



Lower 48 onshore business Safety Operations Update

BP America Inc. Board of Directors Meeting

May 24, 2018

BPA_HCOR_00299330



Agenda

- Performance Review
- Safety Improvement Plan
- Environmental Commitments

L48 HSE Performance – April 2018 YTD

data through end April 2018



	2017 Full Year	April 2017 YTD	April 2018 YTD
Major Incidents and HiPos			
HiPos - All severity	4	3	1
L48 Managed Personal Safety*			
DAFWC	1	1	0
RI (RIF)	6 (0.53)	5 (1.29)	1 (0.29)
Work hours (millions)	2.3	0.8	0.7
Contractor Managed Personal Safety†			
DAFWC	5	2	0
RI (RIF)	18 (0.75)	6 (0.82)	4 (0.56)
Work hours (millions)	4.8	1.5	1.4
Process Safety			
PSE Tier 1	5	1	1
PSE Tier 2	22	10	5
LOPC (A-G) ¹	122	45	48
Oil Spill > 1 bbl	15	4	4
Fire / Explosion	11	5	1
Well Control Events	10	6	1
Leading Indicators			
Dropped Objects	26	9	9
Drops Frequency (DO/Rigs) ²	2.8	0.83	0.77

HiPo (1)

- Level 2 Well Control Event– Unable to close safety valve when well flowed up tubing; closed blind shear rams to secure the well

RI L48 (1)

- Fingers injured during pump maintenance

RI Contractor (4)

- Finger laceration handling compressor engine head
- Turned ankle descending work platform
- Finger laceration making up suction line
- Finger caught between manifold cap and piping

PSE Tier 1 (1)

- Low pressure gas release from compressor on NAPI Compressor Facility

Well Control Events (1) – HiPo as listed above

* Differentiates work performed under L48 versus Contractor Safety Management Systems

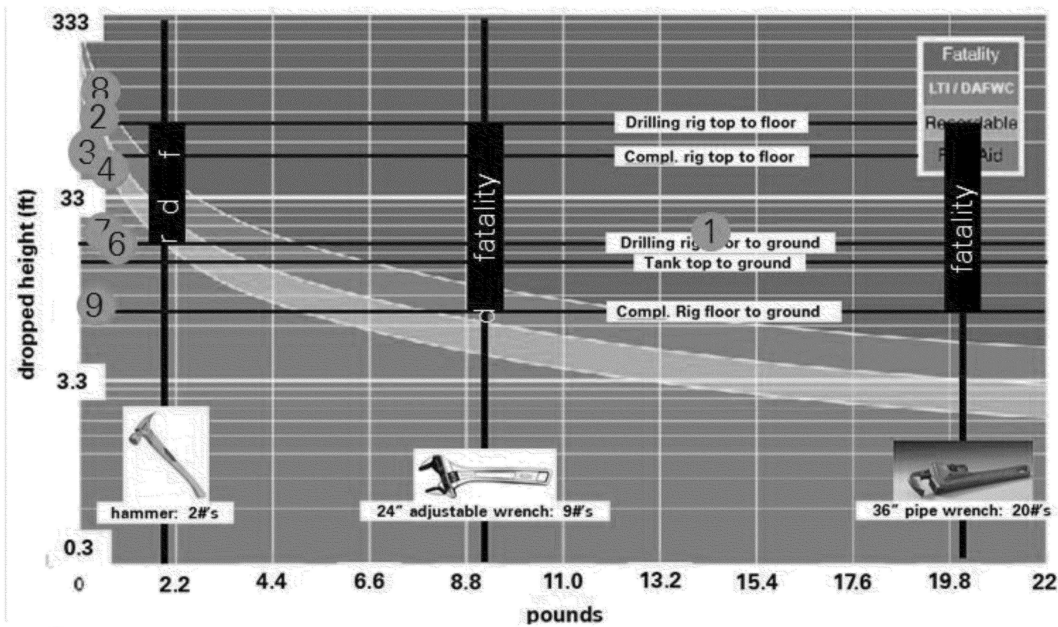
¹ 34 of the 48 LOPC (A-G) in 2018 are hung dump valves

