



29-31 AGUSTUS 2023
YOGYAKARTA

Managing Aging Facilities in Rokan Block

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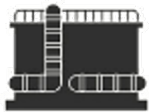
Overview – Rokan Block



Area coverage ~ 6.200 km² 7 regencies (kabupaten) in Riau province



Produced since 1952. Consists of **80 active oil field** with ± 11.300 wells



35 Gathering Stations, ~8 MMBWPD (high water cut)

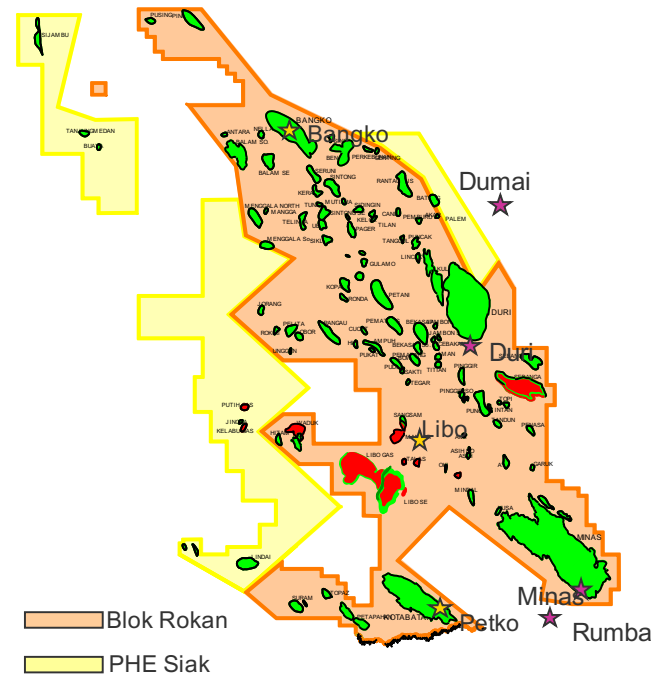


13.000 km piping and pipelines, **~2100** tanks and vessels



~2.250 employees dan more than **35.000** contractor workforce

175 KM



Covering 7 of 12 regency (Kabupaten/Kota) in Riau:

1. Rokan Hulu
2. Rokan Hilir
3. Bengkalis
4. Siak
5. Kampar
6. Pekanbaru
7. Dumai

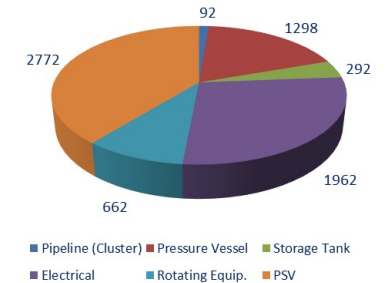
Location	Central Sumatera
Year Founded	1941
Year of Production	1952
Contractor	1951 - August 8, 2021: Production Sharing Contractors (PSC) of Chevron Pacific Indonesia (CPI) August 9, 2021-2041: PSC Pertamina Hulu Rokan (PHR) based on the Decree of Minister of Energy and Mineral Resources No. 1923 K/10/MEM/2018 dated August 6, 2018

Operational Challenges

- ❑ Relatively wide coverage area
- ❑ Large quantities of facility involved
- ❑ Adjacent to public (residential) area
- ❑ > 60% aging facilities
- ❑ Downgraded conditions (derated capacity) → facility constraints



