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Saudi Aramco

Total Maintenance Reliability Program

TMRP

November 11, 2009

Khalid Al-Said

Outline

- Objective
- TMRP Concept
- Elements
- TMRP Outcomes
- Conclusion

Objective

Overview of the Total Maintenance Reliability Programs (TMRP) and Reliability Enhancement Initiatives in Shedgum Gas Plant

TMRP Concept

TMRP is an effective strategy to ensure maximum plant availability to meet committed demand through:

- Enhancing plant equipments reliability
- Optimizing maintenance practices

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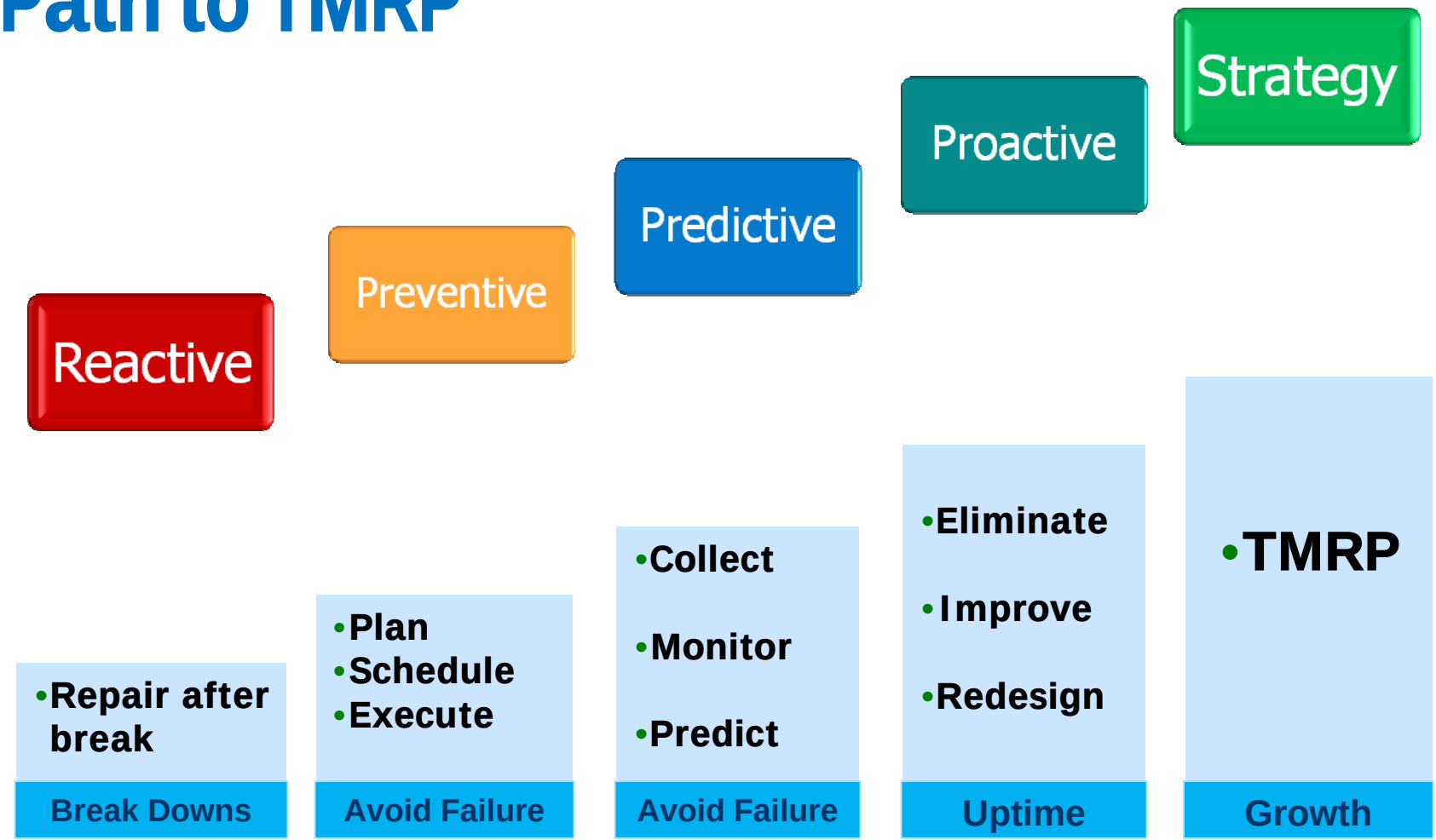
Path to TMRP



