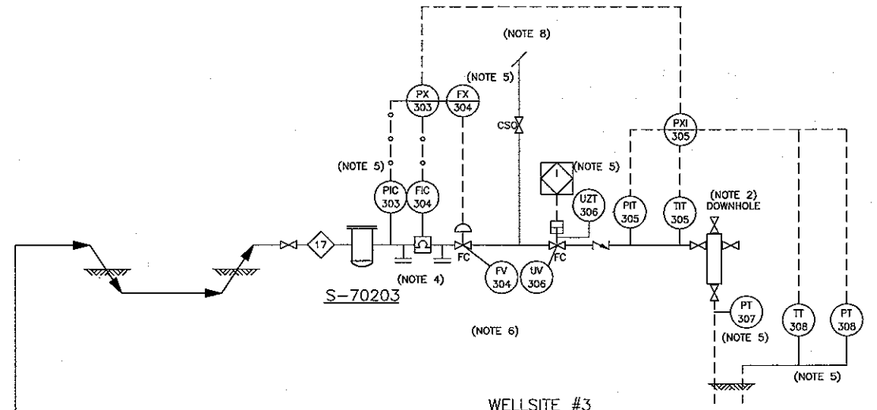
SHELL DWG NO.: 249.0000.000.040.003 REV. 0

1 UPDATED ON 11/07/12 AT 15:06 by DMerlin

SP-24904
PIG RECEIVER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)

S-70203
WELLSITE #3 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS





WELLSITE #3
05-35-59-21 W4M

NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. MULTI-SENSOR.
3. DELETED.
4. METER PROVER TAPS.
5. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
6. ALL WELLSITE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #702 AND ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
7. DELETED.
8. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No. 09223-0-DG-BB-00004.01 | CAD FILE 00401-1265

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
0	12 NOV 09	ISSUED FOR CONSTRUCTION						
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

PROFESSIONAL ENGINEER ALBERTA K. V. MADHUSUDAN 12 NOV 09

TOYO ENGINEERING CANADA LTD. APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVE #6
WELLSITE #3
PROCESS FLOW DIAGRAM

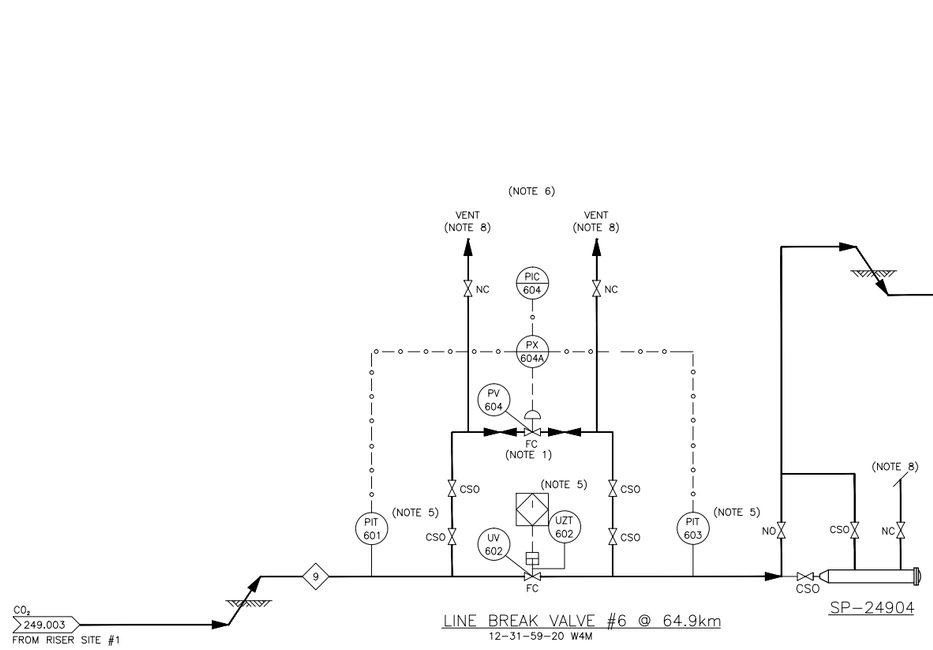
SCALE: NTS

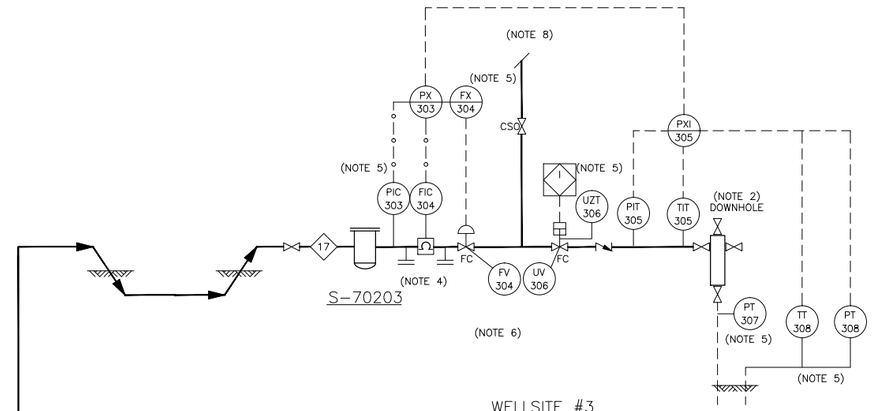
SHELL DWG NO.: 249.0000.000.040.004 REV. 0

1 UPDATED ON 11/07/12 AT 15:07 by DMerlin

SP-24904
PIG RECEIVER
SIZE: 16" OD X 21'-6" (MAJOR BARREL)
SIZE: 12" OD X 40" (MINOR BARREL)

S-70203
WELLSITE #3 FILTER
SIZE: HOLD
MESH SIZE: 5 MICRONS





NOTES

1. PV REGULATES CO_2 FOR P/L FILL AND BLOW-DOWN THROUGH VENT STACKS.
2. MULTI-SENSOR.
3. DELETED.
4. METER PROVER TAPS.
5. PRIMARY INSTRUMENTATION AS SHOWN IS REMOTELY TIED TO SCOTFORD VIA SCADA.
6. ALL WELLSITE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #702 AND ALL LINE BREAK VALVE INSTRUMENTATION NUMBERS ARE PREFIXED WITH UNIT #249.
7. DELETED.
8. ALL VENTS TO SAFE LOCATION.

KEY PLAN

REFERENCE DRAWINGS

1. HEAT AND MATERIAL BALANCE TABLE (249.0000.000.046.001)

LEGEND

XX STREAM NUMBER

TOYO ENGINEERING CANADA LTD.

TOYO-CA DWG. No.	CAD FILE
09223-0-DG-BB-00004.01	00401-1265

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
O	12 NOV 09	ISSUED FOR CONSTRUCTION	DIM	MJM	KVM	GJJ		
H	12 SEP 20	ISSUED FOR CLIENT REVIEW	DIM	MJM	KVM			
G	12 SEP 17	ISSUED FOR INTERNAL REVIEW	DIM	MJM	KVM			

TOYO ENGINEERING CANADA LTD.
APEGGA PERMIT P2034

SHELL CANADA

ALBERTA

QUEST CCS PROJECT
LINE BREAK VALVE #6
WELLSITE #3
PROCESS FLOW DIAGRAM

SCALE: NTS

SHELL DWG NO.: 249.0000.000.040.004 REV. 0

1 UPDATED ON 11/07/12 AT 15:07 by DMerlin

ISSUED FOR DESIGN

REV	DATE	DESCRIPTION	BY	CHK	APP	APP	CLNT APP
0	15-Aug-11	Issued for Basic Design Engineering Package	~~MRAB~~ MRAB	MG	JI		
B	3-Mar-11	Issued For PHA II Review					
A	8-Nov-10	Issued for Information					