² Avg count of rigs: FY16-3.8; FY17-9.4; YTD18-11.7

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Dropped Objects Focus



- 1 MidCon BU, stop plate fell off of hydraulic catwalk to the ground (14.5lbs, 26ft) – January 2018
- 2 East BU, Gatorade bottle fell from tubing board to rig floor (0.31lbs, 90ft) – February 2018
- 3 East BU, radio battery fell to Driller's cabin while being lowered via hoist line (0.17lbs, 80ft) – March 2018
- 4 East BU, shackle pin, nut and retainer key fell to rig floor from top of Kelly hose (0.70lbs, 50ft) – March 2018
- 5 MidCon BU, drill pipe joint fell from elevator to the floor (600lbs, 2ft) - April 2018
- 6 MidCon BU, bar dropped underneath snubbing unit while rebuilding valve (1lb, 14ft) - April 2018
- 7 East BU, balancing strap (hobble) fell striking individual on hard hat, then shoulder (0.84lbs, 20ft) – April 2018
- 8 East BU, sprocket link fell to rig floor (0.64lbs, 97ft) – April 2018
- 9 East BU, two (2) bolts with washers and lock nuts sheared off CRT bracket (0.15lbs each, 8ft) – April 2018

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2017 PSE Tier 1 Summary

1. Five Process Safety Tier 1 events occurred in 2017

Process Safety Event	Date
Kimray Pump Nipple Failure	March 2017
Fiberglass Pipeline Rupture Tier 1 Event	October 2017
Dino 1 Wellsite PSV Dislodge Tier 1 Event	October 2017
Open Wellhead Casing Valve Tier 1 Event	October 2017
3" NPT Nipple Connection Failure 3"	November 2017

2. Key controls that failed in last four PSE Tier 1 events

- Pre-startup safety review (PSSR) and Handover verification
- Energy Isolation
- Control of Work

3. Human error a key contributing factor



Redacted - First Amendment



2018 Safety Improvement Focus

- Three focus areas to improve L48 Safety (Personal and Process) performance in 2018 are:

1. High Risk (D+) Contractor HSE Management Program
2. L48 Energy Isolation Refresh
3. Hazard Identification and Barrier Management Program

Program	Activity	Completion Date
Contractor Management	Assign contractor activity owner for contractors performing high risk activity.	2Q
Contractor Management	Commence verification activity higher risk work performed by contractors.	2Q
Energy Isolation	Conduct L48 training and complete competency assessments for L48 isolation authorities.	2Q
Energy Isolation	Complete competency assessments for contractor isolation authorities and perform targeted	3Q
Hazard Identification	Develop Hazard Identification and Barrier Management training for L48 employees.	3Q
Hazard Identification	Complete training for L48 employees.	4Q

- Other enabling safety programs to be completed in 2018 are:
 1. Back to Basics refresh for all L48 employees; leaders trained leaders (100% completed by March 2018)
 2. Company wide Safety week held in the Business Units in January
 3. Rollout and training of all L48 employees on use of Observation / Verification capture tool Safety+ 3.0 (2018 ACB metric)
 4. Continuation of Dropped Objects program (2017 ACB metric)
- Completed Florida River and Bayfield Plant Process Safety Management (PSM) Audit with no deficiencies that equated to a business level finding across the fifteen PSM elements
- S&OR completed an in depth review of L48 SoHa drilling and completions practices, with no material findings identified.



