THE HAZARD & OPERABILITY OF AC

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HAZOP is Hazard & Operability. The HAZOP process is based on the principle that a team approach to hazard analysis will identify more problems than when individuals working separately combine results The HAZOP team is made up of individuals with varying backgrounds and expertise. The expertise is brought together during HAZOP sessions and through a collective brainstorming effort that stimulates creativity and new ideas, a thorough review of the process under consideration is made.

The HAZOP process creates deviations from the process design intent by combining guide words (No, more, less, etc.) with process parameters resulting in a possible deviation from design ***intent Guidewords*** *: !"No , !"More ,!"Less ,!"As Well As ,!"Reverse ,!"Other Than .and* ***Specific Parameters*** *: Flow, Temperature, Pressure ,Composition ,Phase ,Level ,Relief ,Instrumentation , Sampling ,Corrosion/Erosion, Services/Utilities, Maintenance, Addition, Safety, Reaction, Inserting /Purging ,Contamination.*

The application of parameters will depend on the type of process being considered, the equipment in the process and the process intent. A sample set of parameters includes the following ,Contamination.

AC is Heating Ventilating Air Conditioning (HVAC) , Star Energy is an Oil Company and HVAC Star Energy is HVAC in Kakap Field Platform at North Natuna. The Hazop worksheet of the HVAC ,say that the compressors of the HVAC are the high risk unit. The compressors are the heart of the HVAC.

Key Words*: AC, HAZOP, hazard of compressor*

1.Pendahuluan

Hazop adalah upaya untuk mempelajari rsiko dan pengoperasian suatu peralatan. Konsep dasar dari Hazop adalah investigasi dari masalah yang akan digunakan untuk suatu peralatan. Tujuan utama dari Hazop adalah mengindentifikasi masalah, yang merupakan hasil dari pengalaman yang ada, bukan dari kajian atau analisis prediksi. Sistem yang digunakan pada Hazop yaitu dengan menggunakan “kata pandu” (Guide Word) . Kata pandu ini kemudian dikembangkan dalam berbagai variasi.

Hazop singkatan dari Hazrpd & Operability, kalau Hazops adalah Hazard & Operability Study, adalah standar teknis perihal analisis bahaya yang digunakan untuk penetapan sistem keamanan ,yang kemungkinan terjadi potensi bahaya dan masalah operasinya. Sehingga Hazop merupakan proses untuk meninjau apakah dalam pengoperasian peralatan akan terjadi penyimpangan yang memungkinan terjadi kecelakaan atau resiko yang lain.

Mempelajari Hazop berarti mempelajari penyimpangan dari proses normal . Hazop sendiri mempunyai karakteristik:

a. Sistematika Hazop, menggunakan stuktur /susunan dengan cara penggunaan ”kata pandu” (Guide Work), untuk memastikan bahwa proses operasi peralatan telah sesuai dengan tempat atau lokasi serta peralatan yang di uji .

b. Hazop dapat digunakan juga sebagai “SOP”
c. Hazop digunakan sebagai salah satu cara penafsiran bahaya yang mungkin terjadi.
d. Hazop digunakan sebagai prediksi awal bagi adanya bahaya, walaupun kuantitas nya tidak akurat.

Hazop menggunakan ‘kata kunci” (key word) , seperti

- Deviation : penyimpangan – merupakan kombinasi ”kata pandu” dan ”parameter”
- Consequency : konsekuensi- akibat dari suatu penyimpangan yang kemungkinan terjadi kerugian financial, kapasitas, waktu dll
- Cause : penyebab – kejadian yang kemungkinan akan terjadi penyimpangan
- Safe Guard : Perlindungan Keamanan – adalah perlengkapan untuk mencegah terjadinya penyimpangan yang dapat mengakibatkan resiko.
- Action : Tindakan- usaha yang harus dilakukan agar tidak terjadi penyimpangan untuk mengurangi atau meniadan resiko negatif.
- Node : Titik- yang digunakan untuk pemisahan proses yang satu terhadap yang lain.
- Severity: Kerusakan- tingkat keparahn pada proses penyimpangan .
- Likelihood : Kemungkinan akan terjadi resiko walau sudah ada pengamanan.
- Risk : Resiko- konsekuensi yang harus ditanggung, dan ini merupakan kombinasi dari severity dan Likelihood.