SHELL CANADA ENERGY
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT

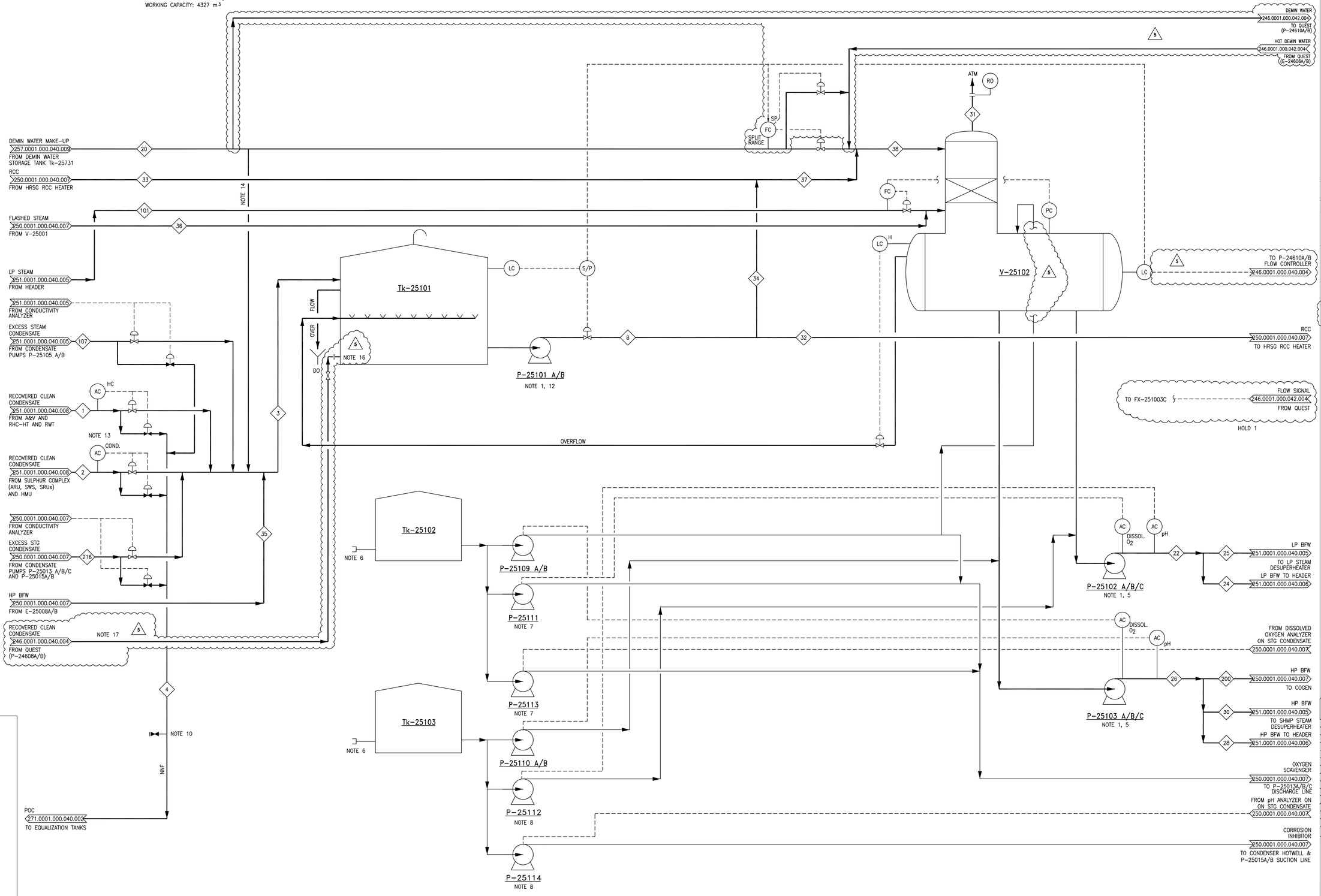
FLUOR

BATTERY LIMIT INTERFACE TABLE
QUEST CAPTURE / PIPELINE INTERFACE
UNIT 249

249.0006.000.067.001

Rev C

	Fluid Description	Pipe CL el	Northing	Easting	Conn. Type	In / Out	Phase	P&ID Number	Sch.	Line Size	Fluid Code	Line Number	Matl. Class	Insulation Type / Mat'l	Thickness	Tracing	Const. Class	Severity Rating	Mass Flow				Pressure		Temperature		Properties		Design Code		Notes	Rev
																			Minimum	Normal	Maximum	Design	Normal	Maximum	Normal	Max	Viscosity	Density / (MW)	Press	Temp		
		m	m	m						(NPS)					mm	Type / °C			kg/h	kg/h	kg/h	kg/h	kPa(ga)	kPa(ga)	°C	°C	mPa-s	kg/m³	kPa(ga)	°C		
Unit 249 EAST																															
ISBL OSBL	CO2 to Pipeline				BW	IN	Dense Phase	247.014		8	GC	247059	PJL(C)							148,496	148,496	148,496	9,000	13,900	43		0.029	402	14,790	60		C
~~ISBL~~ ~~OSBL~~	~~Pipeline Vent~~				~~BW~~	~~OUT~~	~~V~~	~~247.014~~		~~2~~	~~VA~~	~~247011~~	~~PJB(C)~~	~~0~~	~~0~~	~~0~~				~~NNF~~		~~0~~	~~1,500~~		~~22~~						~~HOLD - destination in Quest Capture unit not defined and metallurgy effect not known~~	~~C~~
ISBL OSBL																															



NOTES

1. PUMPS HAVE LOW PRESSURE AUTO-START PROVISION.
2. FOR CORRESPONDING MATERIAL BALANCE, SEE DS-251-B-0101.
3. DELETED.
4. POC IS ROUTED TO EQUALIZATION TANKS.
5. THE HP BFW PUMPS AND LP BFW PUMPS EACH OPERATE NORMALLY ON ONE MOTOR AND ONE TURBINE WITH ONE MOTOR DRIVEN SPARE.
6. PROVIDE AN AIR-DRIVEN PUMP FOR CHEMICAL LOADING. (ONE PUMP TO BE SHARED BETWEEN CHEMICAL SERVICES).
7. USE P-25109B AS A COMMON SPARE FOR P-25111 AND P-25113.
8. USE P-25110B AS A COMMON SPARE FOR P-25112 AND P-25114.
9. AS STG CONDENSER IS NOT PROVIDED WITH DEAERATING CONDENSER, STG CONDENSATE TO HMU WILL SEE A SWING IN OXYGEN CONTENT. PROVISION TO ROUTE 100,000 kg/h STG CONDENSATE TO RCC TANK IS MADE TO TAKE CARE OF HIGH OXYGEN CONTENT OF STG CONDENSATE AT MODERATE LOAD (I.E. NORMAL SUMMER). DESIGN IS BASED ON THE ASSUMPTION THAT OPERATOR ACTION WILL TAKE CARE OF INCREASED OXYGEN CONTENT IN STG CONDENSATE BY INCREASING OXYGEN SCAVENGER DOSING.
10. PROVIDE A CONNECTION FOR UTILITY WATER TO QUENCH POC IF REQUIRED BY WWTU.
11. DELETED.
12. PUMPS ARE SIZED AT 2 x 50% OF THE PEAK FLOW. POSSIBLE SHORTFALLS IN PUMPING CAPABILITY WILL BE MET BY DEMIN M/U PUMPS THAT SHALL BE RATED AT 3 x 33% OF THE PEAK FLOW OF 1560 m^3/h.
13. CONDUCTIVITY IS MEASURED AS A MEANS OF DETECTING AMINE CARRY OVERS.
14. A 4" FILL LINE IS PROVIDED FROM DEMIN WATER HEADER FOR START-UP.
15. THIS DRAWING IS UPDATED BASED ON UNITS 251/250 ISSUED (IFD) P&IDS AND UNIT 285 ISSUED (IFC) INTERCONNECTING P&IDS.
16. USE 6 INCH DRAIN NOZZLE ON SOUTH SIDE OF TANK FOR RCC TIE-IN TO RCC TANK TK-25101 FROM QUEST.
17. UNIT 246 PROVIDES ANALYSER OF RECOVERED CONDENSATE (pH & COND.) AND CONTROL OF SWITCHING VALVES, LOCATED SOUTHWEST OF RCC TANK TK-25101, THAT CAN DIVERT CONDENSATE TO POC. SWITCHING VALVES SHOWN ON PFD 246.004.

HOLD

1. FX-251003C IS A SUMMING BLOCK SHOWN ON P&ID 251.0000.000.041.103. PFD TO BE AS-BUILT WITH FLOW SIGNAL FROM QUEST.

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
5	2013-09-30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
4C	2013-01-08	ISSUED FOR CONSTRUCTION	GB	KB	SL	KH	CV	
4B	2011-08-31	RE-ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SR
4A	2011-03-01	RE-ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SR
4	2010-11-03	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SR
3A	2010-08-16	ISSUED FOR QUEST COARSE HAZOP						
3	2002-11-29	ISSUED FOR AS-BUILT	HC	BY	–	SB	–	
2	2001-06-11	ISSUED FOR CONSTRUCTION	DG	JM	MRAP	JM	BJK	
1	2001-01-31	RE-ISSUED FOR DESIGN		SL	ADR	JM	BKJ	HB
0	2000-05-17	ISSUED FOR DESIGN	ADR	SL		AKG	BJK	
D	1999-12-23	RE-ISSUED FOR APPROVAL	ADR	SL		AKG	BJK	
C	1999-10-25	RE-ISSUED FOR APPROVAL	ADR	SL	AKG	BJK		
B	1999-06-07	ISSUED FOR APPROVAL	HEM	AKG	AKG	BJK		
A	1999-03-29	ISSUED FOR REVIEW	HEM	AKG	AKG	BJK		

"THE SIGNED APEGGA STAMP RESIDES ON THE ORIGINAL IFC DOCUMENT HELD IN DOCUMENT CONTROL. NO DESIGN CHANGES WILL BE MADE TO THIS DRAWING WITHOUT THE APPROVAL OF A REGISTERED ENGINEER."

BANTREL Inc.
PERMIT NUMBER: P 3913
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

BANTREL Inc. CALGARY, ALBERTA Job No. 757

PROCESS FLOW DIAGRAM
RECOVERED CONDENSATE TREATMENT/ BFW TREATMENT SYSTEM

SCALE: NONE

SHELL DWG NO.: 251.0001.000.040.001 REV. 5

CAD FILE: 251000100040001.DWG

P-25101 A/B
RECOVERED CONDENSATE PUMPS
DESIGN FLOW RATE: 780 m^3/h
DIFF. PRESSURE: 586 kPa
NOTE 12

P-25109 A/B
OXYGEN SCAVENGER INJECTION PUMP # 1
DESIGN FLOW RATE: 0.003 m^3/h
DIFF. PRESSURE: 239 kPa

P-25111
OXYGEN SCAVENGER INJECTION PUMP # 2
DESIGN FLOW RATE: 0.0008 m^3/h
DIFF. PRESSURE: 237 kPa

P-25113
OXYGEN SCAVENGER INJECTION PUMP # 3
DESIGN FLOW RATE: 0.0009 m^3/h
DIFF. PRESSURE: 1 kPa

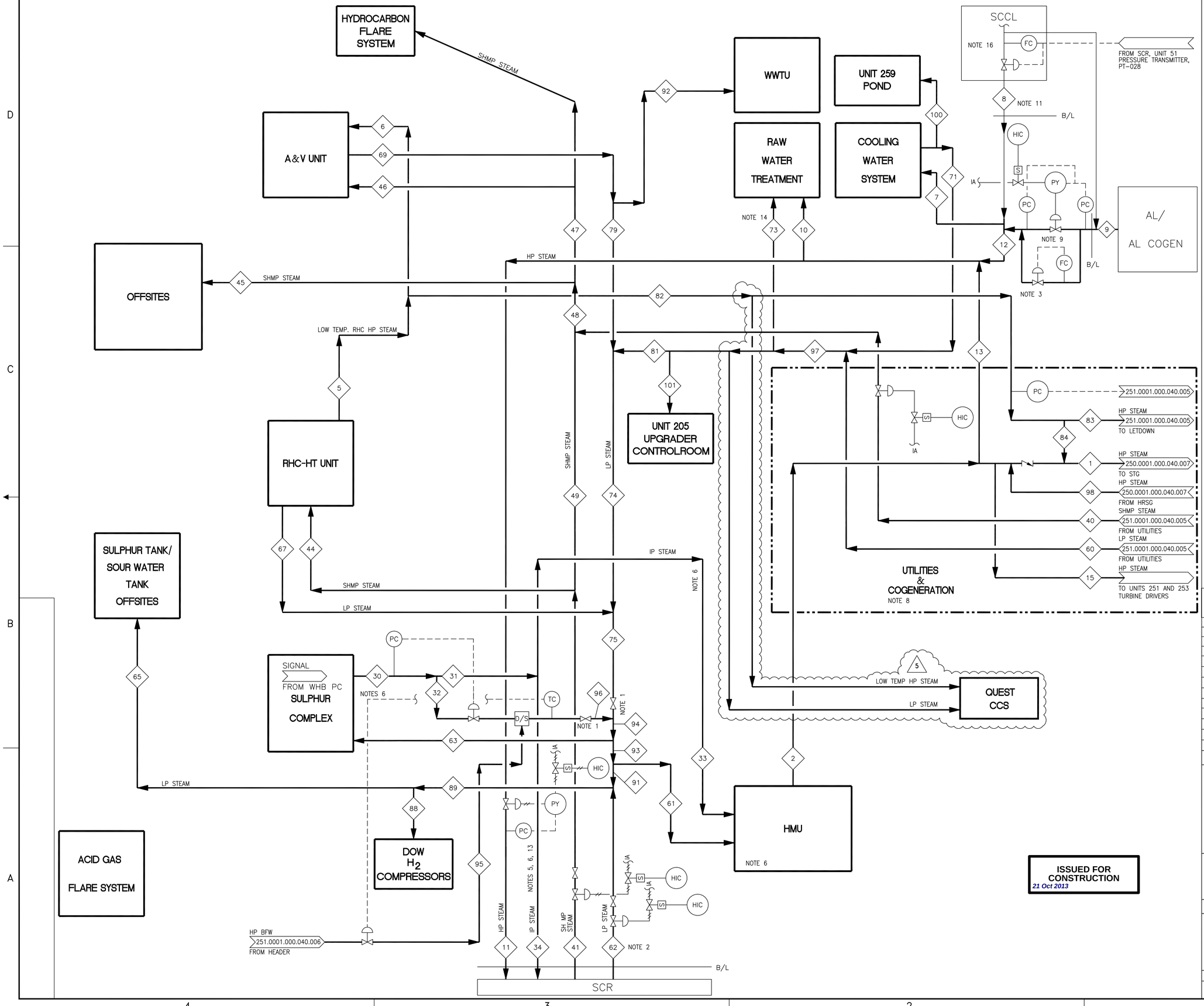
P-25110 A/B
CORROSION INHIBITOR INJECTION PUMP # 1
DESIGN FLOW RATE: 0.01 m^3/h
DIFF. PRESSURE: 239 kPa