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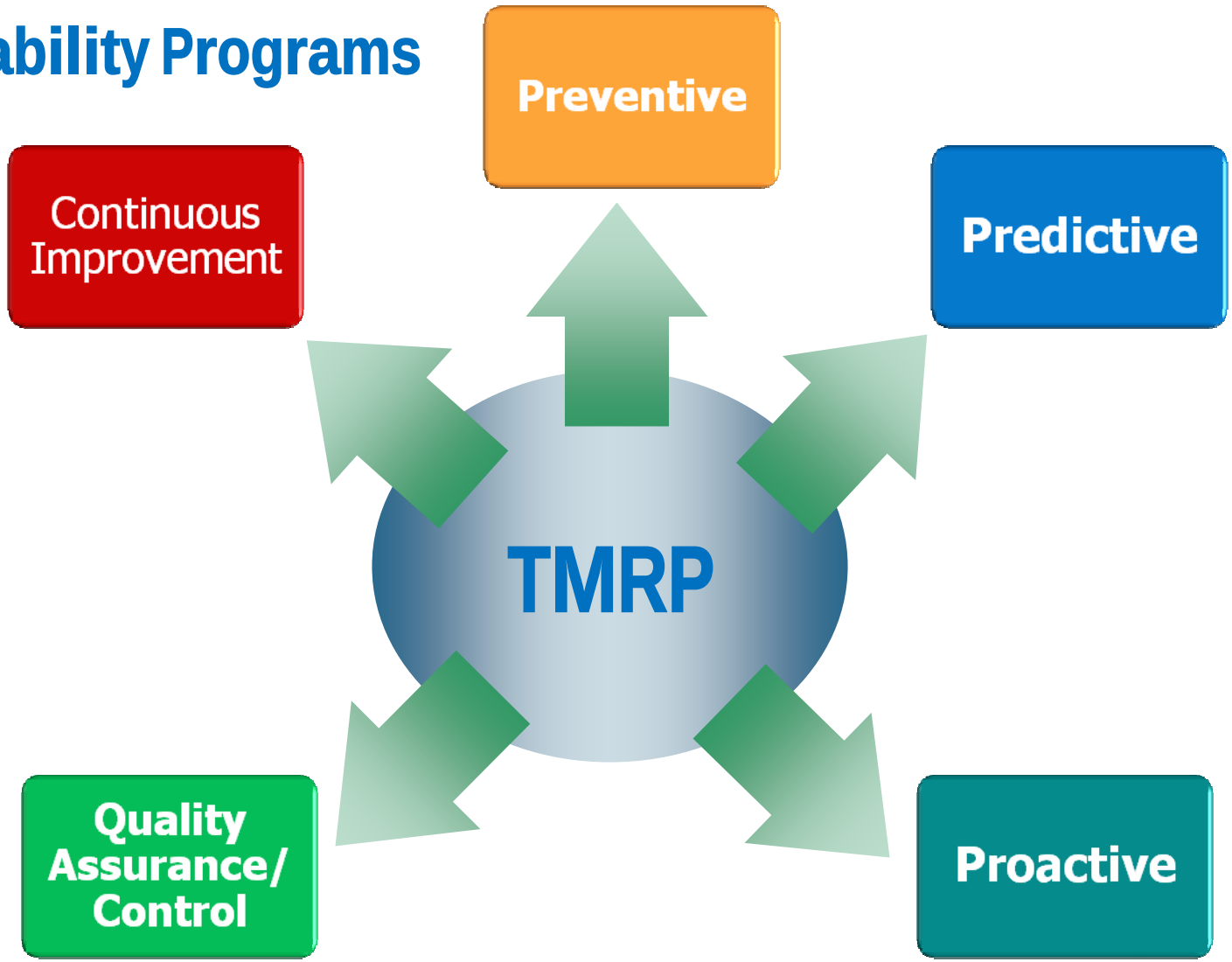
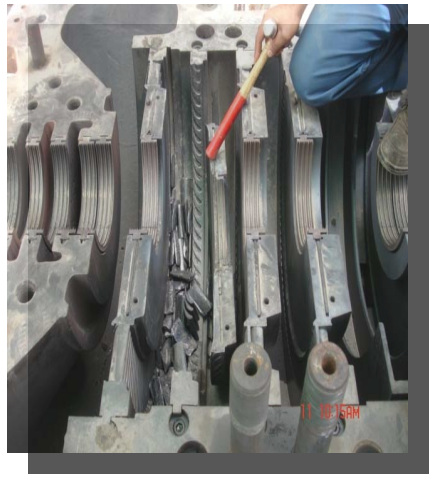
Total Maintenance Reliability Programs