Environmental Commitments

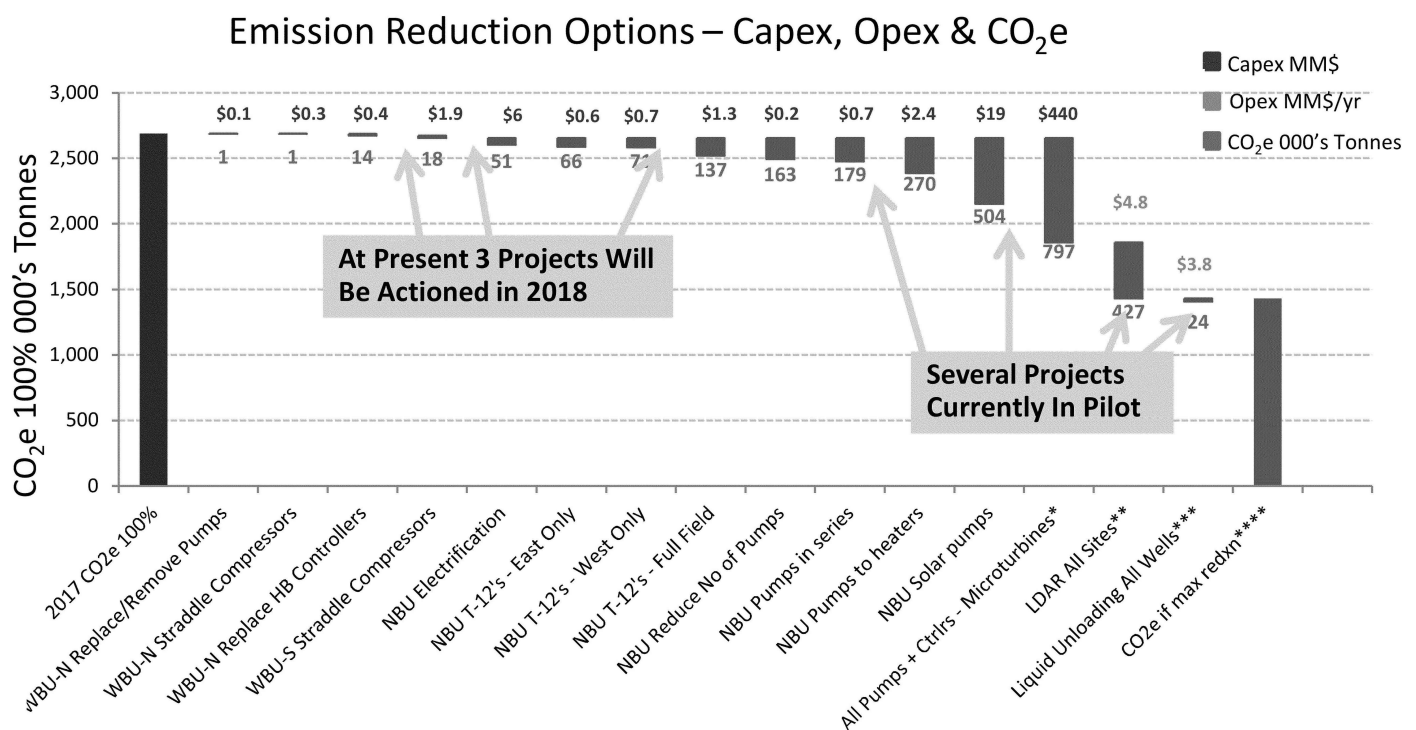


Carbon Roadmap Milestones Update

#	Activity	Date	Status
1	Establish L48 DRB and Execution Team	Aug-17	Complete
2	Conduct multifunctional framing session to align business	Aug-17	Complete
3	Agree on roadmap frame within L48	9/30 2017	Complete
4	Develop and agree to mAIRsure execution plan	10/16/2017	Complete – Trial start Feb 15, 2018
5	Agree to and decide L48 GHG advocacy strategy	10/31/2017	Ongoing
6	Agree to and decide L48 API voluntary program participation	10/16/2017	Ongoing – Evaluating participation level
7	Agree to and decide L48 CCAC participation	12/15/2017	Decision retired after consultation with stakeholders
8	Evaluate methane emission quantification and leak technological options and agree a way forward	11/15/2017	Ongoing - BU action & reduction quantity TBD
9	Evaluate viable technological options for replacement of pneumatic pumps, pneumatic controllers	11/15/2017	Ongoing – recommendation made
10	Review and clean up equipment inventory and emissions calculations	Jan-18	Complete
11	Determine and agree L48 methane reduction quantity	Feb-18	L48 committed to RSR of 350K CO ₂ e MT by 2025. Achieve 76k CO ₂ e MT reduction in 2017
12	Report out on mAIRsure pilot program	Apr-18	On-Track



L48 Priority Emission Sources RSR Options



* Capex assumes 1 microturbine each x 8000 sites @ \$55k per turbine

** Basis: 2017 emissions, assume 1% leak rate; Opex assumes handheld OGI for 8000 sites

*** Basis: 2017 emissions, assume 25% emission reduction; Opex based on Project Kelvin \$425/well/yr x 9000 wells

**** North BU Options not additive, West BU Options are additive

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Upstream Methane Plan - L48 Actions