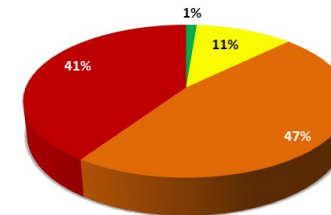
Certified Equipment in WK Rokan



Equipment Service Life in WK Rokan

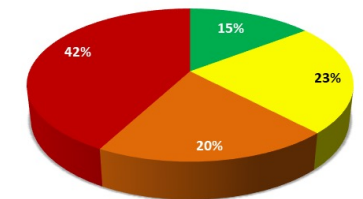
Pipeline

■ 0 - 10 ■ 10 - 20 ■ 20 - 30 ■ > 30



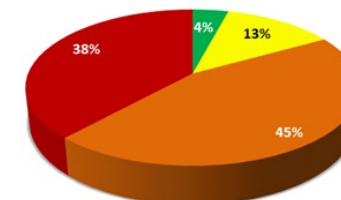
Storage Tank

■ 0 - 10 ■ 10 - 20 ■ 20 - 30 ■ > 30



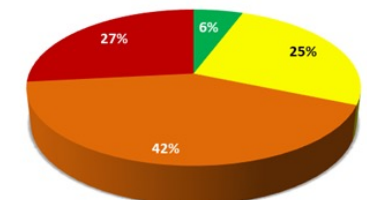
Rotating Equipment

■ 0 - 10 ■ 10 - 20 ■ 20 - 30 ■ > 30

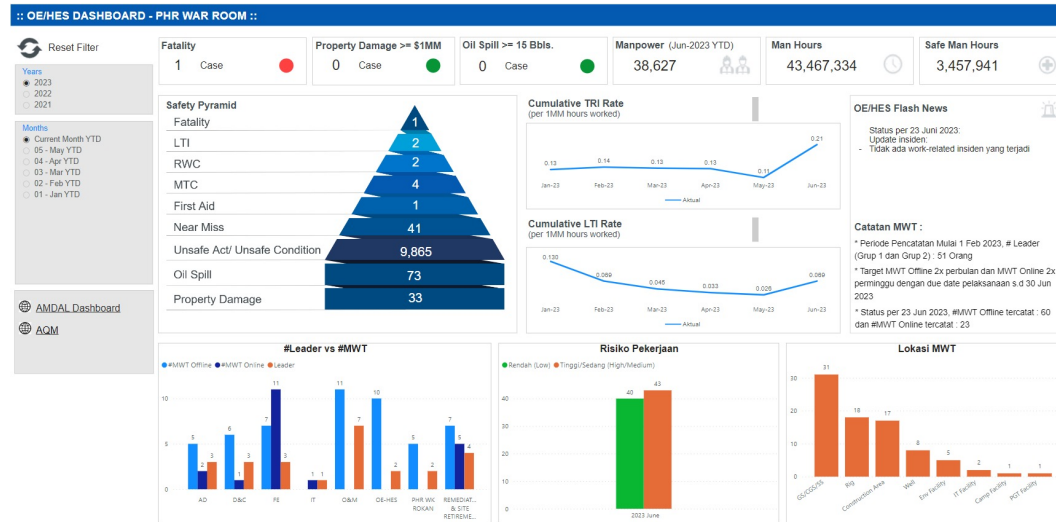


Pressure Vessel

■ 0 - 10 ■ 10 - 20 ■ 20 - 30 ■ > 30



Leading & Lagging Indicator



Leading Indicator:

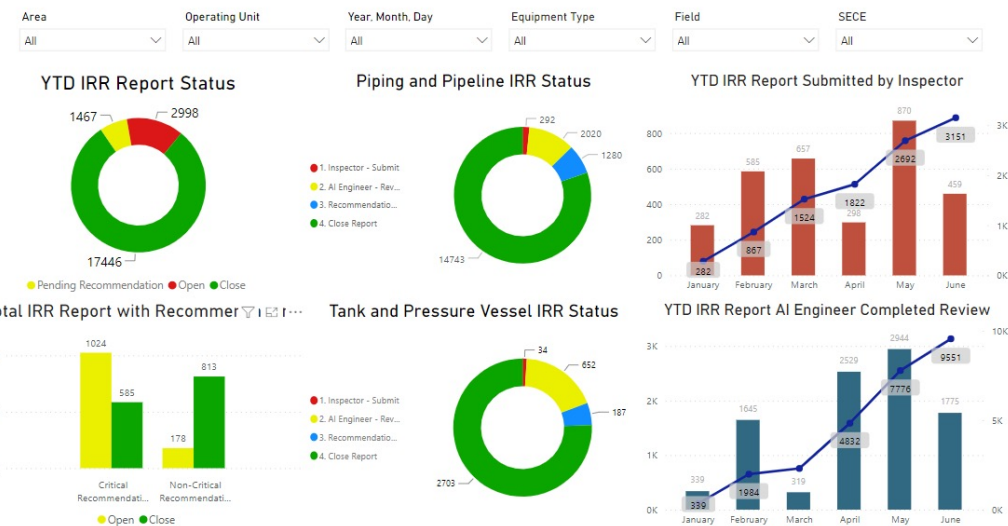
- ❑ # of inspection report
- ❑ # of completed report review and recommendation
- ❑ # of completed recommendations

Lagging Indicator:

- ❑ RAR (Reliability, Availability, Runtime)
- ❑ LPO (Loss Production Opportunity)
- ❑ # of DGS (downgraded systems)
- ❑ # of incidents due to facility integrity