TMRP

Preventive

- Plan
- Schedule
- Execute



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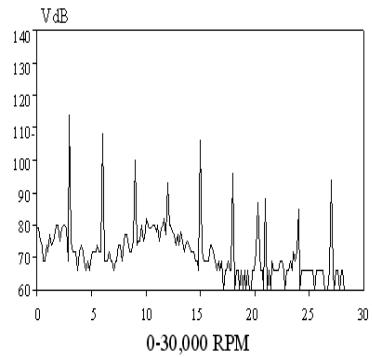
TMRP

Predictive

- Oil Condition Monitoring (OCM)
- Equipment Monitoring Program (EMP)
- Motors partial discharge monitoring (Pd Track)

Collect → Analyze → Recommend → Implement → Track



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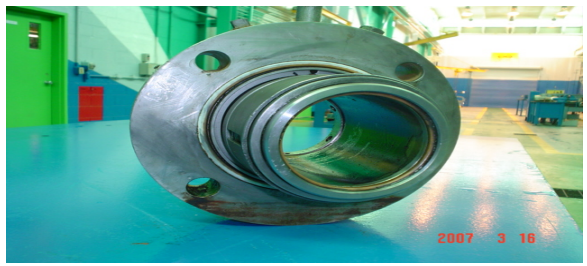
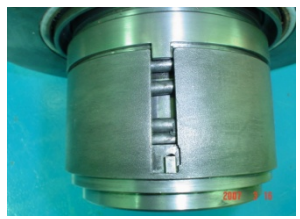
TMRP

Proactive

- Analyze
- Predict
- Recommend





- Plan
- Implement
- Track

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TMRP

Quality Assurance/ Control

Field Check	Zero-Defect (Rework)	SAP Data	Standard Job Plan	Competent Work Force
• Technical Support • Repair forms • Equipment booklet • Awareness sessions • Technical alerts	• Critique Meetings • Analysis • Recommend ations	• Equipment Bill of Material • Critical Parts Verification • Repair History	• Repair Procedure • Safety requirements • Man-Hour/Craft • Materials • Resources	• In-House Post Training • In-House Workshops • Rotational Assignments • Five Years Plan • Critical Crafts Development Plan • Reliability Conference call • Hands on experience

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TMRP

Continuous Improvement

Technology Initiatives

Continuous Improvement

KPI's

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Current KPI's

Future Plan

Automated KPI's

Safety

Reliability

Financial

Planning

Human Resources

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Technology Utilization (On Going)

Motor Filter Enhancement

Flexible Dry Coupling

Dry Ice Cleaning Machine

Advanced Laser Alignment

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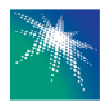
Conclusion

Maintenance is committed to continue improvements to sustain plants availability and reliability through providing the best and most cost effective maintenance

THANK YOU



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TMRP Outcomes

Mode	2006	2007	2008	2009 (August)	Target
Failure Rate	0.013	0.0087	0.0085	0.0088	0.009
MTBF (Month)	79	114	97	111	108
Equipment at Alarm (%)	0.70	0.30	0.33	0.22	0.35