Guiding Principle	Action #	Action	Year	Owner	Responsible
GP-1 Continually Reduce Methane	1	Real Sustainable Reduction - Methane 25% Reduction - 350,000 MT methane as CO2e by end 2019; 350,000 MT CO2e between 2020 and 2025.	2019+	Dave Lawler	Brian Pugh/ Kola Fagbayi
	2	LDAR Focus on find and fix LDAR. Implement LDAR prioritized on 30% of production in 2018/19, 60% of production in 2019/20, and 100% of production by 2020/21. Perform LDAR utilizing existing technology and continue trials to identify efficient and effective alternative means to accomplish LDAR aligned with L48 IO mission.	2018/19/20	Dave Lawler	Brian Pugh
	3	Remote Power Initiate further evaluation in 2018 of additional remote power options for L48's dispersed facilities for pneumatic controllers and pumps.	2018/19	Dave Lawler	Kola Fagbayi
	4	High Bleed Controller Replacement Replace all HB's in L48.	2018	Brian Pugh	Will Burton
	5	NBU Pneumatic Pumps (Heat Trace Pumps) Install identified technology (T12 temp switches) in west area of NBU.	2018	Brian Pugh	Kevin Lanan
	6	NBU Pneumatic Pump & Liquid Unloading Trials Continue ongoing trials, solar pumps, routing pump vents to location fired equipment, removing select pumps, placing pumps in series and Project Kelvin.	2018/19	Brian Pugh	Kevin Lanan
	7	Select and Implement Tried Technology Select technologies to be implemented L48 wide and execute successfully piloted technologies for pneumatic pumps, liquids unloading and LDAR.	2019+	Dave Lawler	Brian Pugh
	8	Crowd Source Pneumatic Solution Use crowd-sourcing or other creative ways to find solutions to the big problem, e.g. pneumatics.	2019	Dave Lawler	Kola Fagbayi
	9	L48 Facility Design Manual (FDM) Update FDM to incorporate design focus on reducing methane emissions from new & modified facilities as appropriate.	2019	Dave Lawler	Kola Fagbayi
GP-2 Advance strong methane performance across the gas value chain	1	API Environmental Partnership Take a leading role in driving forward the Environmental Partnership and identifying natural gas value chain partners to join the program.	2019	Dave Lawler	Kola Fagbayi
	2	L48 NOJV's Build NOJV and other business partners into L48 Carbon Road Map.	2020+	Dave Lawler	Kola Fagbayi

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Upstream Methane Plan - L48 Actions

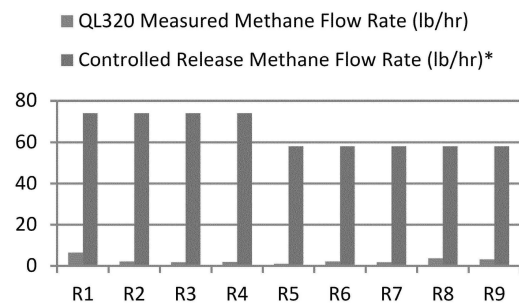
Guiding Principle	Action #	Action	Year	Owner	Responsible
GP-3 Improve accuracy of methane emissions data	1	L48 Emission Inventory Improvement Hold peer assist to review L48 internal GHG calculation approach (inventory, emission factors, calculation methodology). Implement annual review of internal GHG approach and emissions by L48 RCE Mgr.	2018	Kola Fagbayi	Bob Chou
	2	Leak Detection & Quantification Trials Continue current and proposed expanded leak detection and quantification trials (mAIRsure, Providence, drones, satellites, Rebellion). Continue evaluation and decision through L48 governance of emerging technology.	2018	Kola Fagbayi	Kirk Steinle
	3	Peer Benchmarking Develop benchmarking approach to understand peer performance and best practices in methane management.	2019	Dave Lawler / Gordon Birrell	Kola Fagbayi (US) and Liz Rogers (Global)
	4	GHG Reporting - Data Improvement Ensure accuracy of data in L48's systems of record that are used as inputs to emissions calculations; including equipment inventory, production data, operational runtime, and episodic events (i.e. liquid unloading).	2019	Brian Pugh	Will Burton
GP-4 Advocate sound policy and regulations on methane emissions	1	Methane Leadership Define what methane leadership means for L48. Reframe L48 Carbon Road Map to align and support that definition.	2018	Kola Fagbayi	Kirk Steinle
	2	US/L48 Communications Plan Develop and implement US/L48 methane communications plan. Align with Group Communications Campaign, US Advocacy Principles and "what we stand for" work from the C&EA Team.	2018	Mary Streett/Kola Fagbayi	Liz Sidoti
	3	State Industry Group Participation Develop state industry group participation level for methane related issues (for each state) (chair, lead from within, participation, observe).	2018	Steve DeGiusti	Gabrielle Sitomer/ Kirk Steinle
	4	L48 Tactical Advocacy Strategy Develop list of top 5 advocacy points associated with Methane and weave into the already developed advocacy strategy. Continue to implement strategies and update to incorporate elements of the US Advocacy Plan and the "what we stand for".	2018	Kola Fagbayi	Dana Wood
	5	L48 Leadership Workshop Develop and conduct a L48 Leadership workshop.	2019	Dave Lawler	Kola Fagbayi
	6	Develop a L48 "Methane Mindset" Develop communications to engage leaders and workforce to build zero methane emissions mindset.	2019	Dave Lawler	Kola Fagbayi
	7	API Environmental Partnership Develop API Environmental Partnership Plan to define how L48 participates in the broader mission of industry collaboration in the program.	2019	Kola Fagbayi	Kirk Steinle
GP-5 Increase transparency	1	Communicate Externally on L48 Actions Report on L48 historical and current actions to proactively reduce methane emissions through the Group Sustainability Report & US/ L48 External Communications Plan (C&EA).	2019	Dave Lawler	Kola Fagbayi