Gandaria Office Tower, 5th Floor
 Jl. Sultan Iskandar Muda, Jakarta 12240

IRR Static Report

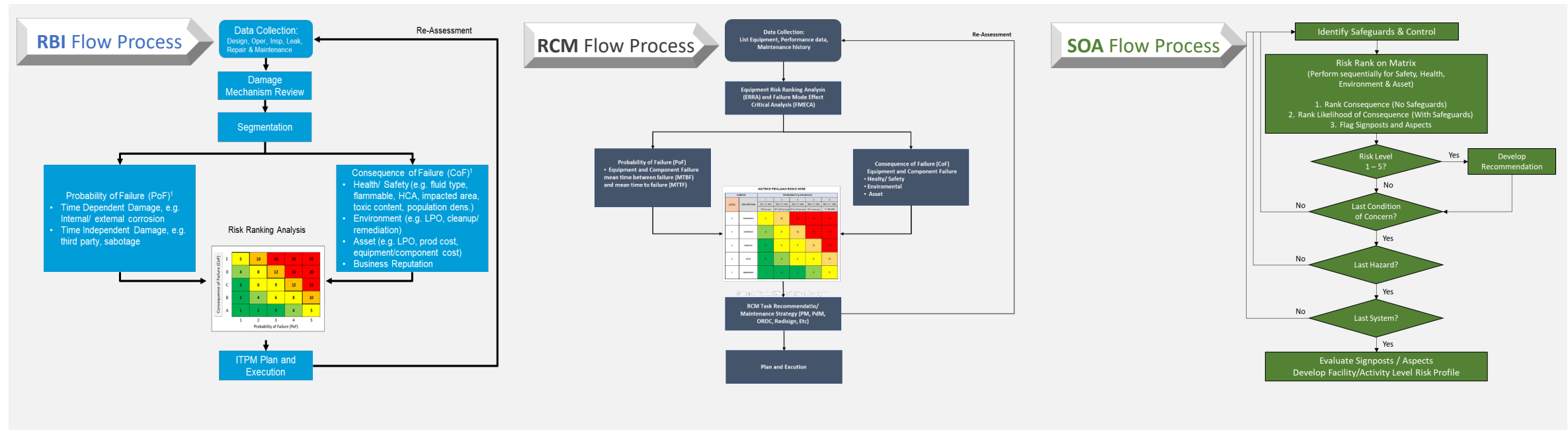


Strategy & Approach (AIMS)

RBI for Static Equipment
RCM for Rotating Equipment
SOA for Electrical & Instrumentation