Reliability Aspects

2008

	Allowable Downtime (%)	SGP
Trip/ Shutdowns	2	0.2

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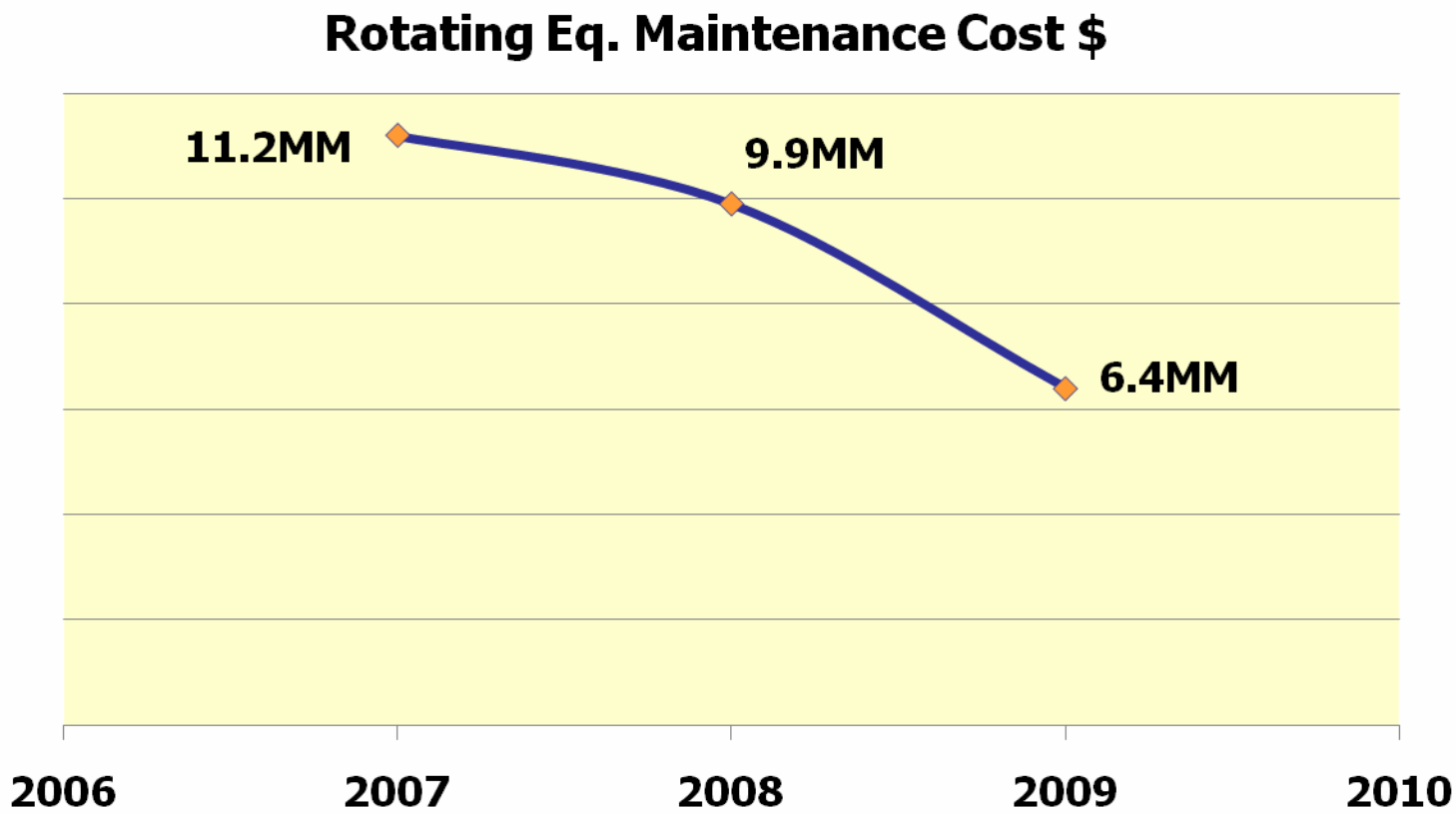
TMRP Outcomes



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TECHNICAL ALERT

Saudi Aramco

Shedgum Gas Plant Maintenance Division

Subject:	Alert No:	Date:
Proper Drive Belt Alignment	MRU-03/001	01/03/2003

Background

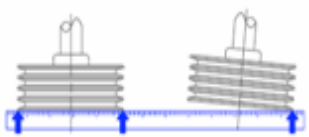
Belt alignment or pulley alignment is an important maintenance task. When carried out correctly, it can prevent breakdowns and save considerable costs. Belt alignment can be carried out by one of two methods, namely the traditional method or the laser one. Traditional methods involve either using visual judgment alone or visual judgment in combination with a straight edge and/or length of string.

This alert outlines various practices to enhance misalignment checks and correction traditional methods to ensure maximum accuracy.