Ongoing Leak Detection/Quantification Trials

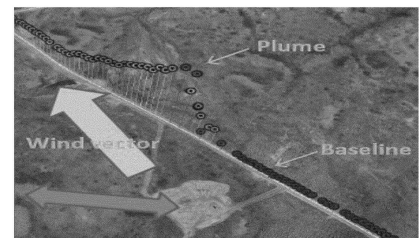
Providence Photonics QL320 with FLIR camera

- QL320 under predicting controlled emission rate
- Continuing work to further optimize pilot
- Collaborating with Upstream Technology on their pilot



BP DIO & L48 vehicle mounted laser-based sensors (mAIRsure)

- 4 sensors are mounted on trucks
- Methane concentration data is flowing from trucks
- Continue to integrate data analytics to improve emission estimates
- Too early to draw conclusions



Precision Hawk Drone

- Added leak detection to existing operations use cases
- Tests conducted in West BU in February
 - Drone mounted sensor readings agreed well with ground sensors
 - Additional pilots occurring in other L48 operating areas in March/April
- Early results are promising



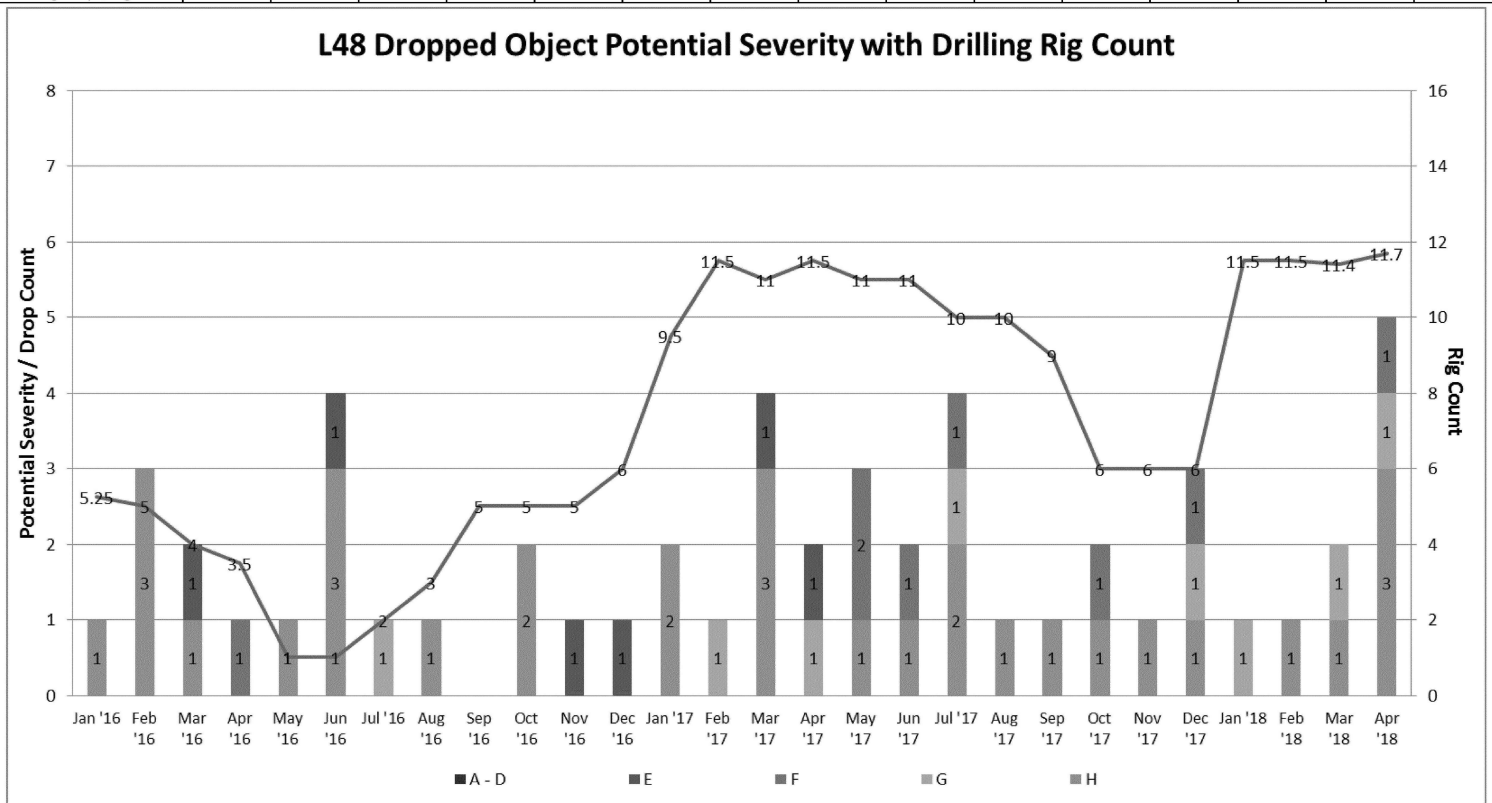


Backup

Dropped Objects Focus



	East			MidCon			West			North			L48 Total		
	2016	2017	YTD Apr 18	2016	2017	YTD Apr 18	2016	2017	YTD Apr 18	2016	2017	YTD Apr 18	2016	2017	YTD Apr 18
Dropped Objects	3	12	6	7	8	3	5	4	0	3	2	0	18	26	9
Avg Rig Count	0.8	3.5	5.9	1.4	3.0	3.0	0.6	1.8	2.3	1.0	1.4	0.5	3.8	9.4	11.7
Avg Drops/Rig	3.9	3.4	1.0	4.9	2.7	1.0	7.9	2.3	0.0	3.0	1.4	0.0	4.7	2.8	0.8



- Overall, improvement in drop rate 2018YTD compared with the previous 2 years
- Uptick in dropped objects, and dropped object potential severity in April 2018
- Dropped objects focus group implementing safety improvement plan actions

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Risk Matrix – Tier 1 PSEs