Risk Prioritization

Execute based on priority – inspect, repair and replace



Strategy & Approach

Conduct Integrity Focus Screening – IFOS prior to RBI Assessment

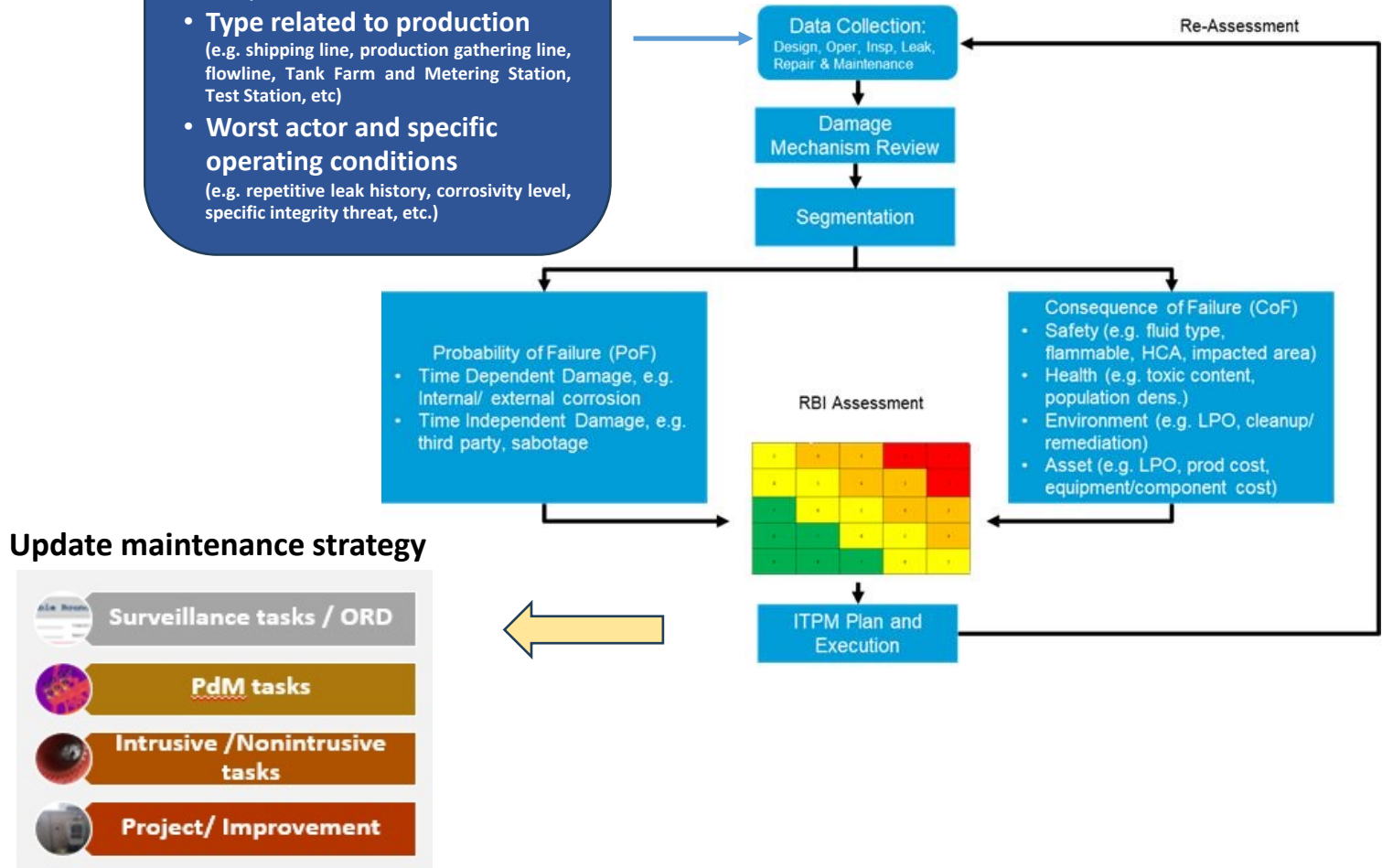
Objectives:

- ❑ Prioritize RBI Assessment for systems / plants with most integrity concern
- ❑ Pre-determine RBI complexity (e.g. semi-quantitative or fully quantitative)

IFOS

- **Potential impact to environment and people**
(e.g. HCA and non-HCA, located at sensitive areas)
- **Type related to production**
(e.g. shipping line, production gathering line, flowline, Tank Farm and Metering Station, Test Station, etc)
- **Worst actor and specific operating conditions**
(e.g. repetitive leak history, corrosivity level, specific integrity threat, etc.)

Flow Process of RBI Assessment



Strategy & Approach

Flow Process of Integrity Focus Screening - IFOS

HCA – Hazardous Classified Area Screening :
Class 3 (P1), Class 2 (P2), Class 1 (P3)

Type related to production Screening :

- **Off plot facility:** Shipping line (P1), Production & Gathering Line (P2), Flow line & others (P3)
- **On plot facility:** Tank Farm and Metering (P1), Gathering Station (P2), Test Station (P3)

Worst Actor and Specific Condition Screening:

- **Leak History:** Repetitive (P1), Freq (P2), Less Freq (P3)
- **Corrosivity Level:** Corrosive (P1), Med (P2), Less (P3)
- **Integrity Threat:** Tend to Rupture (P1), Localize Accelerated (P2), General Corrosion (P3)

Pipe List &
Related
Parameter

Scoring Process

1. Average Score (**Av**) of all screening result
2. Determine the IFOS Category:
 - **Cat1** if $Av < 2$
 - **Cat2** if $Av \geq 2 - 2.5$
 - **Cat3** if $Av > 2.5$

Resources Prioritization:

- **High** for (Cat1, Cat2, Cat 3) with Class 3 - *potential MAH*
- **Med** for Cat1, Cat2
- **Low** for Cat3

Recommended minimum Assessment Complexity:

- **Quantitative** for Cat1
- **Semi-Quantitative** for Cat2
- **Qualitative** for Cat3