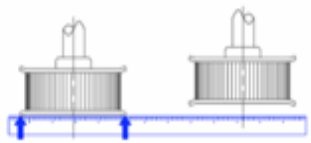
Summary:

Misalignment is one of the most common causes of premature belt failure. Depending on its severity, misalignment can gradually reduce belt performance by increasing wear and fatigue.

Basically, any degree of misalignment, angular or parallel, will decrease the normal service life of a belt drive. There are various types of belt misalignment. In practice, a combination of different misalignments is often encountered. The following illustrations show the three different types of belt misalignment



Angular Misalignment



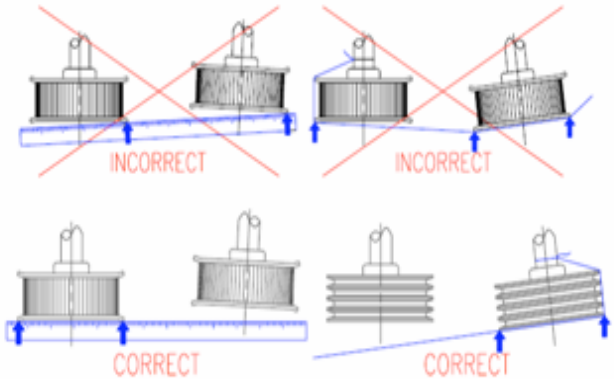
Parallel Misalignment

Belt alignment and pulley alignment are synonymous, as the process of belt alignment hinges on the correct alignment of the pulleys on which the belt runs.

Recommendation:

- When preparing to measure parallel misalignment, must first verify that the edges of both pulleys are of equal thickness, or quantify the difference in thickness
- If using a straight edge, line the straight edge along the outside face of both pulleys and as shown in the photo. If the drive is properly aligned, the straight edge or string will contact each pulley evenly.
- The straight edge or string (pulled tight) should touch the two outer edges of each pulley for a total of four points of contact. Misalignment of pulley and shafts will show up as a gap between the outside face of the pulley and the straight edge.
- Check for tilting or shaft misalignment by using a bubble level. For proper alignment, the bubble should be in the same position as measured on each shaft.

- Maintenance technicians should also check related components, such as brackets and platforms, for proper design and placement



If you have any questions, please contact Walid A. Al-Ghamdi @ 877-4662.

F. S. AL-UMAR, Supervisor
Maintenance Reliability Unit

WAG/ FAM: wag

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	B	C	D	E
1	SJP Header			
2	Event Description	Hours	Men	Craft
3	SA2 KT121 DELVAL TURBINE OVE			
4	00.00 - PREPARATION WORKS	0	0	
5	01-CHK ALL SPECIAL TOOLS & NECESSARY SPARE PARTS NEEDED,	0	0	
6	AVAILABLE IN JOBSITE READY FOR USE.	8	1	MA
7	02-ARRANGE FOR CRANE(50T) & TRUCKS,ETC.	0	0	
8	03-ERECT SCAFFOLDS AT STEAM INLET (4'X4'X10'H)	16	4	
9	04-ERECT SCAFFOLD AT TURBINE EXHAUST MANIFOLDS.	16	4	
10	05-BUILD WORKING PLATFORM/OR BENCH ON THE NORTH SIDE OF	8	2	ME
11	TURBINE SKIDS.	0	0	
12	01.00 - ISOLATIONS	0	0	
13	OPERATIONS TO ISOLATE THE MACHINE AND LOCK-OFF APPRO	0	0	
14	PRIATE VALVES. DEPRESURI ZED TURBINE OIL SYSTEM AND	0	0	
15	VENTED , LOCK - OUT THE LUBE OIL / SEAL OIL PUMPS.	0	0	
16	.	0	0	
17	02.00 - BLINDINGS	0	0	
18	01-SWING STEAM INLET BLIND TO CLOSED POSITION.	9	3	ME
19	02-RMV EXHAUST MANIFOLD,RMV UP PER & LOWER FLNGE BOLT & L	0	0	
20	FT SPECT BLIND INTO CLS POSITION,TIGHTEN FLANGE BOLTS	9	3	ME
21	03-CRANE TO ASSISTS	4	1	
22	04-SEAL EXHAUST MANIFOLD OPENNING W/ PLASTIC COVER.	0	0	
23	05-SEAL THE HOLE IN THE TURBINE COVER.	0	0	