P-25112
CORROSION INHIBITOR INJECTION PUMP # 2
DESIGN FLOW RATE: 0.0005 m^3/h
DIFF. PRESSURE: 328 kPa

P-25114
CORROSION INHIBITOR INJECTION PUMP # 3
DESIGN FLOW RATE: 0.0026 m^3/h
DIFF. PRESSURE: 1 kPa

P-25102 A/B/C
LP BFW PUMPS
DESIGN FLOW RATE: 161 m^3/h
DIFF. PRESSURE: 914 kPa

P-25103 A/B/C
HP BFW PUMPS
DESIGN FLOW RATE: 644 m^3/h
DIFF. PRESSURE: 7492 kPa



NOTES

1. VALVES ARE CLOSED FOR EARLY SCOTFORD MODS.
2. DURING EARLY SCOTFORD MODS THE PRESSURE IN THE LP HDR IS CONTROLLED BY PCV-85006 LOCATED OUTSIDE THE HCU BATTERY LIMIT.
3. A MINIMUM FLOW IS MAINTAINED TO KEEP THE LINE WARM.
4. SCR DESUPERHEATING WATER (FLASHED RCC FROM THE CLEAN CONDENSATE FLASH DRUM V-2120) IS SUPPLIED TO DESUPERHEATER FOR EARLY SCOTFORD MODS AND FOR WHEN THE UPGRADER IS DOWN. THIS DESUPERHEATING FACILITY IS NOW LOCATED IN THE HCU AND ON THE 85 PIPERACK.
5. DURING EARLY SCOTFORD MODS, ALL IP STEAM FROM THE SULPHUR COMPLEX SRUs IS EXPORTED TO THE REFINERY 2500 kPa(ga) STEAM SYSTEM WHICH FEEDS THE SMR. DURING UPGRADER OPERATION, THE BALANCE OF THE IP STEAM NOT USED IN THE HMU AS FEED STEAM IS EXPORTED TO THE REFINERY SMR.
6. IN THE EVENT THE PRESSURE IN THE IP STEAM HEADER DROPS BELOW 4200 kPa(ga) DURING UPGRADER OPERATION, THE SHORTFALL IN IP STEAM TO THE HMUs WILL BE MADE UP THROUGH LETDOWN FROM THE HP STEAM SYSTEM LOCATED INSIDE HMU B/L. ANY EXCESS IN THE IP STEAM SYSTEM WILL BE REMOVED VIA EITHER IP/UPGRADER-TO IP/ REFINERY OR THE IP-TO-LP LETDOWN ADJACENT TO THE SULPHUR COMPLEX.
7. FOR CORRESPONDING MATERIAL BALANCE REFER TO DS-251-B-0107.
8. THE HP-TO-SHMP AND SHMP-TO-LP LETDOWN FACILITIES ARE LOCATED IN THE UTILITIES (PLANT 251) AREA.
9. BOTTLING VALVES ARE PROVIDED TO ENABLE ISOLATION OF THE UPGRADER FROM SCR/SCCL/AL AND PROCESS UNIT WITH HIGH LOADS.
10. DELETED.
11. LINE ISOLATED DURING NORMAL OPERATION.
12. MOST LINES ARE BIDIRECTIONAL; PREDOMINANT FLOW DIRECTIONS ARE INDICATED ON THIS DRAWING.
13. THE IP/UPGRADER – IP/REFINERY LETDOWN CONTROL VALVE, PV-85009 IS LOCATED ON 85 PIPERACK NEAR SMR BATTERY LIMIT.
14. LP STEAM FROM DEAERATOR MAKE-UP WATER PUMP TURBINE EXHAUST JOINS INSIDE RAW WATER TREATMENT PLANT.
15. THIS DRAWING IS UPDATED BASED ON UNITS 251/250 ISSUED (IFD) P&IDs AND UNIT 285 ISSUED (IFC) INTERCONNECTING P&IDs.
16. CURRENTLY THE FLOW OF STEAM FROM SCCL TO SCR IS CONTROLLED BY FLOW AND IS RESET BY PRESSURE FLUCTUATIONS AT SCR, UNIT 51. DURING UPGRADER OPERATION, UPGRADER PRIMARY CONTROL/ADVANT CONTROL WILL RECEIVE A REMOTE SIGNAL FROM SCR, UNIT 51 AND RESPONDS ACCORDINGLY.

LEGEND:

NEW FACILITY

EXISTING FACILITY

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
5	2013-09-30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
4B	2013-01-10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
4A	2011-03-01	RE-ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SB
4	2010-11-03	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
3A	2010-08-10	ISSUED FOR QUEST COARSE HAZOP						
3	2001-11-29	ISSUED FOR AS-BUILT	HC	BY	–	SB	–	
2	2001-06-11	ISSUED FOR CONSTRUCTION	DG	JM	MRAB	JM	BJK	
1	2001-02-05	RE-ISSUED FOR DESIGN	DG	SL	ADR	JM	BJK	JS
0	2000-04-19	ISSUED FOR DESIGN	ADR	SL		AKG	BJK	
D	2000-02-03	RE-ISSUED FOR APPROVAL	ADR	SL		AKG	BJK	
C	2000-01-05	RE-ISSUED FOR APPROVAL	ADR	SL		AKG	BJK	
B	1999-05-31	ISSUED FOR APPROVAL	HEM	AKG	AKG	BJK		
A	1999-03-29	ISSUED FOR REVIEW	HEM	AKG	AKG	BJK		

"THE SIGNED APEGGA STAMP RESIDES ON THE ORIGINAL IFC DOCUMENT HELD IN DOCUMENT CONTROL. NO DESIGN CHANGES WILL BE MADE TO THIS DRAWING WITHOUT THE APPROVAL OF A REGISTERED ENGINEER."

BANTREL Inc.
PERMIT NUMBER: P 3913
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

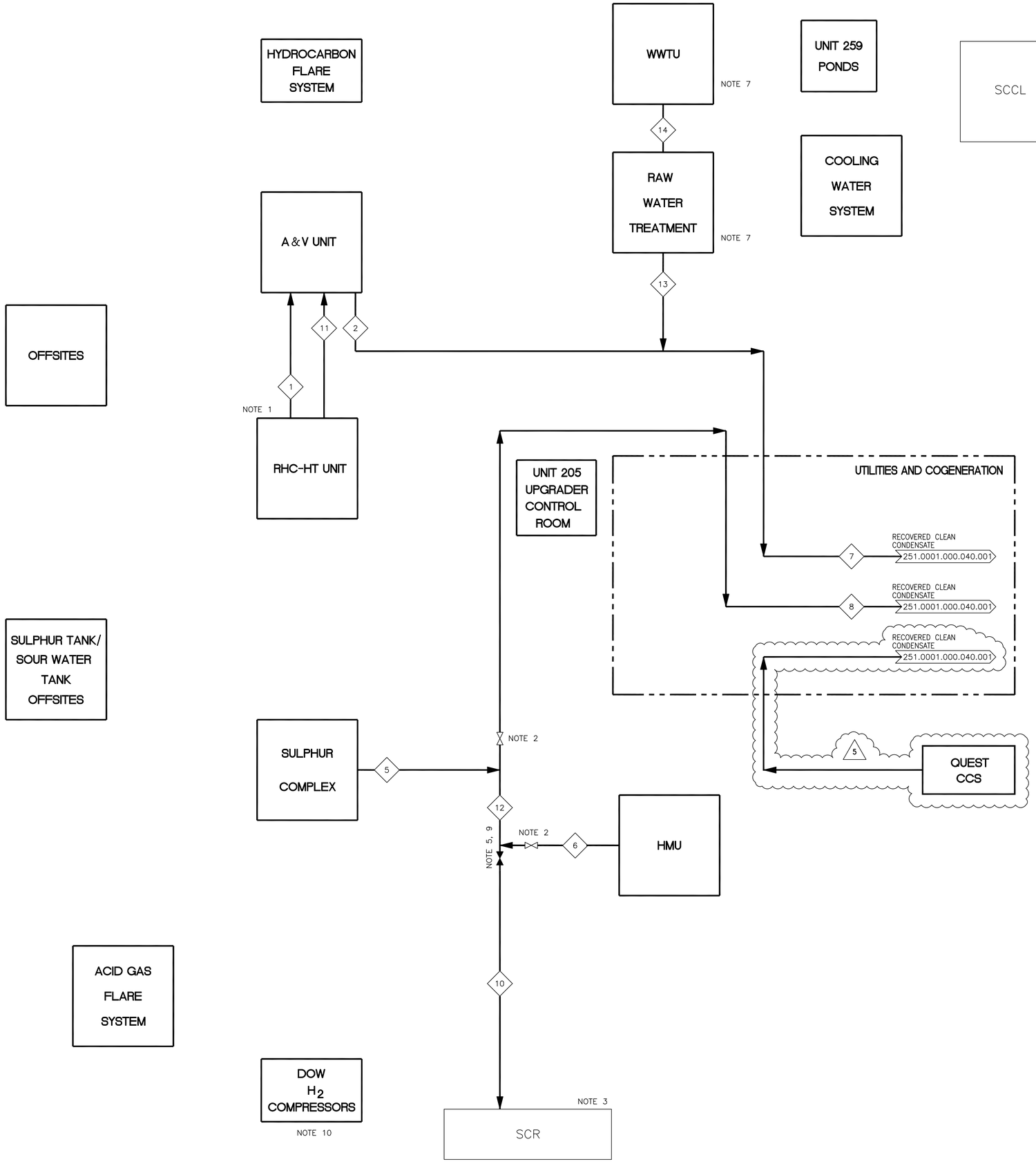
BANTREL Inc. CALGARY, ALBERTA Job No. 757

UTILITY FLOW DIAGRAM
UPGRADER OPERATION
HP, IP, SHMP AND LP STEAM DISTRIBUTION

SCALE: NONE

SHELL DWG NO.: 251.0001.000.040.007 REV. 5

CAD FILE: 251.0001.000.040.007.REV8.DWG BANTREL 757



NOTES

1. RCC FROM THE RHC–HT IS SENT TO THE A&V CONDENSATE COLLECTION DRUM.
2. VALVES ARE CLOSED FOR EARLY SCOTFORD MODS.
3. SCR DESUPERHEATING WATER (FLASHED RCC FROM THE CLEAN CONDENSATE FLASH DRUM V–2120) IS SUPPLIED TO DESUPERHEATER FOR EARLY SCOTFORD MODS AND FOR WHEN THE UPGRADER IS DOWN. THIS DESUPERHEATING FACILITY IS LOCATED IN THE HCU AND ON 85 PIPERACK.
4. FOR CORRESPONDING MATERIAL BALANCE REFER TO DS–251–B–0108.
5. DURING EARLY SCOTFORD MODS AND WHEN THE UPGRADER IS DOWN, RCC FROM THE SULPHUR COMPLEX WILL BE SENT TO THE SCR RCC SYSTEM (TO THE CLEAN CONDENSATE DRUM V–2120). DURING UPGRADER OPERATION, THIS VALVE IS CLOSED.
6. STREAM NUMBERS HAVE BEEN REASSIGNED SINCE REV. A OF THIS DRAWING.
7. RCC FROM WWTU AND RAW WATER TREATMENT WILL BE COLLECTED IN A CONDENSATE DRUM PRIOR TO TRANSFER TO THE HEADER.
8. DELETED.
9. BASED ON CURRENT CONDENSATE BALANCE THERE IS ADEQUATE CAPACITY WITHIN SMR CONDENSATE COLLECTION/PUMPING SYSTEMS TO RECEIVE THE ESM CONDENSATE.
10. CONDENSATE FROM COMPRESSOR BUILDING HEATING IS COLLECTED AND COMBINED WITH THE PLANT WIDE TRAPS CONDENSATE TO BE ROUTED VIA A SEPARATE LINE TO RCC TANK OR WWTU.
11. THIS DRAWING IS UPDATED BASED ON UNITS 251/250 ISSUED (IFD) P&ID'S AND UNIT 285 ISSUED (IFC) INTERCONNECTING P&ID'S.