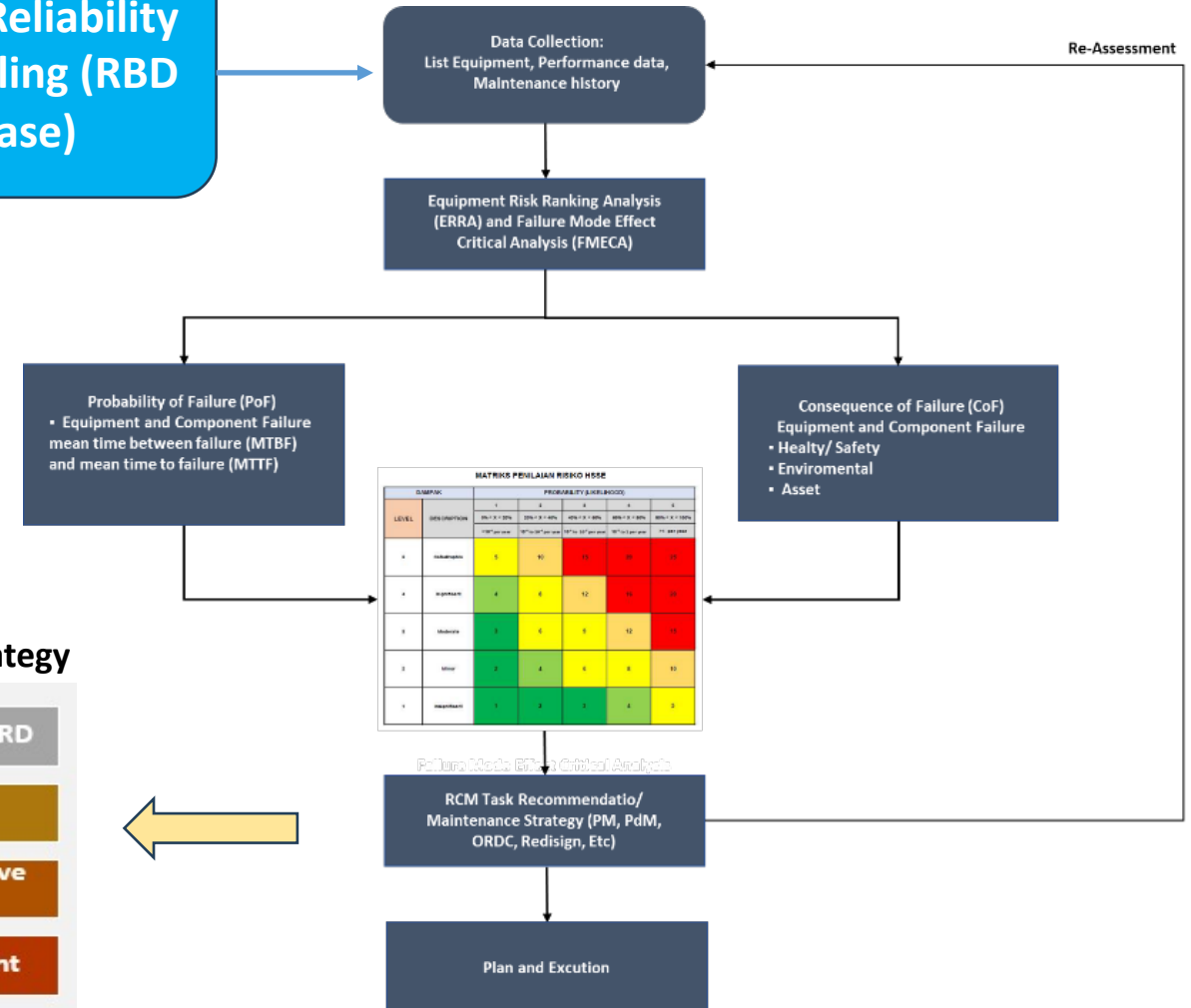
Strategy & Approach

Conduct Plant Reliability Modeling prior to RCM study

Objective: screening RCM candidates through determining worst actors (equipment) in a system/ plant

Plant Reliability Modelling (RBD base)

Flow Process of RCM Assessment



Update maintenance strategy

- Surveillance tasks / ORD
- PdM tasks
- Intrusive / Nonintrusive tasks
- Project/ Improvement



Strategy & Approach

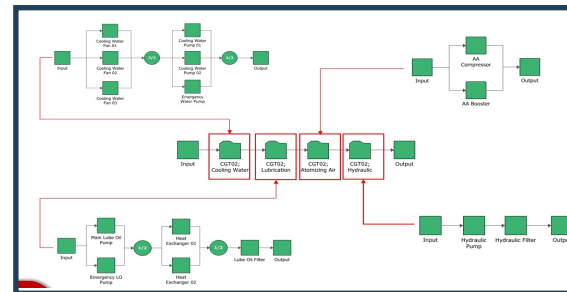
Example of Plant Reliability Modeling and analysis using reliability software