Table- 1 Benefits of Hazop Study

(8 years experience of ICI Mond Division in UK)

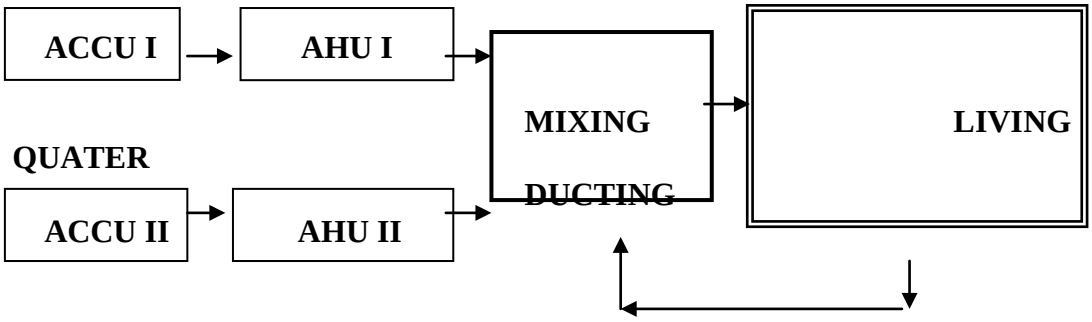
CRITERION	WITH HAZOP	WITHOUT HAZOP
No. of major mods to plant	0	2-3
No. of minor mods to plant	3	10-15
Time from start-up to design flowsheets rates	1	3

2. HVAC Star Energy

Star Energy adalah suatu Oil Company yang mempunyai salah satu wilayah operasi di Laut China Selatan (Utara kepulauan Natuna) , salah satu Platform nya (Off Shore) adalah Kakap Field Platform. HVAC adalah ”Heating Ventilating Air Conditioning ” yang digunakan di Kakap Field untuk pengondisisn udara bagi para operator di dalam Living Quater di Kakap Field tsb. Keberadaan HVAC sangat penting mengingat kondisi udara yang cukup panas

dan ditambah kemungkinan terjadi kontaminasi akibat emisi gas buang dari tiga turbin gas dan pembakaran gas (flare) yang masuk kedalam living quater.

HVAC di Kakap Field Platform menggunakan International Standard (USA Standard), di mana suhu ruangan di living quater 23,5 ^{0} C, RH 50% . HVAC terdiri dari dua unit Condensing Unit setiap unit mempunya dua unit kompresor, serta sistem ducting yang terpadu dengan cooling coil serta hetaing pada bagian ducting nya.



ACCU = AC Condensing Unit
AHU = Air Handling Unit

Gambar 1: HVAC- Kakap Field Platform –Star Energy – Natuna

Gambar 2: Kompresor , AHU, Mixing HVAC Kakap Field Star Energy Natuna

AIR HANDLING UNIT SCHEDULE (NOTE 2,5)

UNIT NUMBER	SERVICE	TOTAL CFM	O.A (CFM)	EST. E.S.P (IN-WG)	FAN MOTOR					DIRECT EXPANSION COOLING COIL								ELECTRIC HEATING						FILTERS			MFR.	MODEL NO.	REMARKS
					H.P.	RPM	ELECTRICAL			AIR TEMP. ENTERING COIL (DB/WB°F)	AIR TEMP. LEAVING COIL (DB/WB°F)	TOTAL HEAT (BTU/HR)	SENSIBLE HEAT (BTU/H)	MAX F.V. (FPM)	FACE AREA (S.F.)	ROWS	MAX F.P.I.	SUCTION TEMP. (°F)	KW.	STAGES	ENTERING AIR (F)	ELECTRICAL			QUANTITY	S-I-E	TYPE			
							VOLTAGE	PHASE	HERTZ												VOLTAGE	PHASE	HERTZ							
AHU-1	ENTIRE BUILDING	19,595	2600	2.0	10	580	480	3	60	87/75	50/49	660,900	365,500	500	28.4	6	8	40	-	-	-	-	-	-	28	16"x25" x 2"	THROW AWAY	CARRIER	39BD MODIFIED	COMPLETELY WATER & WEATHER-PROOF UNIT FOR MARINE ENVIRONMENT COIL MTLS., & COATING PER SPEC.
AHU-2	ENTIRE BUILDING	19,595	2600	2.0	10	580	480	3	60	87/75	50/49	660,900	365,500	500	28.4	6	8	40	-	-	-	-	-	-	28	16"x25" x2"	THROW AWAY	CARRIER	39BD MODIFIED	COMPLETELY WATER & WEATHER-PROOF UNIT FOR MARINE ENVIRONMENT COIL MTLS., & COATING PER SPEC.