NO.	ITEM
1	Plunger, trip assembly
2	Trip spring, over speed trip
3	U lock staple, over speed trip pin
5	Adjusting nut, over speed trip pin
6	Washer, trip spring
7	Journal bearing, bottom
8	Journal bearing, top
9	Carbon rings ass'y
10	Bearing, ball
11	Rotor, turbine assembly
12	Blade, turbine, 12% Chromium
13	Gland, bearing sealing
14	Ring, oil/coupling end & Gov. end
15	Ring, retaining/ball bearing

TOOLS

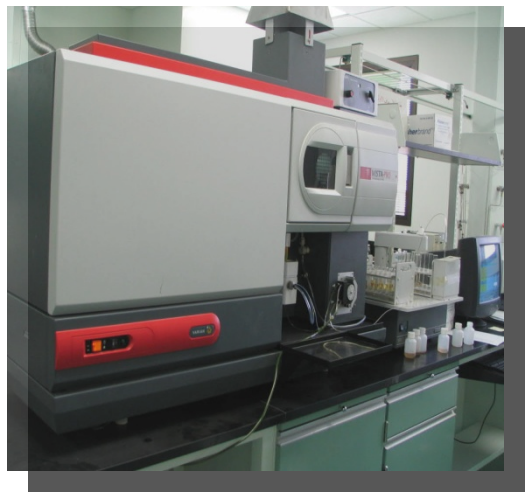
HAND tOOLS	SPECIAL TOOLS
Machinist hand tools	No special tools are required
Torch	
Heater/oven	

MAINTENANCE SUPPORT

NO.	SUPPORT EQUIPMENT
1	Crane
2	Truck
3	Box
4	Blinds

Oil Condition Monitoring (OCM)