LEGEND:

NEW FACILITY

EXISTING FACILITY

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
5	2013-09-30	RE–ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
4B	2013-01-10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
4A	2011-03-01	RE–ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SB
4	2010-11-03	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
3A	2010-08-10	ISSUED FOR QUEST COARSE HAZOP						
3	2001-11-29	ISSUED FOR AS–BUILT	HC	BY	–	SB	–	
2	2001-06-11	ISSUED FOR CONSTRUCTION	DG	JM	MRAB	JM	BJK	
1	2001-01-31	REISSUED FOR DESIGN		SL	ADR	JM	BJK	HB
0	2000-04-12	ISSUED FOR DESIGN	ADR	SL		AKG	BJK	
C	1999-12-23	RE–ISSUED FOR APPROVAL	ADR	SL	AKG	BJK		
B	1999-05-31	ISSUED FOR APPROVAL	HEM	AKG	AKG	BJK		
A	1999-03-29	ISSUED FOR REVIEW	HEM	AKG	AKG	BJK		

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BANTREL Inc.
PERMIT NUMBER: P 3913
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

BANTREL Inc. CALGARY, ALBERTA Job No. 757

UTILITY FLOW DIAGRAM UPGRADER OPERATION CONDENSATE COLLECTION

SCALE: NONE

SHELL DWG NO.: 251.0001.000.040.008 REV. 5

CAD FILE 251.0001.000.040.008.DWG

ISSUED FOR DESIGN

REV	DATE	DESCRIPTION	BY	CHK	APP	APP	CLNT APP
0	15-Aug-11	Issued for Basic Design Engineering Package	MRAB				
B		not issued					
A	3-Mar-11	Issued For PHA II Review					

SHELL CANADA ENERGY
ATHABASCA OIL SANDS
DOWNSTREAM PROJECT
FLUOR.
BATTERY LIMIT INTERFACE TABLE
QUEST CAPTURE INTERFACE
UNIT 251
251.0006.000.067.001
Rev C

	Fluid Description	Pipe CL el	Northing	Easting	Conn. Type	In / Out	Phase	P&ID Number	Sch.	Line Size	Fluid Code	Line Number	Matl. Class	Insulation Type / Mat'l	Thickness	Tracing	Const. Class	Severity Rating	Mass Flow				Pressure		Temperature		Properties		Design Code		Notes	Rev
																			Minimum	Normal	Maximum	Design	Normal	Maximum	Normal	Max	Viscosity	Density / (MW)	Press	Temp	
		m	m	m						(NPS)					mm	Type / °C			kg/h	kg/h	kg/h	kg/h	kPa(ga)	kPa(ga)	°C	°C	mPa-s	kg/m³	kPa(ga)	°C	
Unit 251 Utilities WEST																														
ISBL	CWR Cooling Water Return				BW	IN	L	251.101		30	CWR	251xxx	UAB							5,700,134	5,832,003	6,079,878	340		34		0.73	994.5	1200	58	Design Pressure of Quest CWR is higher than Utility Plant CWS at 800 kPag. Open path is required.	C
OSBL								285.214		30	CWR	285001	UAB																	
ISBL	RCC Recovered Clean Condensate				BW	IN	L	251.130		6	SC	251210	SAB	H /	xx	ET / 10				153,894	161,718	161,718	350		74		0.30	975.6	1400	130	Tie In connection is 6NPS	C
OSBL								285.230		6	SC	285251	SAB	H /	xx	ET / 10														
ISBL	Potentially Oily Condensate				BW	OUT	L	251.130		6	WP	251002	SAB	H /	xx	ET / 10				0	161,718	161,718	350		74		0.30	975.6	1400	130		C
OSBL								285.230		6	WP	285034	SAB	H /	xx	ET / 10														
ISBL	DWR Demin Water Return				BW	IN	L	251.103		6	WI	251013	UJD	H /	xx	ET / 10				184,890	203,400	203,400	416		84		0.49	985.2	xxx TBD	125	Requires new spec for 300#	C
OSBL								285.230		6	WI	285003	UJD	H /	xx	ET / 10														

A&V UNIT
ATMOS.
VACUUM

WASTE WATER TREATMENT

FLARE LIQUIDS COOLER

RHC UNIT
RHC #1
HTU #1
STAB
RHC #2
HTU #2
STRIPPER

SULPHUR COMPLEX
ARU
SRU #1
SWS
SRU #2

CRUDE & CRUDE BLENDING COOLERS

HYDROGEN MANUFACTURING UNIT
HMU #1
HMU #2

COOLING WATER RETURN
252.0001.000.040.001
TO COOLING TOWER

COOLING WATER SUPPLY
252.0001.000.040.001
FROM COOLING TOWER

FI

NOTE 4
NOTE 5

UTILITIES
UNIT 250– COGENERATION
UNIT 251– STEAM/BFW/CONDENSATE
UNIT 253– AIR COMPRESSION
UNIT 254– FUEL GAS/NATURAL GAS

CWR
CWS
QUEST CCS

NOTES

1. EACH UNIT TO HAVE FLOW MEASUREMENT INSTRUMENTATION.
2. ALL UNITS TO PROVIDE SAMPLE POINTS ON RETURN LINES TO COOLING WATER RETURN HEADER (CWRH), PRIOR TO LEAVING ISBL.
3. REFER TO DS–252–B–0102 FOR MATERIAL BALANCE
4. CWS TAKE–OFF TO QUEST SUPPLY AT UNIT 252 BATTERY LIMITS. QUEST CWR TIE–IN TO CWS AT UNIT 251 BATTERY LIMITS. UNIT 251 BATTERY LIMIT VALVE TO BE THROTTLED.
5. QUEST CWS BYPASS TO COGEN AUXILIARY COOLERS.

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
4	2013-09-30	RE–ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
3B	2013-01-10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
3A	2011-03-01	RE–ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SB
3	2010-11-03	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
2A	2010-08-10	ISSUED FOR QUEST COARSE HAZOP						
2	2002-11-29	ISSUED FOR AS–BUILT	HC	BY	–	SB	–	
1	2000-12-12	ISSUED FOR CONSTRUCTION	DG	JM	TZ	JM	BJK	HB
0	2000-03-03	ISSUED FOR DESIGN	JM	AKG		AKG	BJK	
C	1999-12-15	RE–ISSUED FOR APPROVAL	JM	AKG		AKG	BJK	
B	1999-05-13	ISSUED FOR APPROVAL	JM	AKG	AKG	BJK		
A	1999-03-16	ISSUED FOR REVIEW	TZ	JM	AGK	BJK		

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BANTREL Inc.
PERMIT NUMBER: P 3913
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT
BANTREL Inc. CALGARY, ALBERTA Job No. 757

UTILITY FLOW DIAGRAM
COOLING WATER DISTRIBUTION

SCALE: NONE
SHELL DWG NO.: 252.0001.000.040.002 REV. 4

CAD FILE 252.0001.000.040.002.DWG BANTREL 757

1st & 2nd STAGE FLARE

CLARIFIED WATER PUMPHOUSE

WASTE WATER TREATING UNIT

A & V
- ATMOSPHERIC UNIT
- VACUUM UNIT

COOLING TOWER

TANKAGE & OFFSITES

RAW WATER

UTILITIES
- UTILITY AIR SUPPLY 253.0001.000.040.001
- INSTRUMENT AIR SUPPLY 253.0001.000.040.001
- UNIT 250 –COGENERATION
- UNIT 251 –STEAM/BFW/CONDENSATE
- UNIT 253 –AIR COMPRESSION
- UNIT 254 –FUEL GAS/NATURAL GAS

RHC COMPLEX
- RHC #1
- HTU #1
- STABILIZER
- RHC #2
- HTU #2
- STRIPPER

INSTRUMENT AIR
UTILITY AIR
QUEST CCS

SULPHUR COMPLEX
- ARU
- SRU #1
- SWS
- SRU #2

CRUDE BLENDING

SULPHUR LOADING

SOUR WATER TANK

HYDROGEN MANUFACTURING UNIT
- HMU #1
- HMU #2

VAPOUR COMBUSTION

ACID FLARE

HYDROGEN COMPRESSION FACILITY

SCOTFORD REFINERY

NOTE 4

(NOTE 2)

NOTE 4

CSC (NOTE 3) CSC

FI

FI

PI

NOTES

1. ALL PRESSURES ARE MEASURED AT GRADE AND ARE INDICATIVE ONLY.
2. SULPHUR COMPLEX INSTRUMENT/UTILITY AIR TO BE SUPPLIED FROM PORTABLE COMPRESSORS FOR EARLY SCOTFORD MODS OPERATION.
3. INSTRUMENT/UTILITY AIR HEADER ISOLATION VALVE BETWEEN UPGRADER AND REFINERY NORMALLY CLOSED.
4. ISOLATION VALVES REQUIRED FOR EARLY SCOTFORD MODS OPERATION/ UPGRADER SHUTDOWN, OTHERWISE NORMALLY OPEN.
5. FOR MATERIAL BALANCE REFER TO DS–253–B–0102
6. DRAWING REVISED TO MATCH LATEST PLOT PLAN AND PIPING LAYOUT AND TO INCLUDE THE HYDROGEN COMPRESSION FACILITY.

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP.
5	2013-09-30	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF	KH	CV	
4B	2013-01-10	ISSUED FOR CONSTRUCTION	GB	KB		KH	CV	
4A	2011-11-03	RE-ISSUED FOR QUEST DESIGN	GB	SM	MB	JI	CV	MD/SB
4	2011-11-03	ISSUED FOR QUEST DESIGN	JH	SM	MB	JI	CV	MD/SB
3A		ISSUED FOR QUEST REVIEW						
3	2002-11-29	ISSUED FOR AS-BUILT	HC	BY	–	SB	–	
2	2000-12-12	ISSUED FOR CONSTRUCTION	MAC	JM	TZ	JM	BJK	HB
1	2000-04-27	RE-ISSUED FOR DESIGN	JM	AKG		AKG	BJK	
0	1999-11-11	ISSUED FOR DESIGN	MP	JM	AKG	BJK		
B	1999-05-13	ISSUED FOR APPROVAL	JM	AKG	AKG	BJK		
A	1999-03-23	ISSUED FOR REVIEW	TZ	JM	AKG	BJK		

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SHELL CANADA LTD.
ATHABASCA OIL SANDS DOWNSTREAM PROJECT

BANTREL Inc. CALGARY, ALBERTA Job No. 757

UTILITY FLOW DIAGRAM UTILITY & INSTRUMENT AIR DISTRIBUTION

SCALE: NONE

SHELL DWG NO.: 253.0001.000.040.002 REV. 5

CAD FILE 253.0001.000.040.002.DWG BANTREL 757

E-44005
NITROGEN RECYCLE COMPRESSOR COOLER
Duty (MW) = 0.224
(UNIT S/U)

V-44004
NITROGEN RECYCLE COMPRESSOR KNOCKOUT DRUM
914 mm ID x 2300 mm T/T
(UNIT S/U)

C-44002
N2 RECYCLE COMPRESSOR
Cap. 15198 m3(st)/hr
Pss 800 kPa (ga)
Pds 1200 kPa (ga)
Driver 335 kW
(UNIT S/U)

E-44001
NATURAL GAS PREHEATER
Duty (MW) = 2.31/1.88
HOLD

S-44006
E-44001 CONDENSATE LIFTER
Cap. 6.5 m3/h

LP STEAM B.L.