Spesifikasi AHU HVAC Kakap Field Star Energy Natuna

AIR COOLED CONDENSING UNIT SCHEDULE (NOTE 1,2)

UNIT NUMBER	CAPACITY (BTU/H)	SAT SUCT TEMP. (F)	AIR TEMP TO COIL (F)	ELECTRICAL			COMPRESSOR		FAN MOTOR FLA	MFR.	MODEL NO	REMARKS
				VOLTS	PHASE	HERTZ	FLA	LRA				
ACCU-1	768000	40	94	480	3	60	53/53	253/253	2.3/2.3	CARRIER	38AG064	EPOXY COATED CASING & COIL MARINE ENCLOSURE FOR ELEC. ITEMS
ACCU-2	768000	39	94	480	3	60	53/53	253/253	2.3/2.3	CARRIER	38AG064	EPOXY COATED CASING & COIL MARINE ENCLOSURE FOR ELEC. ITEMS

SUPPLY/EXHAUST FAN SCHEDULE (NOTE 1,2)

UNIT NO.	SERVICE	AIR QUANTITY (CFM)	S.P. (IN H_2O)	MAX. RPM	FAN TYPE	DRIVE	MOTOR MIN. H.P.	ELECTRICAL (1) VOLTAGE	PHASE	HERTZ	HIRESTAT SETTING °F	CONTROL METHODS	SELECTION BASED ON MFR.	MODEL NO.	SOUND POWER LEVEL	REMARKS
EF-101	COOLER/FREEZER COND. UNIT EXH. & TOILET EXH.	2470	0.250	1830	IN-LINE CENTRI-FUGAL	BELT	3/4	115	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-157H	80	FLANGED CONNECTING ENDS 20 1/2"W x 20 1/2"H x 28 1/8"L
EF-102	KITCHEN EXHAUST HOOD	5400	1.25	1750	VANE AXIAL (HIGH TEMP)	BELT	3	480	3	60	160	ON/OFF SWITCH AT HOOD	HARTELL	95-24-143	80	FLANGED CONNECTING ENDS NOM. 24"ø
EF-103	KITCHEN EXHAUST HOOD MAKE-UP AIR SUPPLY	4500	1	1760	VANE AXIAL	BELT	2	480	3	60	160	TURNS ON AND OFF WITH EF-102	HARTELL	54-21-143	83	FLANGED CONNECTING ENDS NOM. 21"ø
EF-104	DISHWASHING ROOM EXHAUST HOOD	1125	0.125	1750	DUCT FAN IN VERTICAL	DIRECT	1/4	115	1	60	160	ON/OFF SWITCH AT HOOD	HARTELL	38-WD3	69	IN-LINE WITH HOOD
EF-201	TOILET/JANITOR CLOSET EXHAUST	980	.125	1910	IN-LINE CENTRI-FUGAL	DIRECT	1/22	119	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER
EF-202	EXAM./PATIENT ROOM EXHAUST	460	.125	1250	IN-LINE CENTRI-FUGAL	DIRECT	1/22	115	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER
EF-301	TOILET EXHAUST	340	.125	1250	IN-LINE CENTRI-FUGAL	DIRECT	1/22	116	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER
EF-302	TOILET EXHAUST	240	.125	1250	IN-LINE CENTRI-FUGAL	DIRECT	1/22	119	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER
EF-401	TOILET EXHAUST	240	.125	1250	IN-LINE CENTRI-FUGAL	DIRECT	1/22	119	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER
EF-402	TOILET EXHAUST	240	.125	1250	IN-LINE CENTRI-FUGAL	DIRECT	1/22	116	1	60	160	ON/OFF MAN. MOTOR STARTER FOR CONT. OPERATION	ACME	XD-100-G	63	FLANGED CONNECTING ENDS 14"W x 14"H x 18 3/16"L 9 7/8" IMPELLER

Spesifikasi ACCU HVAC Kakap Field Star Energy – Natuna

3. HAZARDOUS AND OPERABILITY STUDY WORKSHEET

Work sheet yang banyak digunakan dalam operasi Hazop dapat dilihat di bawah ini:

Site: Kakap Field Platform, Natuna
Plant: HVAC
Line/Equipment

Guide Word	Deviation	Cause	Consequence	Action

Table 1 : Kata Pandu (Guide Word) dan Penyimpangan (Deviasi)

Guide Word	Deviation

Flow	More No Less Reverse Other Also
Pressure	More Less
Temp	More Less
Viscosity	More Less
Relief	Other
Samples	Other
Instruments	Other
Corrosion	More
Erosion	More
Services	Other
Maintenance	Other
Static	Other

HAZARD AND OPERABILITY STUDY ACTION SHEET

DATA FILE:

ACTION ON:	RESPOND BY:
ACTION NO:	MEETING DATES:
DOCUMENT REFERENCE: TITLE:	REVISION:
ITEM:	
CAUSE:	
CONSEQUENCE:	

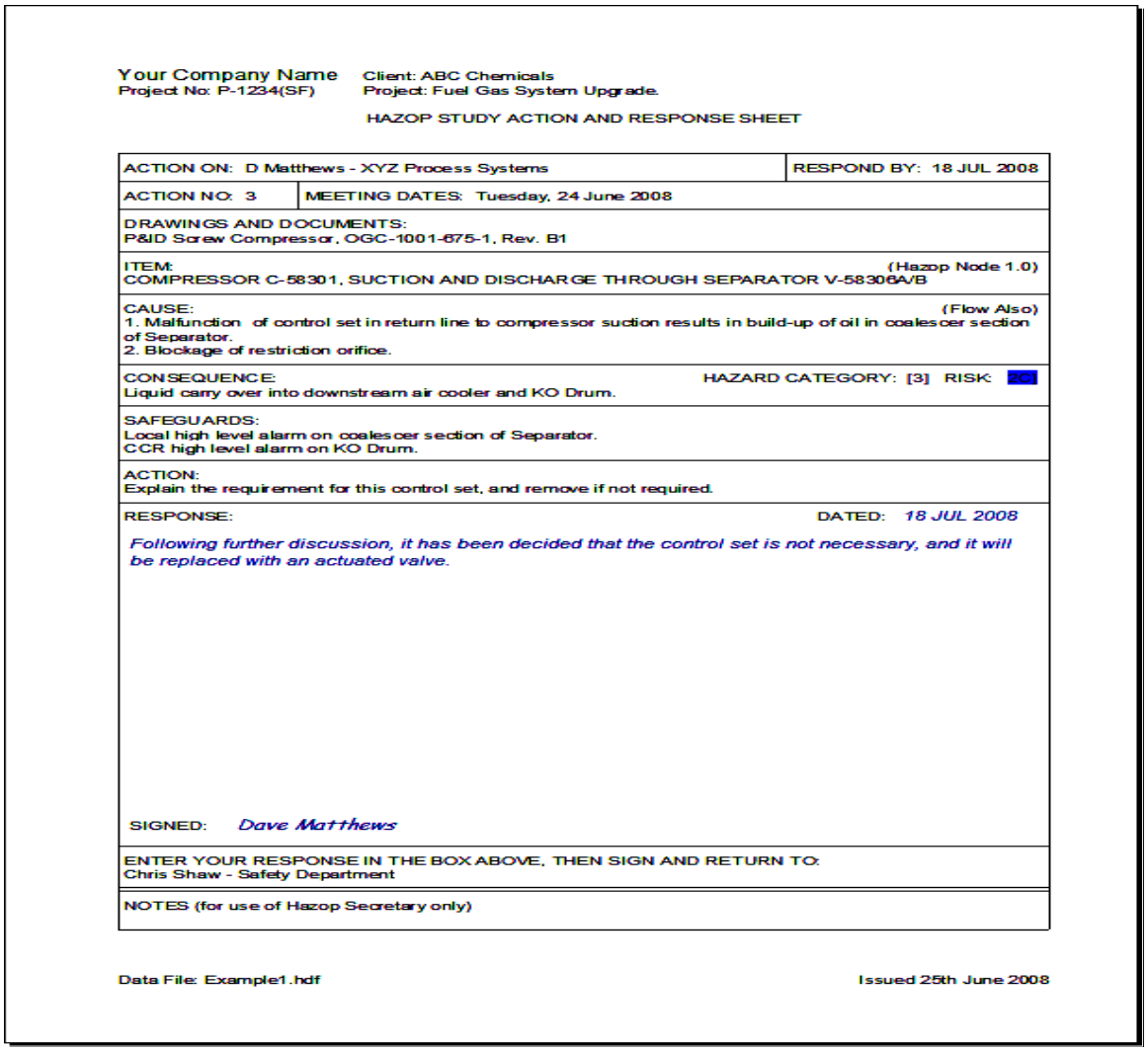
SAFEGUARDS/COMMENTS:
ACTION:
RESPONSE: DATED:

Section 5: Accumulator V-1					
Deviation	**Causes**	**Consequences**	**Safeguards**	**Risk**	**Recommendations**
High level	Insufficient flow from P-1 (**See the generic FMEA for centrifugal pumps**) Operator fails to start or inadvertently stops P-1 . . .	Overflow of V-1, possibly causing a major upset at the flare and/or in other systems connected to the flare header High pressure in C-1 (see the high pressure deviation for C-1)	Field checks of the sightglass on V-1 (**See the generic FMEA for sightglasses**) Control room indication from LT-1 (**See the generic FMEA for level control loops**)	Medium	Add independent high level switch/alarm to V-1 (Engineering)
. . .	. . .	. . .	. . .		. . .

Gambar 3: Salah satu contoh Hazop Work Sheet

Table B.1 – Example HAZOP worksheet for introductory example

STUDY TITLE: PROCESS EXAMPLE								**SHEET: 1 of 4**	
Drawing No.:			**REV. No.:**					**DATE:** December 17, 1998	
TEAM COMPOSITION:			LB, DH, EK, NE, MG, JK					**MEETING DATE:** December 15, 1998	
PART CONSIDERED:			**Transfer line from supply tank A to reactor**						
DESIGN INTENT:			**Material:** A **Activity:** Transfer continuously at a rate greater than B **Source:** Tank for A **Destination:** Reactor						
No.	**Guide word**	**Element**	**Deviation**	**Possible causes**	**Consequences**	**Safeguards**	**Comments**	**Actions required**	**Action allocated to**
1	NO	Material A	No Material A	Supply Tank A is empty	No flow of A into reactor Explosion	None shown	Situation not acceptable	Consider installation on tank A of a low-level alarm plus a low/low-level trip to stop pump B	MG
2	NO	Transfer A (at a rate >B)	No transfer of A takes place	Pump A stopped, line blocked	Explosion	None shown	Situation not acceptable	Measurement of flow rate for material A plus a low flow alarm and a low flow which trips pump B	JK
3	MORE	Material A	More material A: supply tank over full	Filling of tank from tanker when insufficient capacity exists	Tank will overflow into bounded area	None shown	Remark: This would have been identified during examination of the tank	Consider high-level alarm if not previously identified	EK



Your Company Name
Project No: P-1234(SF)
Client: ABC Chemicals
Project: Fuel Gas System Upgrade.

HAZOP STUDY ACTION AND RESPONSE SHEET

ACTION ON: D Matthews - XYZ Process Systems	RESPOND BY: 18 JUL 2008
ACTION NO: 3	MEETING DATES: Tuesday, 24 June 2008
DRAWINGS AND DOCUMENTS: P&ID Screw Compressor, OGC-1001-675-1, Rev. B1	
ITEM: (Hazop Node 1.0) COMPRESSOR C-58301, SUCTION AND DISCHARGE THROUGH SEPARATOR V-58306A/B	
CAUSE: (Flow Also) 1. Malfunction of control set in return line to compressor suction results in build-up of oil in coalescer section of Separator. 2. Blockage of restriction orifice.	
CONSEQUENCE: HAZARD CATEGORY: [3] RISK: 2C1 Liquid carry over into downstream air cooler and KO Drum.	
SAFEGUARDS: Local high level alarm on coalescer section of Separator. CCR high level alarm on KO Drum.	
ACTION: Explain the requirement for this control set, and remove if not required.	
RESPONSE: DATED: *18 JUL 2008* *Following further discussion, it has been decided that the control set is not necessary, and it will be replaced with an actuated valve.*	
SIGNED: *Dave Matthews*	
ENTER YOUR RESPONSE IN THE BOX ABOVE, THEN SIGN AND RETURN TO: Chris Shaw - Safety Department	
NOTES (for use of Hazop Secretary only)	

