Fractal Solutions

PM Optimization

Improving your Existing PM Program

2004 Maintenance & Reliability Technology Summit

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www.FractalSolutions.com

Introduction

- PM Optimization is a PM Task-Based evaluation
- Identifies the intent of the PM task
- It develops a documented basis for PM task performance
- Examines the functional failure and impact on operation, safety, environment

Introduction

- Limited to existing PM program
- Enables long-term review and improvement of PM task effectiveness

Introduction

- PM Optimization is useful when:

1. Establishing a basis for your existing PM program before performing RCM on remainder of plant
2. Performing re-analysis after completing RCM to improve PM performance
3. Migrating to a new maintenance management system

Key Terms and Definitions

- Failure Mode
  - Equipment's inability to meet a standard of performance with respect to it's function
  - How equipment can fail in a general or overall sense
  - Examples:
    - Fails to run
    - Fails to close
    - Erratic output

Key Terms and Definitions

- Failure Effect
  - Defines the consequences of an equipment failure mode
  - Failure consequence in terms of:
    - Environmental
    - Health
    - Safety
    - Economic factors

Key Terms and Definitions

- Preventive Maintenance (PM) Activity
  - A series of maintenance actions scheduled and performed as a bundled work package
    - Activities usually have multiple actions
- PM Task
  - Specific, discernible action applied to a piece of equipment
  - One action, one equipment

Key Terms and Definitions

- Credited PM
  - PM Activities considered part of the plant recognized (official) PM Program
    - Usually activities scheduled in the maintenance management system.
- Critical Failure
  - Equipment loss of function with undesirable consequences
  - Any failure vital to the operation of the plant, system, or safety

What You'll Need

- Equipment list
  - Maintenance management system
  - Plant drawings
  - Interviews
- List of standard Failure Modes
  - Dependent on Equipment Type
  - List available on the Fractal Solutions' web site

What You'll Need

Example Failure Mode list

Description
Misdistribution of air
Degraded performance
External leak
Erratic output
Fails as is
Insufficient agitation or mixing
Fails to fully charge
Fails high
Fails High/Low
Fails in last position
Fails low
Fails to open/close
Fails to operate
Fails to remain closed
Fails to remain open
Fails to close
Fails to filter
Fails to govern/regulate/control
Fails to open