C1 FLOW CALCULATION 441-001

C1 FLOW CALCULATION 441-001

FUEL GAS MIX DRUM B.L.

CHEMICAL FEED B.L.
FROM RHC/IHT

HYDROGEN B.L.
(NOTE 4)

C1 FLOW CALCULATION 441-001

HP NATURAL GAS B.L.

82 / 82 — 16022 / 16022 (4) — 5144 / 5144 — 16173 / 16174 (4)

PC — FC — FC — PC — FT

5 / 5 — 29273 / 29360 (4) — 4900 / 4900 — 40403 / 40581 (4)

NC

26

160 / 160

4812 / 3271

435 / 435

FC

AI (NOTE 1)

TC

E-44001

105 / 105 — 45295 / 45382 (4) — 4210 / 4231 (4)

4

MIXED FEED 441-003 TO E-44116

136 / 136

27

4812 / 3218 (4) — 354 / 354

CONDENSATE LIFTER
S-44006

STEAM CONDENSATE 440-011 TO V-44007
(NOTE 3)

E-44005

CWR — CWS

FC

TT — FT — PT — PT — TT — HC

NITROGEN RECYCLE 441-004
FROM V-44106
NNF

NC

V-44004

C-44002

DO

NITROGEN MAKE-UP B.L.
NNF

NOTES:

1. COMPLETE ANALYSIS TO DETERMINE EQUIVALENT C1 BY COMMON ANALYZER.
2. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.
   CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.
   CASE #21: FLUE GAS RECYCLE ONLINE AT 100%. (4)
3. CONDENSATE DRUM & PUMPS ARE SHOWN ON UFD, DWG. # 440.0001.000.040.011
4. HYDROGENATION GAS STREAM IS SUPPLIED FROM RECYCLE/PURGE LINE FROM BASE PLANT RHC/IHT.

REFERENCE

STREAM NUMBER

(4)

TEMPERATURE – CHECK CASE V REV 2 (°C)
TEMPERATURE – CASE #21 (°C)

PRESSURE – CHECK CASE V REV 2 (kPa-a)
PRESSURE – CASE #21 (kPa-a)

FLOW – CHECK CASE V REV 2 (kg/Hr)
FLOW – CASE #21 (kg/Hr)

Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	13.30.09	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	12.21.12	ISSUED FOR CONSTRUCTION	GB	KB			KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN	JH	SM	SM		JI	CV	MD/SB
3A	03.04.11	RE-ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
3	10.25.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10

BECHTEL

M5-IH-440001

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 440
FEED INTAKE

SCALE: NONE

SHELL DWG NO.: 440.0001.000.040.001 REV. 4

BORDER NAME: HMJ_A1PDF_Shell.DWG

440.0001.000.040.001.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\440-REV-2\440.0001.000.040.001.DWG;MODEL DATE: 04-23-2007, 8:35am BAOF

S-44109
EXPORT STEAM SILENCER
Cap: 120000 kg/hr EXPORT STEAM

VA

DO

S-44109

PC

SUPERHEATED
HP-STEAM EXPORT
B.L.

39

4 400 400 160677 158898 4600 4600

30

4 400 401 177360 178457 4730 4730

SUPERHEATED
HP STEAM
441-002
FROM E-44110

7

4 16682 19559

SULPHUR
PLANT STEAM
B.L.

9

4 255 255 48200 47600 4250 4250

HC

PC

25

4 284 287 64882 67159 4180 4049 4

FEED/STEAM MIXING
441-001

NOTES:

1. STEAM CONDENSATE RATES BASED ON HEATING REQUIREMENT FOR 5°C AIR AND 5°C HP NATURAL GAS.
2. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.

CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.

CASE #21: FLUE GAS RECYCLE ONLINE AT 100% 4

REFERENCE

STREAM NUMBER 4

TEMPERATURE – CHECK CASE V REV 2 (°C)
TEMPERATURE – CASE #21 (°C)

PRESSURE – CHECK CASE V REV 2 (kPa-a)
PRESSURE – CASE #21 (kPa-a)

FLOW – CHECK CASE V REV 2 (kg/Hr)
FLOW – CASE #21 (kg/Hr)

Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	09.20.13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	12.21.12	ISSUED FOR CONSTRUCTION	GB	KB			KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM		JI	CV	MD/SB
3A	03.04.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS		JI	CV	MD/SB
3	11.03.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10

BECHTEL

M5-IH-440002

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 440
STEAM AND COND.

SCALE: NONE

SHELL DWG NO.: 440.0001.000.040.002 REV. 4

BORDER NAME: HMU_A1PDF_Shell.DWG

440.0001.000.040.002.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\440-REV-2\440.0001.000.040.002.DWG:MODEL DATE: 04-16-2007, 12:54pm BAOF

TAG NO. PV-441067
SERVICE: V-44119
SIZE: 6"
SET PRESS: N/A

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
13	57.158	35	11.05	131

TAG NO. RV-441023
SERVICE: V-44118
SIZE: 1-1/2F2
SET PRESS: 3500 kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	5.370	177	33.9	164
10	6.553	177		

CONVENTIONAL

10" 10" 6"

3

TAG NO. RV-443115 (NOTE 8)
SERVICE: S-44301
SIZE: 8T10
SET PRESS: 700kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
6	124816	35	10.9	344
10	146254			

PILOT

TAG NO. RV-443129 (NOTE 8)
SERVICE: S-44301
SIZE: 8T10
SET PRESS: 700kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
6	124816	35	10.9	335
10	146254			

PILOT

TAG NO. PV-443398
SERVICE: HMU PSA UNIT
SIZE: 8"
SET PRESS: N/A

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
11	15141	40	2.04	

15" 16" 10" 3" 8"

TAG NO. RV-443032
SERVICE: HYDROGEN
SIZE: 1D2
SET PRESS: 3400kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	112	182	2.04	51
10	632	150		

CONVENTIONAL

TAG NO. RV-443101 THRU RV-443112
SERVICE: V-44301 THRU V-44312
SIZE: 1.5F2 (TYP. OF 12)
SET PRESS: 3400 kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	3850	154	25.8	150
10	5188			

CONVENTIONAL

TAG NO. RV-443116 (NOTE 8)
SERVICE: S-44301
SIZE: 8T10
SET PRESS: 735kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
6	124816	35	10.9	331
10	146254			

PILOT

16"

TAG NO. PV-443161
SERVICE: HMU PSA TG
SIZE: 16"
SET PRESS: N/A

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
13	27593	27	27.8	

16"

TAG NO. PV-441376
SERVICE: H2 RAW GAS
SIZE: 16"
SET PRESS: N/A

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
11	118370	35	11	

TAG NO. RV-441375B (NOTE 2)
SERVICE:
SIZE: 6R8
SET PRESS: 3400kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
1	160050	171	12.30	632
3	146780	158	12.05	619
4	114158	65	11.01	578
6	113455	35	10.98	575
7	2604	253	18.02	337
10	168748	185		

PILOT

TAG NO. RV-441375A (NOTE 2)
SERVICE: COOLING TRAIN EQUIPMENT
SIZE: 6R8
SET PRESS: 3400kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
1	160050	171	12.30	632
3	146780	158	12.05	619
4	114158	65	11.01	578
6	113455	35	10.98	575
7	2604	253	18.02	337
10	168748	185		

PILOT

20" 20" 20" 20"

440-003

24"X20" 20"

6" 6" 6" 10"

TAG NO. RV-441017A
SERVICE: V-44102A
SIZE: 1.5F2
SET PRESS: 4,800kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	2849	647	16.7	288
10	4097	410		

CONVENTIONAL

TAG NO. HV-441053
SERVICE: FD GAS STARTUP TO FLARE
SIZE: 8"
SET PRESS: N/A

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
11	14980	365	16.7	

TAG NO. RV-441017B
SERVICE: V-44102B
SIZE: 1.5F2
SET PRESS: 4,800kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	2849	647	16.7	288
10	4097	410		

CONVENTIONAL

TAG NO. RV-441016
SERVICE: V-44101
SIZE: 1.5F2
SET PRESS: 4,800kPag

CASE	FLOW Kg/hr	TEMP °C	MW	BACK PRES. kPag
7	3043	640	16.7	283
10	4110	410		

CONVENTIONAL

NOTES

1. RELIEF CASES:
   1. SITE WIDE POWER FAILURE
   2. UNIT WIDE POWER FAILURE
   3. SINGLE POWER FAILURE
   4. COOLING WATER FAILURE
   5. INSTRUMENT AIR FAILURE
   6. BLOCKED OUTLET
   7. FIRE
   8. SPLIT EXCHANGER TUBE
   9. AUTO CONTROL FAILURE
   10. RATED CAPACITY OF RV AND DESIGN TEMPERATURE
   11. DEPRESSURING
   12. REVERSE FLOW
   13. VENTING.
2. ONE OPERATING AND ONE SPARE.
3. SEE RELIEF VALVE NARRATIVES FOR EXPLANATION OF PARTICULAR RELIEF CASES.
4. PER DEP 80.45.10.10-SCAN, SECTION 4.5, THE MAX ALLOWABLE VELOCITY IN THE MAIN RELIEF HEADER SHALL BE LIMITED TO 0.5 MACH, AND UP TO 0.7 MACH IN SUBHEADERS AND RV TAILPIPES UNLESS OTHERWISE NOTED.
5. BACK PRESSURES ARE CALCULATED BASED ON A 48" DIAMETER MAIN OSBL HEADER, USING PRELIMINARY EQUIVALENT PIPING LENGTHS AND PRELIMINARY RELIEF LOAD ESTIMATES FOR RHC AND A&V (GLOBAL CASES 1, 4 AND 5).
6. DELETED.
7. DELETED.
8. THE REQUIRED RATE SHOWN IS FOR RV-443115 AND RV-443116 COMBINED. RV-443129 IS A COMMON SPARE.