	Likelihood of Risk Event							
	1	2	3	4	5	6	7	8
Severity Level	A similar event has not yet occurred in our industry and would only be a remote possibility	A similar event has not yet occurred in our industry	Similar event has occurred somewhere in our industry	Similar event has occurred somewhere within the BP Group	Similar event has occurred, or is likely to occur, within the lifetime of 10 similar facilities	Likely to occur once or twice in the facility lifetime	Event likely to occur several times in the facility lifetime	Common occurrence (at least annually) at the facility
A								
B								
C								
D								
E				5				
F				5	1,2	3		
G					4	3		
H					1,2,4	6		
Frequency	10 ⁻⁶ /yr or Lower	>10 ⁻⁶ to 10 ⁻⁵ / yr	>10 ⁻⁵ to 10 ⁻⁴ / yr	>10 ⁻⁴ to 10 ⁻³ / yr	>10 ⁻³ to 10 ⁻² / yr	>10 ⁻² to 10 ⁻¹ / yr	>10 ⁻¹ to 1 / yr	>1 / yr
Probability	10 ⁻⁶ or Lower	>10 ⁻⁶ to 10 ⁻⁵	>10 ⁻⁵ to 10 ⁻⁴	>10 ⁻⁴ to 10 ⁻³	>10 ⁻³ to 10 ⁻²	>.01 to 0.1	>.1 to 0.025	>0.25

	Actual Consequence
	Potential Consequence

2017

1. Tier 1, LOPC F—WBU: the ¾" nipple on the dehy broke at Treating Site 2
2. Tier 1, LOPC F—WBU: a soil segment sloughed off of ditch and fell impacted pipeline
3. Tier 1, LOPC F—MCBU: a casing valve was left open following a workover and the well was returned to production
4. Tier 1, LOPC F—EBU: Dino PSV failure and gas release
5. HiPo, Tier 1, LOPC G, DAFWC—EBU: Soape 22H struck by pressure during well testing

2018

6. Tier 1, LOPC F—WBU: gas released from compressor when crosshead failed



Risk Matrix – Tier 2, LOPC G* (2)

(*unless noted otherwise)