Data File: Example1.hdf
Issued 25th June 2008

4. Analisis

Analisis menggunakan Hazop bertujuan untuk meninjau suatu proses pada sistem secara sistematis dan menentukan arah- apakah pada proses penyimpangan dapat mengarah kepada suatu kejadian atau kecelakaan/kerugian . Salah satu bagian atau part dari HVAC yang paling beresiko tinggi terhadap kerugian adalah kompresor. Sebab apabila kompresor unjuk kerja nya turun, misalnya kapasitas/putaran turun, maka kemampuan HVAC secara keseluruhannya juga turun, sehingga tidak mampu memberikan kondisi udara dingin pada living quarter sesuai standar yang ada. Kegagalan operasi pada bagian utama kompresor seperti, katup, piston, cincin torak, serta lubrikasi merupakan bagian yang beresiko tinggi .

5. Kesimpulan

1. Identifikasi dengan menggunakan HAZOP ternyata menjadi lebih detail dan dapat menunjukan akan terjadinya resiko pada peralatan HVAC tersebut, terutama pada bagian kompressornya.

2. Dengan menggunakan HAZOP dapat dilihat bahwa resiko yang tertinggi dari peralatan HVAC pada kondisi extreme Risk pada komponen kompresor.
3. Rekomendasi yang diusulkan dalam menangani adanya extreme risk dengan merubah menjadi medium risk, ataupun dengan pola RCM (Reliability Centered Maintenance).
4. Untuk memperoleh data sheet pada HAZOP yang baik, perlu dilakukan pelatihan2 pada operator/maintenance-man agar dapat menghasilkan hasil work sheet yang dapat di andalkan.

6. Pustaka

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Lampiran.

Line/Equipment: Compressor HVAC –Kakap Field Platform

Guide Word	Deviation	Cause	Consequence	Action
Pressure	More Pressure	Resist in flow	Compressor shut down	Check pipeline
	Low Pressure	Less refrigerant	Not cooling	Add refrigerant

	More pressure difference	Cooling load high	Compressor shutdown, high power	Less cooling load
Temperature	More	Overload	Compressor shut down	Less cooling load
	Low	Less refrigerant	Not cooled	Add Refrigerant
Flow	More refrigerant flow	High cooling load	High power need	Less cooling load
	More refrigerant .flow	Piping leakage	No cooling	Check leakage
	Low refrigerant	Less refrigerant	No cooling	Add refrgerant

Line/Equipment: **Blower HVAC** Kakap Field Platform

Guide Word	**Deviation**	**Cause**	**Consequence**	**Action**
Pressure	Low pressure	Less RPM	Less flow	Check motor
	More pressure	Overrunning	Motor-heat	Check motor
Temperature	More	Vane/flap shut	Motor trip	Check vane/flap
	Low	No flow	No cooling	Check ducting
Flow	More	Overload	High power	Check load
	Low	Less RPM	Less cooling	Check motor

Line/Equipment: Ducting System HVAC Kakap Field Platform

Guide Word	**Deviation**	**Cause**	**Consequence**	**Action**
Flow	High	Blower over running	High power	Check blower
	Low	Less blower RPM or ducting leak	Less cooling	Check blower

Line/Equipment : **Compressor Controller HVAC** Kakap Field Platform

Guide Word	**Deviation**	**Cause**	**Consequence**	**Action**
Pressure	More difference pressure	Overload	Compressor shut down	Check the load
	Less suction pressure	Less refrigerant	No cooling	Add refrigerant

HAZARD AND OPERABILITY STUDY ACTION SHEET
DATA FILE:

ACTION ON: Compressor HVAC	RESPOND BY: Greg
ACTION NO: --	MEETING DATES: May,2011
DOCUMENT REFERENCE: TITLE: Compressor AC	REVISION:
ITEM: Compressor AC	
CAUSE: The compressor shut down	
CONSEQUENCE: The Air Conditioning is off, and the living quarter is high temperature	
SAFEGUARDS/COMMENTS: There no suction pressure-meter, the safety switch is on because of the high difference pressure, and the compressor is shut down.	
ACTION: Check the load of compressor, check the difference pressure of compressor, check the power/electrical etc	
RESPONSE: As soon as the compressor shut down, check the probem. And then it was known that the difference pressure is high. DATED: March, 2011	