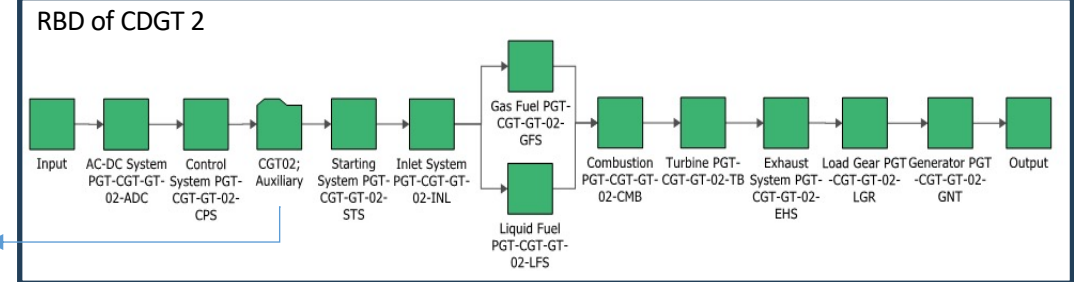
Life Data		
Distribution		
2P-Weibull		
Analysis Settings		
RRX	SRM	
FM	MED	
Analysis Summary		
Parameters		
Beta	1.949374	
Eta (day)	256.402209	
B14		
State F or S	Time to F or S (day)	
1	F	225
2	F	239
3	F	303
4	F	195
5	F	77
6	F	95
7	F	383
8	S	110

TTF Data

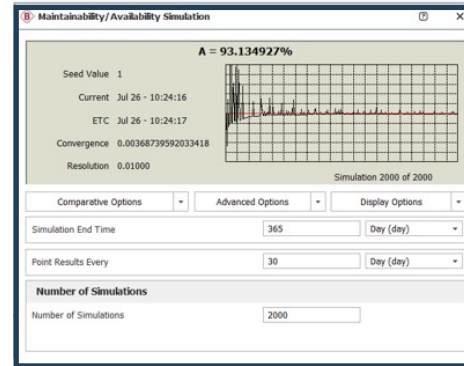
Weibull analysis



Create RBD of Plant



Forecast Availability in 1 Year



Simulation & Outcome



List of the weakest equipment

Block Name	RS DECI	Mean Av. (All Events)
Cooling Water Fan 03	31.29%	0.831409
AC-DC System PGT-CGT-GT-02-ADC	26.59%	0.982289
Cooling Water Fan 01	24.94%	0.805255
Cooling Water Fan 02	14.35%	0.969639
Generator PGT-CGT-GT-02-GNT	2.82%	0.998668
AA Compressor	0.00%	0.823566
Cooling Water Pump 01	0.00%	0.8319
Liquid Fuel PGT-CGT-GT-02-LFS	0.00%	0.943456

Strategy & Approach

N o.	RCM without Plant Reliability Modeling	RCM with Plant Reliability Modeling
1.	Don't know which one should be prioritized to improve	Pinpoint to improve the weakest equipment of a system
2.	Not measurable improvement (difficult to quantify the improvement)	Measurable improvement
3	Scope RCM : All system and equipment	Scope RCM : focus/prioritized to the weakest equipment and system

An example, Bekasap GS-EOR, it has 4 system:

1. Oil System
2. Utility System
3. WTP A System
4. WTP B System

Without RBD, we will conduct **RCM revalidation** for all 4 systems that consists of **51 equipment**

Using reliability modeling for Bekasap GS-EOR, RCM revalidation needed only for **6 equipment**

No.	System	Block Name	RS DECI	Mean Av. (All Events)
1	WTP A	WIP F_P-104F	34.91%	0.781926
2	WTP B	BWM A_P-0104	14.83%	0.924606
3	WTP A	Disposal Pump B_P-105B	9.58%	0.964158
4	WTP A	WIP E_P-104E	8.92%	0.953444
5	WTP B	BWM C_P-0106	8.66%	0.961986
6	WTP A	AMAN WIP H_P-106A	5.91%	0.974773
7	WTP A	WIP G_P-104G	3.41%	0.984145
8	WTP A	AMAN WIP I_P-106B	2.76%	0.985434
9	Oil	Metering#2	2.76%	0.987668
10	Oil	Metering#1	2.49%	0.986321
11	WTP A	WIP D_P-104D	2.36%	0.990517
12	WTP B	BWM B_P-0105	1.18%	0.994923
13	WTP A	WIP A_P-104A	1.05%	0.995806
14	WTP A	WIP B_P-104B	0.79%	0.996572
15	WTP A	Disposal Pump A_P-105A	0.39%	0.998651
16	Oil	Shipping Pump#2	0.00%	0.907767
17	Oil	Gas Boot#2	0.00%	0.93517
18	Utility	SULAIR COMPRESSOR_C2	0.00%	0.953996
19	Utility	SULAIR COMPRESSOR_C3	0.00%	0.964834
20	WTPA	Charge Pump A_P-103A	0.00%	0.995259