	Actual Consequence
	Potential Consequence

Severity Level	Likelihood of Risk Event							
	1	2	3	4	5	6	7	8
	A similar event has not yet occurred in our industry and would only be a remote possibility	A similar event has not yet occurred in our industry	Similar event has occurred somewhere in our industry	Similar event has occurred somewhere within the BP Group	Similar event has occurred, or is likely to occur, within the lifetime of 10 similar facilities	Likely to occur once or twice in the facility lifetime	Event likely to occur several times in the facility lifetime	Common occurrence (at least annually) at the facility
A								
B								
C								
D								
E								
F						9	9	
G			17	2,3,4,5,6,7,8,11,12	16	10,14,15,26	1,19,20,21,22,24	
H			17	2,3,4,5,6,7,8,11,12	18	26	13,23,25,27	
Frequency	10 ⁻⁶ /yr or Lower	>10 ⁻⁶ to 10 ⁻⁵ / yr	>10 ⁻⁵ to 10 ⁻⁴ / yr	>10 ⁻⁴ to 10 ⁻³ / yr	>10 ⁻³ to 10 ⁻² / yr	>10 ⁻² to 10 ⁻¹ / yr	>10 ⁻¹ to 1 / yr	>1 / yr
Probability	10 ⁻⁶ or Lower	>10 ⁻⁶ to 10 ⁻⁵	>10 ⁻⁵ to 10 ⁻⁴	>10 ⁻⁴ to 10 ⁻³	>10 ⁻³ to 10 ⁻²	>.01 to 0.1	>.1 to 0.025	>0.25

2017

Events (1-22)

2018

- 23. EBU: top came off environmental pot
- 24. NBU: 3 bbl condensate tank overrun during fluid transfer
- 25. WBU: regulator on fuel gas system froze
- 26. WBU: lubricator connection loosened from plunger catcher
- 27. MCBU: stainless steel line pushed out of ferule fitting

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2017 Tier 2, LOPC G* (Detail)

(*unless noted otherwise)



- 1.MCBU: Ina 4 cyclonic valve body cut out
- 2.WBU: Florance AB 035 the 1/2" tubing line from fuel pot to pit left open
- 3.WBU: NEBU 031 the 1" ball valve broke off due to mechanical failure
- 4.WBU: Archrock compressor cooler leak on NEBU 500
- 5.WBU: the 2" piping on dump line froze on the Southern Ute 28-1 1
- 6.WBU: stainless steel equalizing line broke on the Robert McCoy A2
- 7.WBU: Sims Mesa compressor malfunction *(fire, damage \$2.5-95K)
- 8.WBU: nipple on compressor broke on the EE Elliott 8M
- 9.MCBU: Weld on compressor cooler tube failed at Mendota 63-9
- 10.MCBU: Merchants 1 plunger and lubricator cap found on the ground; wellhead venting
- 11.WBU: broken compressor swage on the Southern Ute 13-2R2
- 12.WBU: valve open at wellhead; line not hooked to separator at Riddle C LS 005
- 13.NBU: Hi-Hi did not function properly; 21 bbls condensate overflowed tank
14. Tier 2, LOPC G—WBU: pipeline leak at the McCarville-Maestas site
15. Tier 2, LOPC G—WBU: Jacquez COM 005 tank overflow following flash flood
16. Tier 2, LOPC G—MCBU: Cypert #3 manual dump valve bypass left partially open
17. Tier 2, LOPC G—MCBU: Bue 2/3 compressor head failure
18. Tier 2, LOPC G—EBU: Nipple broke on suction scrubber dump line
19. Tier 2, LOPC G—MCBU: Dump valve body cut out on the Donald Loftis 1-4H
20. Tier 2, LOPC G—MCBU: choke body on Resh 2 well cut out due to sand
21. Tier 2, LOPC G—MCBU: manual dump valve left open on Cypert 3 well
22. Tier 2, LOPC G—MCBU: dump valve on separator at Binns 6 well cut out due to sand

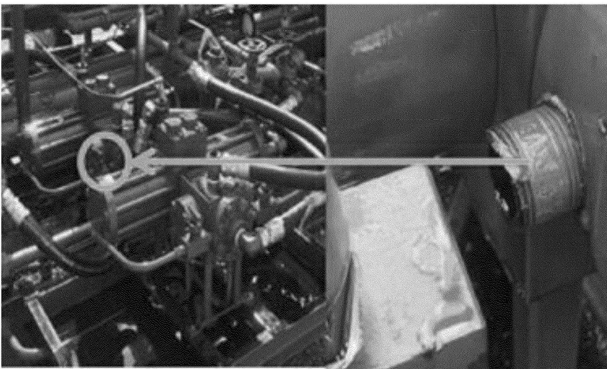


2017 Tier 1 Process Safety Event Review



Kimray Pump Nipple Failure Tier 1 Event

March 2017



What Failed?

- Nipple on Kimray glycol pump experienced fatigue failed of metallurgy due to vibration associated with the pump running dry
- ESD failed to operate because automation reverted back to manufacturer set points after outage

What are we doing about it?