- Collecting Sample
- Testing & Recommendations
- Corrective Action



Shedgum Gas Plant Department

Maintenance Division

ME and FA Unit

Vibration Group E.M.P Program

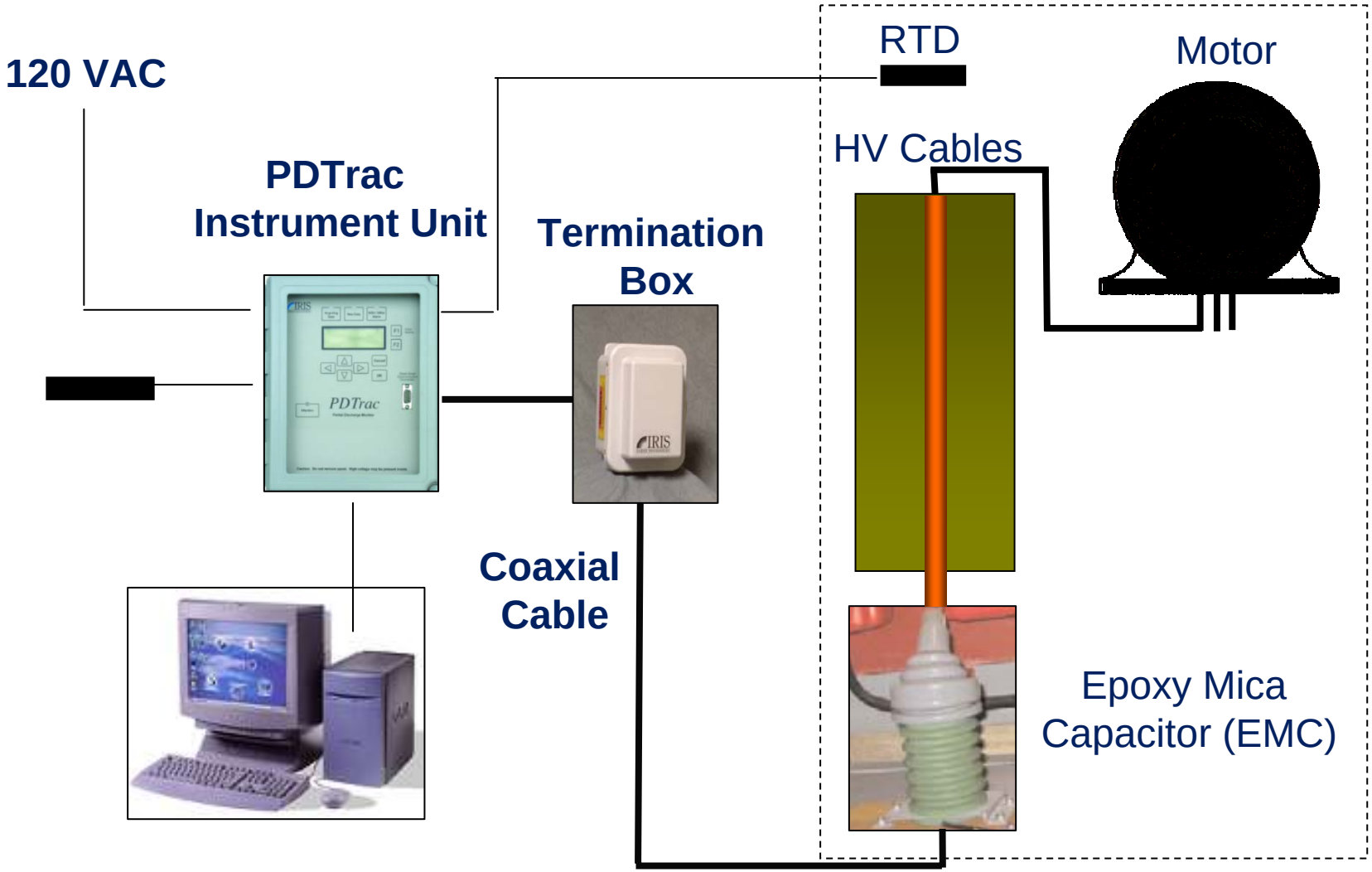
Drive Safely

Monthly Major Repairs Status

Tuesday, November 03, 2009

Date	Equipment No	Reason	Recommendation	Repairs Completed	Initial Vibration	Post Vibration	Current Status
CHILLDOWN NORTH			Total Equipment in Area =3				
10/21/2009	G-265	AFTER REPAIR	INSPECT PUMP COUPLING AND CORRECT UNIT ALIGNMENTS	NEW PUMP & OVERHAULED MOTOR			AT S.A.S
7/6/2009	KG-261B	EMP FOLLOW UP	CHECK COUPLING SPOOL CONDITION THEN SEND IT TO SHOP FOR RUN OUT CHECK,CHECK RUBBER BLOCKS CONDITION COUPLING GAP AND CORRECT UNIT MISALIGNMENT	AWAIT ACTION	3 MILS PK-PK		NO ETC DATE
10/11/2009	KM-162	EMP FOLLOW UP	REPLACE MOTOR LABYRINTHS SEAL AND CLEAN MOTOR INTERNAL	AWAIT ACTION			NO ETC DATE
CHILLDOWN SOUTH			Total Equipment in Area =5				
7/6/2009	E-367B-02	EMP FOLLOW UP	REPLACE FAN SHAFT BEARINGS	AWAIT ACTION	1.54G-S		NO ETC DATE
9/8/2009	G-364B	EMP FOLLOW UP	INSPECT PUMP INTERNAL	AWAIT ACTION	.54 IS		NO ETC DATE
9/8/2009	GM-364B	EMP FOLLOW UP	REPLACE MOTOR BEARINGS	AWAIT ACTION	.25 IS		NO ETC DATE
8/3/2009	GM-366	EMP FOLLOW UP	TEST MOTOR UNCOUPLE	AWAIT ACTION			NO ETC DATE
3/20/2007	K-441	OP'S REPORTED HIGH VIBRATION	INSPECT COMPRESSOR INTERNAL	AWAIT ACTION			NO ETC DATE

Partial Discharge Monitoring



Partial Discharge Monitoring

- PD Track is an online Partial Discharge monitoring system
- Detects the small electrical sparks that occur within voids of high voltage insulation system
- Benefits
  - Reduce turn around time
  - Reduce maintenance cost
  - Alert for allocation of spare
  - Increase availability of plant equipment

Safety

- Job Safety Analysis (JSA)
- Plant Access Safety Orientation
- Multi Languages Safety Posters
- Safety Qualification Check List
- Pre-Job Safety Meeting