Strategy & Approach



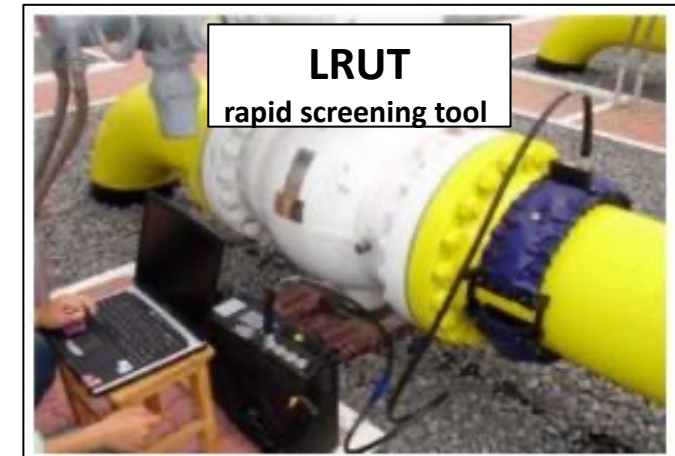
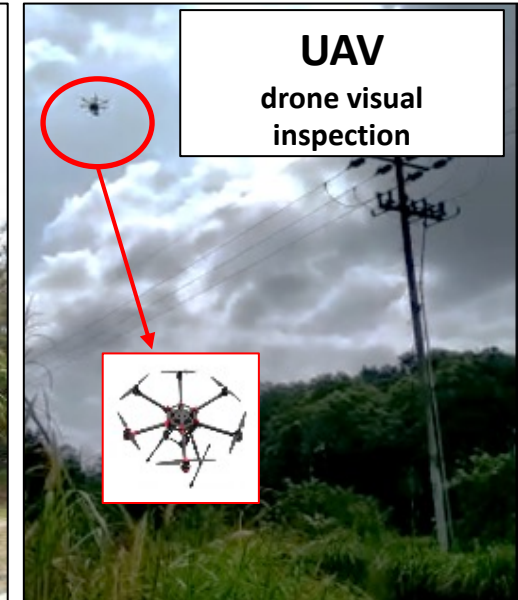
Inspection Technology

Conventional Method

Visual, walkthrough,
UT, MT, PT

Advanced Method

ILI, LRUT, AET, PECT,
LIXI, Digital
Radiography, **UAV**,
Robotic crawler, 3D
Laser Scan, etc.



Strategy & Approach

PdM Technology

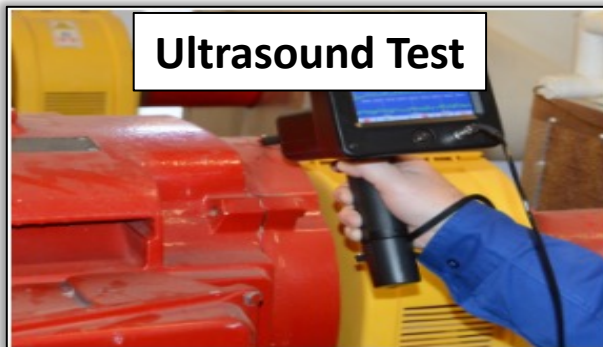
Rotating

Vibration, Flowrate, Tribology, Thermal Ultrasound, MCSA, Engine Analyzer

Electrical

Partial Discharge, DGA, Inframetric, Topography

Ultrasound Test



Gandaria Office Tower, 5th Floor
Jl. Sultan Iskandar Muda, Jakarta 12240

Inframetric (electrical connection)

Identifications and Parameters					
Tag No	Equipment Type	Equipment Part	Longitude (E)	Latitude (N)	Load Phase
04 2 17	TX	Connection	101°13.227'	01°19.475'	218 A
Thermogram					
			Area		
			Temperature		
			Recently	Previously	
			E1 Maximum	41,2 °C	
			E2 Maximum	93,5 °C	
E3 Maximum	39,4 °C				
Dt1 (E12.Max - E13.Max)	54,1 °C				