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHD	PRS	CS	PDP	MC	APE	PEM	CLIENT APP
3	2013/05/30	RE-ISSUED IFC ON NEXT HARD REV									
2A	2013/01/09	ISSUED FOR CONSTRUCTION	GB	KB					KH	CV	
2	2011/08/31	ISSUED FOR QUEST DESIGN	GB	SM	KH				JI	CV	MD/SB
1	2010/05/11	ISSUED FOR DESIGN	XC	CAC	DM						
0	08/02/14	ISSUED FOR DESIGN	PP	CJC	HC						
A	06/15/06	ISSUED FOR APPROVAL	CWR	RAT	MPC						

SHELL CANADA ENERGY
SCOTFORD UPGRADER EXPANSION 1

BANTREL
APEGGA PERMIT: P 3913

Job No. 25183

RELIEF & DEPRESSURING FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1 PROJECT
HMU – UNITS 440, 441, 443

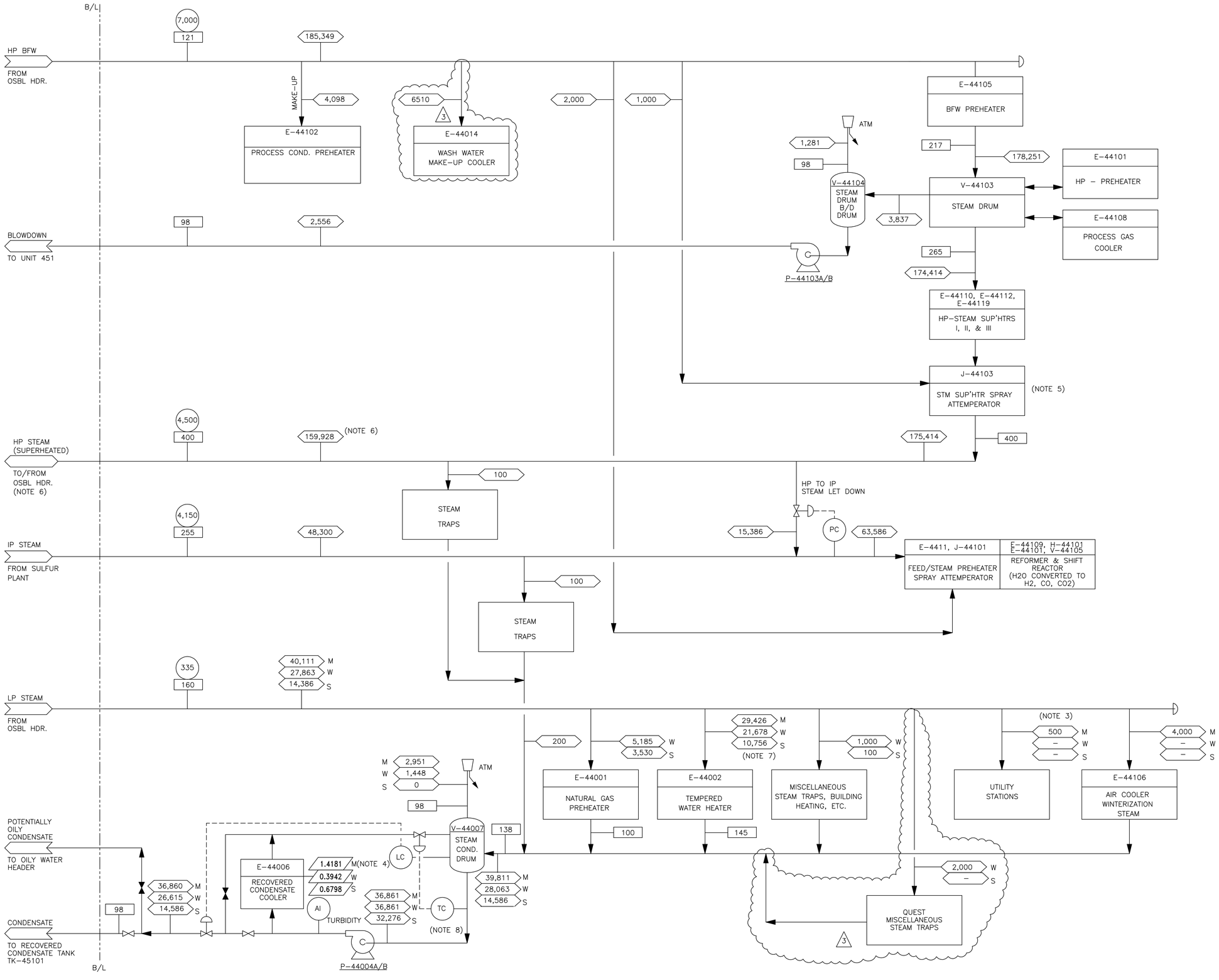
SCALE: NONE

SHELL DWG NO.: 440.0001.000.040.004 REV. 3

BANTREL File: W:\1010\PIPING\HMU\UNIT-440\REV-0\440.0001.000.040.004_REV1 11/05/2010 9:44am KAMINSKIM

440.0001.000.040.004_REV1.DWG

FILE: T:\1010\PIPING\HMU\UNIT-440\REV-0\440.0001.000.040.004.DWG\MODEL DATE: 02-07-2008, 10:24am PANESARB



NOTES:

1. THE CONFIGURATION OF THE DRAWING DOES NOT REPRESENT GEOGRAPHICAL LAYOUT.
2. DELETED.
3. NOT MORE THAN TWO UTILITY STATIONS ARE OPERATING AT ANY TIME IN THE HMU AREA. NORMALLY NO FLOW.
4. MAXIMUM EXCHANGER DUTY IS BASED ON COOLING ALL THE CONDENSATE FROM V-44007 TO 65°C AND ROUTING IT TO OILY WATER HEADER.
5. J-44102 AND J-44104, NORMALLY NO FLOW. NEEDED ONLY FOR THE 200 T/H HP STEAM PRODUCTION CASE (ELIMINATED FROM THE DESIGN SCOPE).
6. NORMAL EXPORT FLOW. AT START-UP HP STEAM IS IMPORTED.
7. WINTER STEAM CONSUMPTION RATE IS BASED ON HEATING AIR FROM -43°C TO 80°C. SUMMER STEAM CONSUMPTION RATE IS BASED ON HEATING AIR FROM 19°C TO 80°C.
8. HI LEVEL IN V-44007 OVERRIDES TC.
9. MATERIAL BALANCE TO BE UPDATED FOR UHDE INPUT FOR QUEST OPERATION. 3

LEGEND

- ▭ – TEMPERATURE, °C.
- ◯ – PRESSURE, kPag.
- ⬭ – FLOW, Kg/hr
- ▱ – DUTY, MW
- W – WINTER
- S – SUMMER
- M – MAXIMUM

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CKD	PRS	CS	PDP	MC	APE	PEM	CLIENT APP
3	09/30/13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC		LMF			KH	CV	
2B	01/10/13	ISSUED FOR CONSTRUCTION	GB	KB					KH	CV	
2A	03/01/11	RE-ISSUED FOR QUEST DESIGN	GB	SM	MB				JI	CV	MD/SB
2	11/03/10	REISSUED FOR DESIGN	GB	SM	MB				JI	CV	MD/SB
1	05/10/06	REISSUED FOR DESIGN	HG	RCD	CJK				JT	RSN	
0	11/21/05	ISSUED FOR DESIGN	RAT	PAN	CJK				JT	RSN	
A	9/30/05	ISSUED FOR APPROVAL	GM	PAN	CJK				JT	RN	

SHELL CANADA LTD.
AOSP - DOWNSTREAM EXPANSION PROJECT

BECHTEL Job No. 25183-C10

UTILITY FLOW DIAGRAM
AOSP DOWNSTREAM EXPANSION PROJECT
HYDROGEN MANUFACTURING UNIT
STEAM/CONDENSATE/BFW

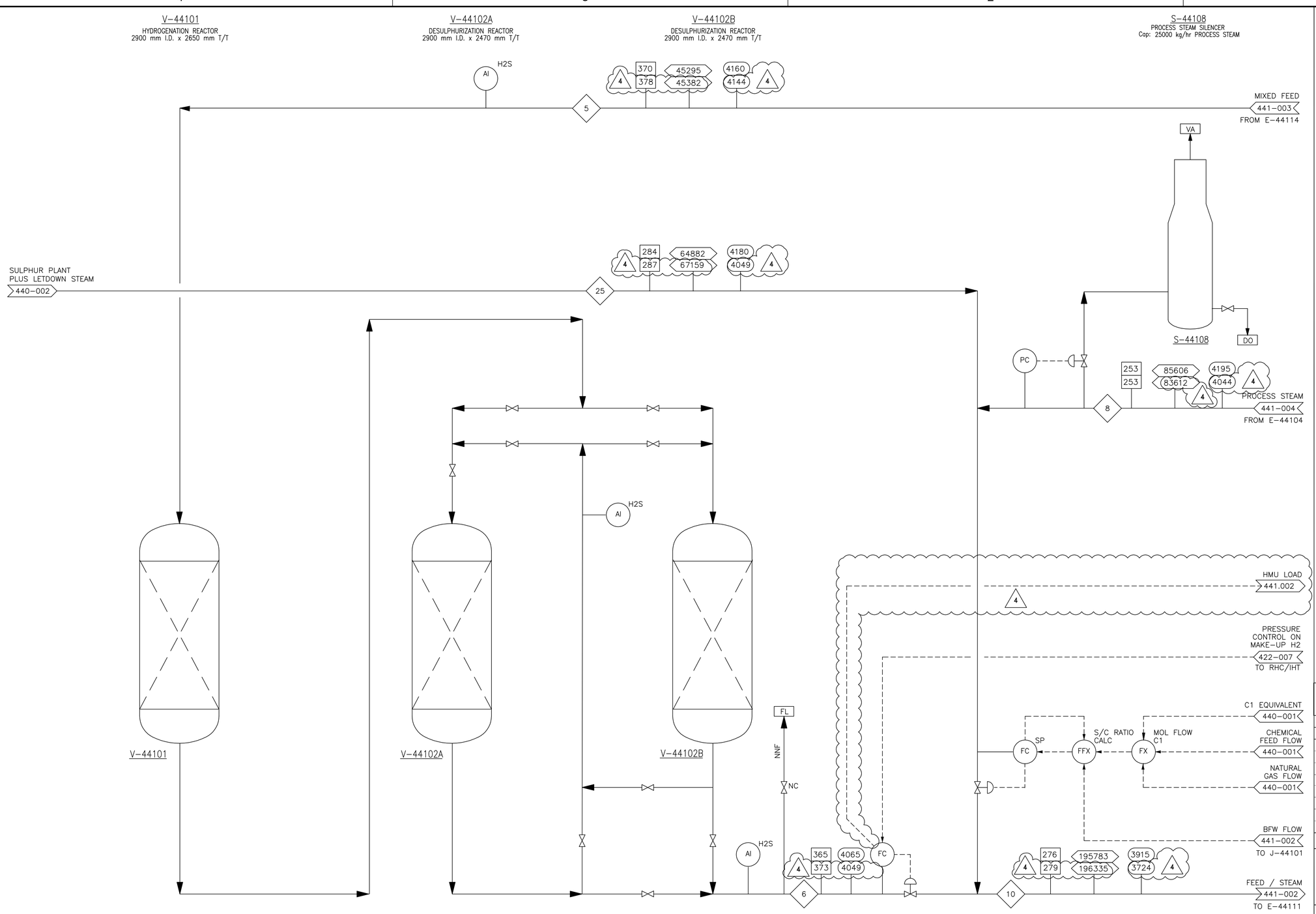
SCALE: NONE

SHELL DWG NO.: 440.0001.000.040.011 REV. 3

440.0001.000.040.011.DWG

FILE: \\HOUS2010\AOSP_PENG-CADD\HM UNIT\PFD'S\UNIT 440\440.0001.000.040.011.DWG MODEL DATE: 05-10-2006, 11:01am ARAMOS1

A1PFD_Shell.dwg



NOTES:

1. HYDROGEN HEADER PRESSURE AT RHC/IHT WILL AUTOMATICALLY ADJUST HMU PRODUCTION.
2. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.

CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.

CASE #21: FLUE GAS RECYCLE ONLINE AT 100%

REFERENCE

STREAM NUMBER

TEMPERATURE – CHECK CASE V REV 2 (°C)
TEMPERATURE – CASE #21 (°C)

PRESSURE – CHECK CASE V REV 2 (kPa-a)
PRESSURE – CASE #21 (kPa-a)

FLOW – CHECK CASE V REV 2 (kg/Hr)
FLOW – CASE #21 (kg/Hr)

Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	09.30.13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	12.21.12	ISSUED FOR CONSTRUCTION	GB	KB	LMF		KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN.	GB	SM	BS		JI	CV	MD/SB
3A	03.04.11	RE-ISSUED FOR QUEST DESIGN.	GB	SM	BS		JI	CV	MD/SB
3	11.03.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10

BECHTEL

M5-IH-441001

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 441
FEED GAS DESULPHURIZATION

SCALE: NONE

SHELL DWG NO.: 441.0001.000.040.001 REV. 4

BORDER NAME: HM_A1PDF_Shell.DWG

441.0001.000.040.001.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\441-REV-2\441.0001.000.040.001.DWG:MODEL DATE: 04-16-2007, 1:06pm BAOF

H-44101
STEAM REFORMER
Absorbed Duty (MW): 158.38 / 146.44
NOTE 3

J-44101
FEED/STEAM PREHEATER
SPRAY ATTEMPERATOR
Cap. (kg/h): 8001/500

J-44102
STEAM SUPERHEATER
SPRAY ATTEMPERATOR I
Cap. (kg/h): 0/0

J-44103
STEAM SUPERHEATER
SPRAY ATTEMPERATOR II
Cap. (kg/h): 1200/500

J-44104
STEAM SUPERHEATER
SPRAY ATTEMPERATOR III
Cap. (kg/h): 0/110

E-44101
PROCESS GAS COOLER
Duty (MW): 77.21 / 78.61

V-44103
STEAM DRUM
2200 mm I.D. x 10100 mm T/T

P-44103 A/B
STEAM DRUM BLOWDOWN
DRUM PUMPS
CAP.: 11.3 M^3/HR
DIFF.: 409.5 KPa
DRIVER: 7.5 KW

H-44102
CONVECTION BANK

COIL	DESIGNATION	Duty (MW)
E-44108	HP-STEAM GENERATOR	13.94 / 13.94
E-44109	FEED/STEAM PREHEATER II	9.29 / 8.39
E-44110	HP-STEAM SUPERHEATER III	9.57 / 9.70
E-44111	FEED/STEAM PREHEATER I	28.68 / 28.96
E-44119	HP-STEAM SUPERHEATER II	12.30 / 11.50

V-44104
STEAM DRUM BLOWDOWN DRUM
650mm I.D. x 2950mm T/T

SUPERHEATED HP STEAM 440-002
HMU PSA OFFGAS 443-001 FROM S-44301
HC PSA TAIL GAS 443-003 FROM S-44320
FUEL GAS B.L.
FEED/STEAM 441-001 FROM V-44102 A/B
STEAM/CARBON RATIO CONTROLLER 441-001
BFW MAKE-UP FLOW CONTROLLER 441-004
BOILER FEED WATER 441-004 FROM E-44105
COMBUSTION AIR 441-003 FROM E-44113
SATURATED HP STEAM 441-003 TO E-44112
SH HP STEAM 441-003 FROM E-44112
INJECTION BOILER FEED WATER 441-004
ID FAN DAMPER 441-003 CONTROLLER
REFORMED GAS 441-004 TO V-44105
BLOW DOWN B.L. TO UNIT 451

(NOTE 1)

NOTES:

1. PROCESS SIDE TEMPERATURE IS CONTROLLED, WITH CHANGES IN FLUE GAS TEMPERATURE USED TO INITIATE TAIL GAS AND/OR FUEL GAS FLOW CHANGES TO MINIMIZE DEVIATIONS IN THE PROCESS TEMPERATURE.
2. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.
   CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.
   CASE #21: FLUE GAS RECYCLE ONLINE AT 100%.
3. EXISTING BURNER LANCES TO BE REPLACED WITH LANEMARK LOW NOX BURNERS.

REFERENCE

- STREAM NUMBER
- TEMPERATURE – CHECK CASE V REV 2 (°C)
  TEMPERATURE – CASE #21 (°C)
- PRESSURE – CHECK CASE V REV 2 (kPa-a)
  PRESSURE – CASE #21 (kPa-a)
- FLOW – CHECK CASE V REV 2 (kg/Hr)
  FLOW – CASE #21 (kg/Hr)
- Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	09.30.13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	12.21.12	ISSUED FOR CONSTRUCTION	GB	KB			KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM		JI	CV	MD/SB
3A	03.04.11	RE-ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
3	11.03.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10
BECHTEL
M5-IH-441002

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 441
STEAM REFORMING

SCALE: NONE
SHELL DWG NO.: 441.0001.000.040.002 REV. 4

BORDER NAME: HM_A1P0F_Shell.DWG
441.0001.000.040.002.DWG
FILE: T:\1010\PIPING\HMU\HMU_PFDS\441-REV-2\441.0001.000.040.002.DWG:MODEL DATE: 04-16-2007, 1:28pm BAOF

H-44102
CONVECTION BANK

COIL	DESIGNATION	Duty (MW)
E-44112	HP-STEAM SUPERHEATER I	0 / 0.25
E-44113	COMBUSTION AIR PREHEATER II	20.13 / 21.74
E-44114	FEED PREHEATER II	10.52 / 10.04
E-44115	PROCESS CONDENSATE PARTIAL EVAPORATOR	30.29 / 31.10
E-44116	FEED PREHEATER I	0 / 0
E-44117	COMBUSTION AIR HEATER I	10.64 / 10.79

C-44101
FORCED DRAFT (COMBUSTION AIR) FAN
Cap. 291346 m3(st)/hr
Diff 3.32 kPa
Driver 1250 kW

C-44102
INDUCED DRAFT (FLUE GAS) FAN
Cap. 392557 Nm3/hr
Diff 6.4 kPa
Driver 2680 kW

S-44104
FLUE GAS SILENCER

S-44103
STACK
4500 mm I.D. x 55 m

C-44105
FLUE GAS RECIRCULATION FAN
Cap. 53926 Nm3/h
Diff 4.63 kPa
Driver 149 kW

E-44121A/B
COMBUSTION AIR PREHEATER - I
DUTY(MW): 6.62 / 5.0

E-44122A/B
COMBUSTION AIR PREHEATER - II
DUTY(MW): 10.37 / 6.85

S-44101
COMBUSTION AIR SILENCER

MIXED FEED
440-001
FROM E-44001

MIXED FEED
441-001
TO V-44101

SATURATED HP STEAM
441-002
FROM V-44103

COMBUSTION AIR
441-002
TO H-44101

TEMPERED WATER
440-012
NOTE 6

MASTER HMU LOAD CONTROLLER
441-001

CAPTURED CO2 FEEDFORWARD
441-005

AIR INTAKE

NOTE 7

NOTE 8

SH HP STEAM
441-002
TO J-44102

TEMPERED WATER
440-012
TO V-44005
NOTE 6

PROCESS CONDENSATE
441-004
FROM E-44102

PART. EVAPORATED PROCESS CONDENSATE
441-004
TO V-44109

H-44101
PRESSURE CONTROLLER
441-002

E-44113 E-44112 E-44114 E-44115 E-44116 E-44117 C-44101 E-44122A/B C-44105 S-44104 C-44102 E-44121A/B S-44103 S-44101

NOTES:

1. PROCESS SIDE TEMPERATURE IS CONTROLLED, WITH CHANGES IN FLUE GAS TEMPERATURE USED TO INITIATE NATURAL GAS FLOW CHANGES TO MINIMIZE DEVIATIONS IN THE PROCESS TEMPERATURE.
2. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.
   CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.
   CASE #21: FLUE GAS RECYCLE ONLINE AT 100%
3. DELETED.
4. DELETED.
5. DELETED.
6. TEMPERED WATER SYSTEM IS SHOWN ON UFD DWG. # 440.0001.000.040.012.
7. FLOW CONTROL ON COMBUSTION AIR WITH TRIM FROM EXCESS O2 AT BURNER OUTLET.
8. FLUE GAS RECIRCULATION FAN CONTROLLED BY TOTAL CONVECTION SECTION FLOW WITH FEEDFORWARD FROM CO2 CAPTURED.

REFERENCE

- STREAM NUMBER
- TEMPERATURE - CHECK CASE V REV 2 (°C)
  TEMPERATURE - CASE #21 (°C)
- PRESSURE - CHECK CASE V REV 2 (kPa-a)
  PRESSURE - CASE #21 (kPa-a)
- FLOW - CHECK CASE V REV 2 (kg/Hr)
  FLOW - CASE #21 (kg/Hr)
- Std. VOL. FLOW - CHECK CASE V REV 2 (m^3 (st)/hr)
  Std. VOL. FLOW - CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	09.30.13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	01.08.13	ISSUED FOR CONSTRUCTION	GB	KB	LMF		KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM		JI	CV	MD/SB
3A	03.04.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS		JI	CV	MD/SB
3	11.03.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10
BECHTEL
M5-IH-441003

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING - UNIT 441
STEAM REFORMING

SCALE: NONE

SHELL DWG NO.: 441.0001.000.040.003 REV. 4

BORDER NAME: HMU_A1PDF_Shell.DWG

441.0001.000.040.003.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\441-REV-2\441.0001.000.040.003.DWG:MODEL DATE: 04-16-2007, 2:21pm BAOF

V-44105
HT-SHIFT CONVERTER
4300 mm I.D. x 2340 mm T/T

V-44109
PROCESS STEAM SEPARATOR
1250 mm I.D. x 2100 mm T/T

E-44104
PROCESS CONDENSATE EVAPORATOR
Duty (MW): 19.09 / 19.88

E-44105
BFW PREHEATER
Duty (MW): 21.04 / 21.09

E-44120
BLOWDOWN COOLER
Duty (MW): 0.108 / 0

E-44102
PROCESS CONDENSATE PREHEATER
Duty (MW): 7.48 / 7.61

V-44108
HOT PROCESS CONDESATE SEPERATOR
3050 mm I.D. x 5150 mm T/T

E-44106
AIR COOLER
Duty (MW): 48.67 / 49.05

E-44107
FINAL COOLER
Duty (MW): 3.81 / 3.82

P-44101 A/B
PROCESS CONDENSATE PUMPS
CAP.: 93.6 M^3/HR
DIFF.: 1684 KPa
DRIVER: 112 KW

V-44106
PROCESS CONDENSATE SEPARATOR
2400 mm I.D. x 5800 mm T/T

V-44111
PROCESS STEAM BLOWDOWN DRUM
1370 mm I.D. x 4975 mm T/T

PROCESS CONDENSATE
441-003
TO E-44115

STEAM DRUM LC
441-002

BOILER FEED WATER
441-002
TO V-44103

PROCESS STEAM
441-001

PART. EVAPORATED PROCESS COND
441-003
FROM E-44115

BOILER FEED WATER
441-002
TO SPRAY ATTEMPERATORS

HP BOILER FEED WATER MAKE-UP
B.L.