What You'll Need

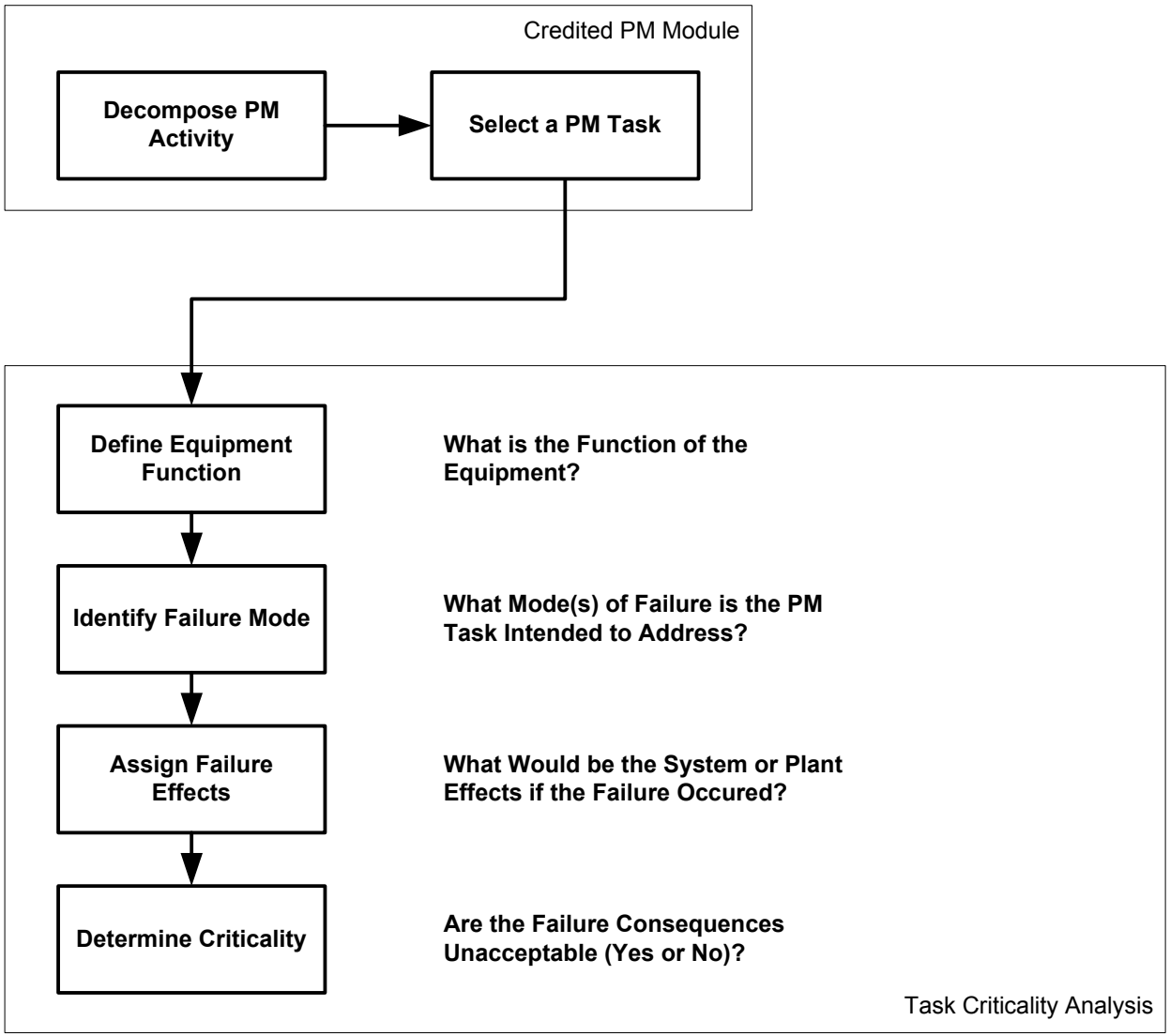
- List of Failure Effects
- Reflects your company's strategic plan and objectives
  - Establishes logic for qualifying the impact of equipment failure
  - Effects typically cover environmental, safety, and economic issues
  - List usually contains 8 – 12 items

What You'll Need

Example PMO Failure Effect list

Effect ID	Failure Effect
A01	Unit Shutdown
A03	Unit Throughput Loss
B01	Minor Throughput Loss
C01	Startup Delay
H01	Personnel Hazard
H02	Personnel Hazard - Low probability of injury
I01	Environmental Reg. Event - Major Incident
I02	Environmental Reg. Event - Incident
I03	Environmental Reg. Event - Near Miss
OT1	PM Task does not address critical failure
OT2	PM Task is redundant
M01	No Effect

Overview


Credited PM Module
Decompose PM Activity
Select a PM Task
Define Equipment Function
What is the Function of the Equipment?
Identify Failure Mode
What Mode(s) of Failure is the PM Task Intended to Address?
Assign Failure Effects
What Would be the System or Plant Effects if the Failure Occured?
Determine Criticality
Are the Failure Consequences Unacceptable (Yes or No)?
Task Criticality Analysis

Step 1: Decompose PM Activity

- Break scheduled activity down to it's constituent tasks
  - Each activity may have several PM tasks
  - Research maintenance procedures to get affected equipment
    - Develops Equipment List
    - Defines the analysis boundary
  - PMO Analysis is performed on each PM task

Step 2: Group ‘Like’ PM Tasks

- Grouping PM tasks for analysis
  - Should have the same
    - Referenced procedure
    - Equipment type
    - Duty cycle
    - Environment
  - Consider and assume the end result of the optimized task will be applicable to all the equipment selected

Step 3: Define Equipment Function

- Always relate to operating context
  - Startup, normal ops, shutdown, special, and emergency
- Has clearly defined conditional requirements
  - Supply….To…During…
- Has quantifiable conditions when possible
  - Pressure, temperature, flow, range, etc.