- Remove Kimray energy pumps from this application and replace with Rotor-tech to eliminate risk
- PM created to replace safety critical PLC batteries
- Checking memory settings on critical automation functions

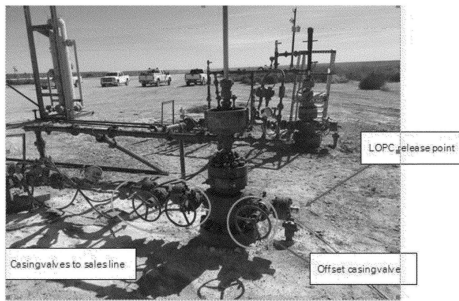
What can be improved?

- Evaluate automation support functions account for power interruption
- Review operating parameters and maintenance programs for high volume equipment
- Evaluate methods to monitor functionality of high volume equipment in remote areas



Open Wellhead Casing Valve Tier 1 Event

October 2017



What Failed?

- Casing valve open and bull plug not replaced
- Bull plug was removed to verify zero energy on well head
- Human factors analysis indicated high level of trust amongst team members leading to lack of verification

What are we doing about it?

- Rolling out Energy Isolation (EI) policy in January 2018
- Utilizing job procedures to evaluate wellhead configuration with specific emphasis on EI consideration
- Establishing expectations for well isolation and hand-over
- Establishing well / facility reinstatement policy

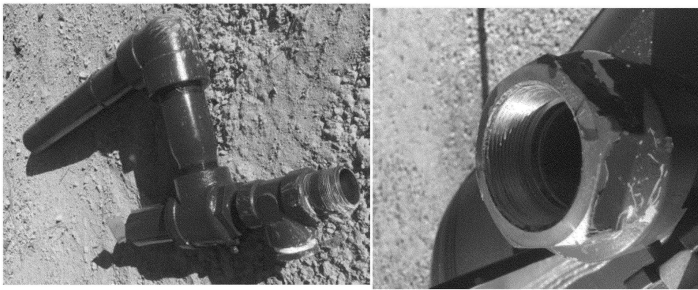
What can be improved?

- EI practices; implementation planned early 2018
- Workover job procedures to explicitly include EI considerations
- Handover handback verification process

Dino 1 Wellsite PSV Dislodge Tier 1 Event



October 2017



What Failed?

- High pressure event due to back pressure caused by hydrate plugs in cooler
- Manual override in place on wellhead ESD prevented shut-in and extended pressure relief
- PSV dislodged from fitting due to inadequate thread engagement and support
- Review of PSSR log indicated positive verification of components that failed

What are we doing about it?

- Inspected well brought online post 2016 for overrides and threaded fitting engagement
 - 7 out of 151 wells had a form of ESD override
 - 21 out of 196 sites had a form of inadequate PSV engagement
- Installing engineered support for PSVs as required
- Reviewing operating window and alarm management for SoHa wells
- Reviewing procedure for new well startup

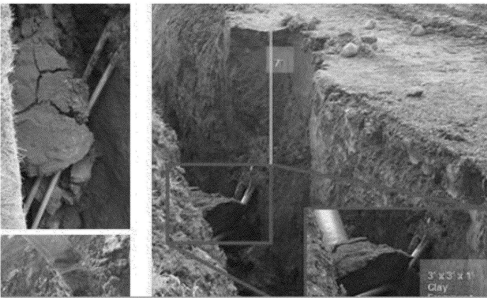
What can be improved?

- Simplification of design
- PSSR verification process
- Logic control philosophy (alarm management)



3" Fiberglass Pipeline Rupture Tier 1 Event

October 2017



What Failed?

- Risk assessment did not identify and eliminate soil instability hazards
- No barriers put in place to prevent soil falling and impacting pipeline
- Automation / alarm system not configured to recognize small quantity leaks

What are we doing about it?

- Updated WBU TRAT requiring VP approval of all fiberglass line crossing
- Sloping now required for all non-metallic pipeline crossing work
- Unattended non-metallic piping will be supported using sand
- Performing targeted verifications on non-metallic piping work

What can be improved?

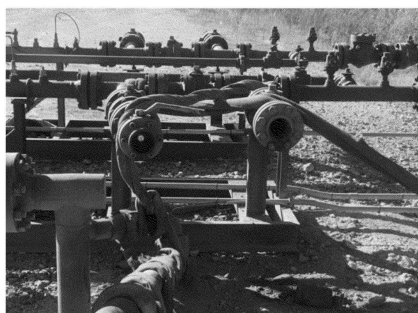
- Risk assessment and barrier management
- Control of work



3" NPT Nipple Connection Failure

Privileged & Confidential: Attorney Client Communication

November 2017



What Happened?

- Restricted fluid flow resulted in increased line pressure up to MAOP. State of connection being evaluated
- Contract company did not follow its well test practices and procedures

Investigation Conducted Under
Attorney-Client Privilege