REFORMED GAS
441-002
FROM E-44101

H2 RAW GAS FLOW
441-005

H2 RAW GAS
441-005
TO V-44118

H2 RAW GAS
441-005
FROM V-44119

H2 RAW GAS
443-001
TO S-44301

QUEST WASTE WATER
441-005
FROM P-44108A/B

NNF
N2 RECYCLE
440-001
TO V-44004

UTILITY WATER
B.L.

P-44101 A/B
(NOTE 3)

E-44106
(NOTE 2)

NOTE 4

NOTE 5

COMP

CWR

CWS

DO

NNF

NOTES:

1. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.
   CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.
   CASE #21: FLUE GAS RECYCLE ONLINE AT 100% LOAD.
2. 100% VFD; SHELL CANADA "TYPE III" WINTERIZATION
3. START-UP NOTE: ENSURE THAT THE INTERNAL IP STEAM HEADER PRESSURE CAN BE REDUCED SUCH THAT THE PROCESS COND. STEAM RECYCLE AT NORMAL PUMP DIFFERENTIAL HEAD IS NOT OBSTRUCTED.
4. UTILITY WATER IS NNF. UTILTITY WATER IS ONLY REQUIRED DURING STARTUP WHEN 20000 kg/hr IS BLOWN DOWN FROM E-44104 AND THERE IS NO BLOWDOWN FORM V-44106.
5. INCLUDES PURGE WATER FROM QUEST ABSORBER BLOCK.

REFERENCE

STREAM NUMBER

TEMPERATURE – CHECK CASE V REV 2 (°C)
TEMPERATURE – CASE #21 (°C)

PRESSURE – CHECK CASE V REV 2 (kPa-a)
PRESSURE – CASE #21 (kPa-a)

FLOW – CHECK CASE V REV 2 (kg/Hr)
FLOW – CASE #21 (kg/Hr)

Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

ISSUED FOR CONSTRUCTION
21 Oct 2013

FLUOR. FLUOR'S RESPONSIBILITY IS LIMITED TO THE REVISION CONTENT SHOWN IN THIS DOCUMENT.

REV	ISSUED DATE	DESCRIPTION	BY	CHKD	PL	EGA	APE	PEM	CLINT APPR
4	09.31.13	RE-ISSUED IFC ON NEXT HARD REV	GB	CC	LMF		KH	CV	
3C	01.08.13	ISSUED FOR CONSTRUCTION	GB	KB	LMF		KH	CV	
3B	08.31.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	SM		JI	CV	MD/SB
3A	01.03.11	RE-ISSUED FOR QUEST DESIGN	GB	SM	BS		JI	CV	MD/SB
3	11.03.10	ISSUED FOR QUEST DESIGN	JH	SM	BS		JI	CV	MD/SB
2A	08.24.10	ISSUED FOR QUEST COARSE HAZOP	JH						
2	04.17.07	ISSUED FOR DESIGN	PD	HG	RCD	RCD	PG	PB	
1	06.15.06	ISSUED FOR DESIGN	RCD	HG		CJK	JT	RN	
0	10.19.05	ISSUED FOR DESIGN	RCD	GM	PAN	CJK	JT	RN	
A	09.01.05	ISSUED FOR APPROVAL	RCD	GM	PAN	CJK	JT	RN	

SHELL CANADA ENERGY

JOB No: 25183-C10

BECHTEL

M5-IH-441004

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 441
CO-CONVERSION COOLING TRAIN

SCALE: NONE

SHELL DWG NO.: 441.0001.000.040.004

REV. 4

BORDER NAME: HMU_A1PDF_Shell.DWG

441.0001.000.040.004.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\441-REV-2\441.0001.000.040.004.DWG;MODEL DATE: 04-23-2007, 8:38am BAOF

E-44014
WASH WATER MAKE-UP COOLER
DUTY: 0.70 MW

V-44118
AMINE ABSORBER 3
4270 mm ID X 23500 mm T/T

V-44119
ABSORBER 3
WASH WATER VESSEL
2100 mm ID X 10700 mm T/T
NOTE 4

E-44129
ABSORBER 3
CIRCULATING WATER COOLER
0.31 MW
NOTE 4

H2 RAW GAS FLOW 441.004

NOTE 6

CAPTURED CO2 FEEDFORWARD 441.003

FX

NNF

START-UP

FLARE

COMP

FX

PC

PT SP FT TI

35 2934

50,458

3C

HY

H2 RAW GAS 441.004 TO HMU3 PSA S-44301

START-UP NOTE 7

HV

NOTE 2

CWR

BOILER FEED WATER 440.011 FROM HEADER

25

FC

E-44014 NOTE 3

CWS

35

23C

9 7 6 1

FC

22C

33

NOTE 4 32 2961

LC

V-44119

VFD

SP

CWR

2C

20C

NOTE 4 38

21C

P-44108A/B NOTE 4

E-44129 NOTE 3,4

CWS

LEVEL SIGNAL 246.001

24C

28

PURGE WATER 441.004 TO V-44111

LEAN AMINE 246.002 FROM P-24602A/B/C

4C

30

FC

25

1

H2 RAW GAS 441.004 FROM HMU3 V-44106

1C

35 3004

114,312

HV

START-UP NOTE 7

GI NOTE 5

V-44118

LC

5C

64

SP

RICH AMINE 246.001 TO E-24602A/B

P-44108A/B
ABSORBER 3
CIRCULATING WATER WASH PUMPS
FLOW: 51.4 m3/h
DIF. PRESSURE: 205 kPa
POWER: 2.9 kW

NOTES

1. REFER TO HEAT AND MATERIAL BALANCE, DOCUMENT NUMBER 246.0001.000.046.001, FOR STREAM INFORMATION.
2. FEED GAS BYPASS AROUND HMU3 CO2 CAPTURE TRAIN.
3. COOLING WATER SOURCE IS HMU3 COOLING WATER SYSTEM SOURCE TEMPERATURE IS 25°C FOR DESIGN.
4. WATER WASH SECTION IS DESIGNED FOR A HIGHER TREATED GAS TEMPERATURE OF 39°C FROM THE AMINE ABSORBER.
5. NITROGEN PURGE FOR START-UP.
6. CAPTURED CO2 CALCULATED AND USED AS AN INPUT TO CONTROL THE FLUE GAS RECIRCULATION FAN (C-44105).
7. H2 RAW GAS BYPASS FOR SYSTEM PURGE AND PRESSURIZATION AT START-UP.

LEGEND

XXX — STREAM NUMBER

XXX — TEMPERATURE, °C

XXX — PRESSURE, kPag

XX,XXX — FLOW, kg/h

REV	ISSUED DATE	DESCRIPTION	DWN	CHKD	ENG	APP	APP	CLNT APP
1	12/11/23	ISSUED FOR CONSTRUCTION	GB	KB	LMF	KH	CV	
0B	11/08/31	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0A	11/03/01	RE-ISSUED FOR DESIGN	GB	SM	KH	JI	CV	MD/SB
0	10/11/08	ISSUED FOR DESIGN	JH	QC	KH	JI	CV	MD/SB

ISSUED FOR CONSTRUCTION
07 Feb 2013

SHELL CANADA

FLUOR

PROCESS FLOW DIAGRAM
QUEST CCS PROJECT
HMU3 AMINE ABSORBER

SCALE: NONE | TOE DWG. No.:

SHELL DWG NO.: 441.0001.000.040.005 | REV. 1

FORMAT A1

V-44301-44306
HMU PSA ADSORBERS
3200 mm I.D.x 5920 mm T/T

V-44316
HMU H2 PRODUCT FILTER

V-44307-44312
HMU PSA ADSORBERS
3200 mm I.D.x 5920 mm T/T
NOTE 4
4

S-44301
HMU PSA UNIT

S-44302
HMU PSA SILENCER-I

S-44303
HMU PSA SILENCER-II

V-44315
HMU PSA OFFGAS DRUM
3800 mm I.D.x 30000 mm T/T

S-44301
NOTE 4,5
4

V-44316

H2
CO
CO2
N2
AI

FL

PC

159444
159444

40
40

20

13768
13768

2900
2900

HYDROGEN PRODUCT
TO HYDROGEN HEADER
B.L.

299

HYDROGEN PRODUCT
443-002
FROM S-44320
(HC PSA UNIT)

H2 RAW GAS
441-004
FROM V-44106
19

35
35

114345
50396
4

3035
3030
4

PROD

EQ3/EQ4

EQ1/EQ2

PURGE

V-44301 V-44307 V-44302 V-44308 V-44303 V-44309

V-44304 V-44310 V-44305 V-44311 V-44306 V-44312

HMU PSA OFFGAS
TO H-44101
441-002
21

PC

27
27

110577
36628
4

130
130

FL

FEED BYPASS TO PURGE GAS
(NOTE 2)

PC

NOTE 3

S-44303

NOTE 3

NOTE 3

S-44302

NOTE 3

V-44315

NOTES:

1. DELETED.
2. PSA BYPASS LINE TO BE SIZED FOR 30% OF INLET FLOW.
3. PIPING FROM HMU PSA ADSORBERS OFFGAS HEADER TO HMU PSA SILENCER I & II AND FROM HMU PSA SILENCERS I & II TO HMU PSA OFFGAS DRUM WILL BE PROVIDED BY BECHTEL.
4. MODIFICATIONS TO THE PSA UNIT TO BE DESIGNED BY UOP.
5. LOGIC CHANGES FOR SWITCHING BETWEEN RICH AND LEAN CO2 CASES TO BE DETERMINED.
6. FLOWS AND DUTIES: CHECK CASE V REV 2 / CASE #21.

   CHECK CASE V REV 2: CHEMICAL FEED + NG @105°C, HC PSA TAILGAS MAKE-UP FUEL, STEAM EXPORT OF ~160+/h.

   CASE #21: FLUE GAS RECYCLE ONLINE AT 100%. 4

REFERENCE

- STREAM NUMBER 4
- TEMPERATURE – CHECK CASE V REV 2 (°C)
  TEMPERATURE – CASE #21 (°C)
- PRESSURE – CHECK CASE V REV 2 (kPa-a)
  PRESSURE – CASE #21 (kPa-a)
- FLOW – CHECK CASE V REV 2 (kg/Hr)
  FLOW – CASE #21 (kg/Hr)
- Std. VOL. FLOW – CHECK CASE V REV 2 (m^3 (st)/hr)
  Std. VOL. FLOW – CASE #21 (m^3 (st)/hr)

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21 Oct 2013

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SHELL CANADA ENERGY

JOB No: 25183-C10

BECHTEL

M5-IH-443001

Uhde

PROCESS FLOW DIAGRAM
SCOTFORD UPGRADER EXPANSION 1
HYDROGEN MANUFACTURING – UNIT 443
HMU – H2 PURIFICATION

SCALE: NONE

SHELL DWG NO.: 443.0001.000.040.001 REV. 4

443.0001.000.040.001.DWG

FILE: T:\1010\PIPING\HMU\HMU_PFDS\443-REV-2\443.0001.000.040.001.DWG:MODEL DATE: 04-25-2007, 1:06pm BAOF

BORDER NAME: HM_A1PDF_Shell.DWG