Step 3: Identify Failure Mode

- Identify which mode of failure the PM is addressing
  - Ask: What mode of failure is the PM task intended to address?
  - It's possible that the PM doesn't
  - PM tasks may address multiple failure modes

Step 4: Assign Failure Effects

- For each Failure Mode:
  - Identify all effects for each selected failure mode
  - Consider full range of operation
    - start-up, operating, and shut down
  - Consider worst realistic case
  - Information sources:
    - System descriptions
    - Operating procedures
    - Interviews

Example – Decompose

Step 1 PMO

Credited PM List - Decompose

	Date: May 12, 2004	Page: 1 of 12
Plant: PREMO	Plant ID: PX	
Analysts: LP Johnson		
Equipment IDs: 145-361, 145-362		

Master ID	PM Title	Task	Task Title	Frequency
MWO 123	Circ Water Motor Annual Maintenance	1	Clean and Inspect	12 M
		2	Sample Oil Uppper/Lower Bearing	12 M
		3	Megger Motor	12 M
MWO 421	Circ Water Motor 3 Year Maintenance	1	Change Oil Upper Bearing	36 M
		2	Change Oil Lower Bearing	36 M

Example

Step 2 PMO

Task Criticality Analysis

		Date: May 12, 2004	Page: 1 of 20
Plant: PREMO		Plant ID: PX	
Analysts: LP Johnson			
Equipment IDs:	145-361, 145-362		
Equipment Function:	The Circulating Water Pump moves water from Lake Michigan through the Main Condenser to condense the steam exhausted from the Main Turbine.		