Thermal Scanning

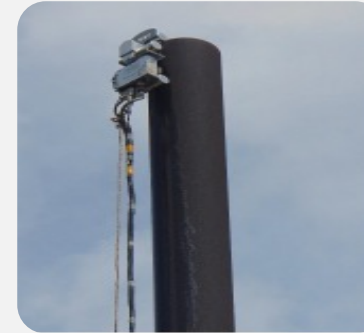
Parameters		Emissivity	
Bx1	Max 71.0 °C		
Bx2	Max 85.5 °C		
Bx3	Max 69.4 °C		
Bx4	Max 71.6 °C		
Parameters		Emissivity 0.95	
Thermal Scanning Pada Exhaust Turbine			
Bx1	Max 185.1 °C		
	Min 24.0 °C		
	Average 108.5 °C		
Bx2	Max 183.5 °C		
	Min 30.7 °C		
	Average 86.2 °C		
Bx3	Max 164.8 °C		
	Min 23.5 °C		
	Average 68.8 °C		
Bx4	Max 185.9 °C		
	Min 25.6 °C		
	Average 96.1 °C		
Parameters		Emissivity 0.95	

Lube Oil Tribology

PHR OIL ANALYSIS Inspection Data Management							
OIL ANALYSIS REPORT OF GAS ENGINE COMPRESSOR							
Lab Team	PdM Mini Lab	Oil Sampling Date	15 May 2023				
Equipment Number	Gas Engine Compressor	Report Date	16 May 2023				
Model	-	JDE No	-				
Location	DGF	Analyst	-				
Equipment Desc	Gas Engine Compressor	Oil Brand & Type	Pertamina NG Lube SAE 40				
LUBE OIL ANALYSIS REPORT							
Analysis Parameter	Unit	Limit				ENGINE	
		LL	L	H	HH	LUBE OIL CONDITION	
						15 May 2023	
						Normal	
Multigrade	Viscosity @ 40C	cSt	101.5	104.1	149.7	152.3	108.3
	Viscosity @ 100 C	cSt	11.44	11.73	16.87	17.16	12.9
Laserlight Flash Particle Count	4 Micron	Count/1 mL	-	-	-	-	5139
	6 Micron	Count/1 mL	-	-	-	-	842
	14 Micron	Count/1 mL	-	-	-	-	47
	ISO Code 4406	-	-	-	-	-	20/17/13
NAS CLASS 1638	-	-	-	-	-	10	
Fulfilmen Chemical Properties	TBN	Mg KOH/g	2.6	-	-	-	3.96
	Water Content	% Vol	-	-	0.23	0.3	0.0
	IR Oxidation	au	-	-	-	-	11.82
	Iron (Fe)	ppm	-	-	75	100	1
OSA Laboratory On-Site Analyser	Chromium (Cr)	ppm	-	-	30	40	2
	Aluminum (Al)	ppm	-	-	30	40	3
	Copper (Cu)	ppm	-	-	30	40	15
	Plumbum (Pb)	ppm	-	-	75	100	0
	Tin	ppm	-	-	-	-	2
Vanadium	ppm	-	-	-	-	7	

Opportunity – Continuous Improvement

- ❑ Advanced inspection technology application, remaining challenges:
 - Underground pipe inspection
 - Online tank bottom plate inspection
- ❑ Digitalization of asset management system
→ improve cycle time and decision quality
- ❑ Obsolete equipment management
- ❑ Using of AI for early failure detection → moving from predictive to proactive maintenance



Robotic crawler for vent stack



PECT for insulated pipelines



UAV for flare Stack and power poles



Temporary mobile tank to support inspection & repair

Opportunity – Continuous Improvement

Evergreen

Continue to sustain process implementation and continue to seek improvement thru lookback and study

Advanced Level

Achieve Financial Optimization
Continues Improvement and Robust Design Engineering
Digitalization and Inspection Technology
Reliability Modeling & Equipment Health Index

Intermediate Level

Fully Implemented Asset Integrity & Reliability Process and Sub process including RBI, RCM, PHA/SOA, Deviation Management, ODR, FFS, Corrosion Control, Turn Around Management, etc.

Basic Level

All basic level process document available and implemented including critical asset identified, PM/ PDM, ITPM, ORDC, CMMS, WO Management and Organization Capability



We aim to be here



2024

2030+



Terima Kasih