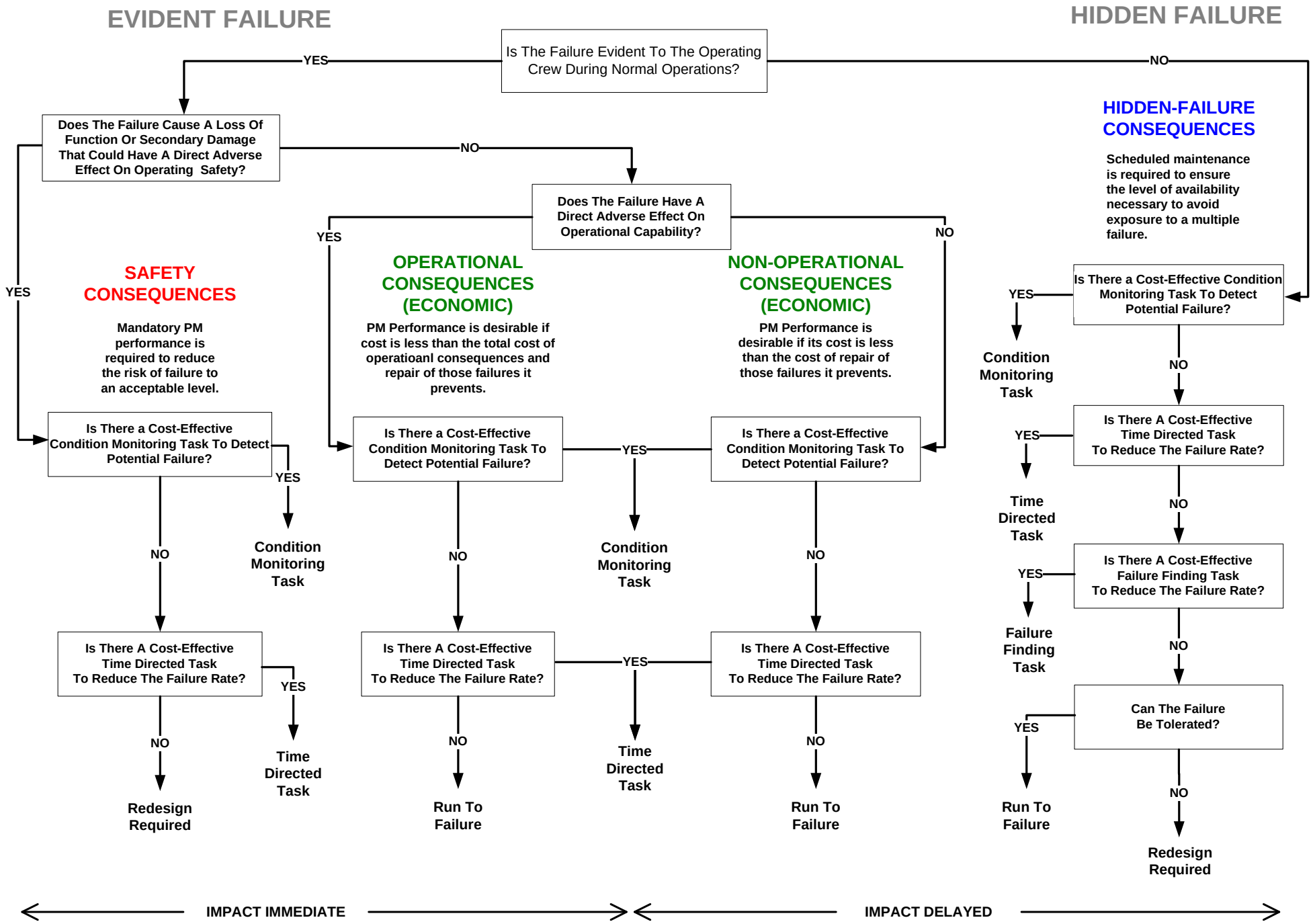
PM / Task		Failure Modes	Failure Consequences	Critical Task?
PMWO 123				
1	Clean and Inspect	Fails to Run and/or Fails to Continue Running	Reduced Power Generation	YES
2	Sample Oil Uppper/Lower Bearing	Fails to Run and/or Fails to Continue Running	Reduced Power Generation	YES
3	Megger Motor	Fails to Run and/or Fails to Continue Running	Failure Effect Critical, PM Doesn't Address Failure	NO
PMWO 421				
1	Change Oil Upper Bearing	Fails to Continue Running		
		Fails To Start	Failure Effect Critical, Redundent Task	NO
2	Change Oil Lower Bearing	Fails to Continue Running		
		Fails To Start	Failure Effect Critical, Redundent Task	NO

Notes:

Step 5: Determine Criticality

- Determine if PM addresses a critical failure
  - Ask: Are the Failure Consequences Unacceptable (Yes or No)?
  - Yes – PM task receives in-depth analysis via Logic Tree
  - No – PM task receives low-level review of other factors that may require keeping the PM task

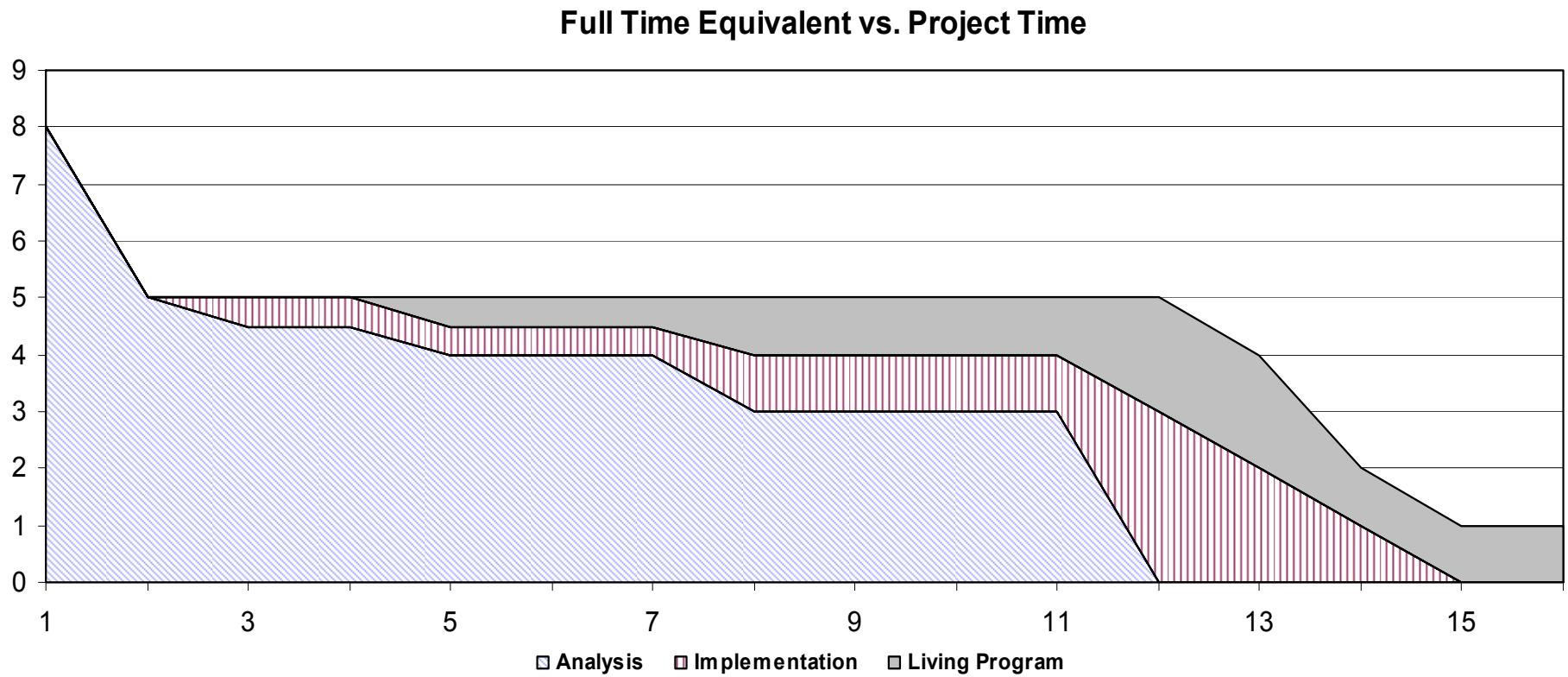
Decision Logic for Task Selection



Example PM Optimization Project

- 65 systems
- 1 year evaluation time
- 6,593 Tasks Evaluated
  - 686 Tasks Deleted
  - 109 Tasks Added
- $159,000 1st year savings
- $400,000 annualized savings

Project Staffing



4 Years Later (Follow-up)

- $1.5 million saved from interval extension and task elimination
- 0% change in corrective maintenance
- RCM Manager is a now staff position
- 150 new tasks added because of new commitments and department preference
- 5,370 PM work requests reduced to 1,753 by performance grouping
- NRC Strength during two separate SALP reviews
- INPO recognized Equipment Reliability program as strength over multiple evaluations
- Acceptance of new program was made through craft involvement

Step 1 PMO

Credited PM List

			Date:	**Page: of**
Plant:			**Plant ID:**	
Analysts:				
Equipment IDs:				
Master ID	**PM Title**	**Task**	**Task Title**	**Frequency**
Notes:				

Step 2 PMO

Task Criticality Analysis

		Date:	**Page: of**
Plant:		**Plant ID:**	
Analysts:			
Equipment IDs:			
Equipment Function:			

PM / Task	Failure Modes	Failure Consequences	Critical Task?

Notes: