



APT

ASSET PERFORMANCE TECHNOLOGIES
Connecting Preventive Maintenance, Reliability, and ROI.

Achieving Reliability Goals Using Less Human Resources

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Scope is Focused on PM Improvement

- **Once equipment is installed in a plant and is operating, a good PM program is at the heart of ensuring acceptable equipment reliability at a reasonable cost**
- **The barriers to improving PM are both technical and logistical, and these two requirements act against each other to raise program development costs**
- **A significant barrier holding back progress is the need to assign whole teams of vital plant personnel to such work for extended periods**
- **This paper shows how this effort can be greatly reduced**

A Traditional RCM Team is Full Time

➤ Team Composition

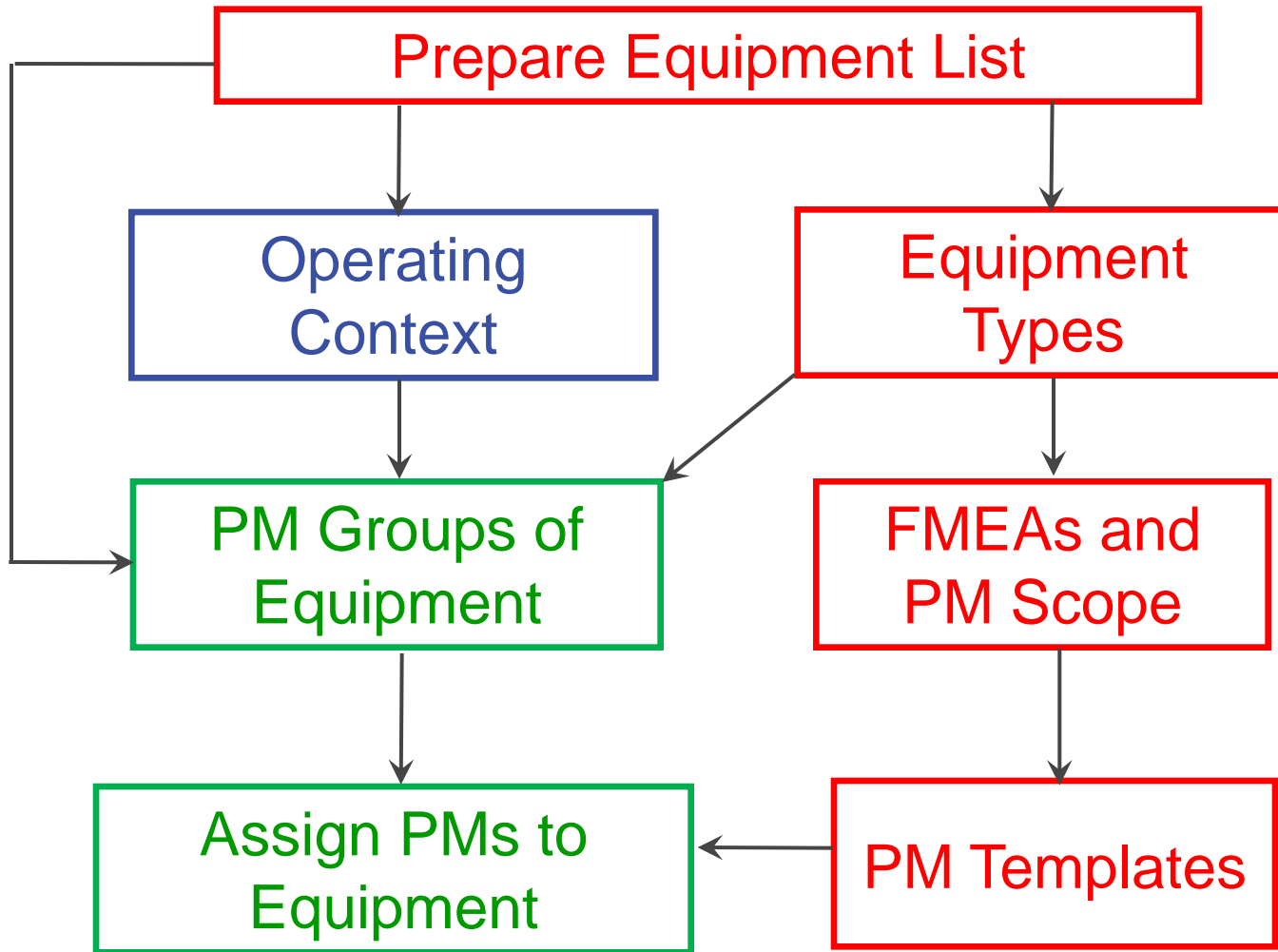
- ❖ Operator
- ❖ Process engineer or system engineer
- ❖ Machinery specialists (electrical, mechanical)
- ❖ Instrumentation specialist
- ❖ Maintenance technicians (electrical, mechanical)

➤ Team works through all equipment and tasks together

- ❖ Very linear progression through
 - Functional analysis
 - FMEAs
 - PM assignments

➤ Work smarter by using PM Templates!

Work Flow for PM Improvement



The PM Template Process

FMEA for Equipment Type

Degradation Mech. Info.	PM1	PM2	PM3....
	x		x
		x	x
	x	x	x
	x		x
.....			



PM Template for Equipment Type

PM Task	CHS	CLS	CHM	CLM	MHS....
PM1	1Y	2Y	2Y	4Y	NR
PM2	1M	3M	1M	3M	1Y
PM3	5Y	5Y	5Y	5Y	NR
.....					

PM tasks and intervals from the relevant operating context in the Template are applied to the correct subset of equipment items

CHS

CHM

Equipment List

XYZ-123
XYY-124
AYZ-123
BYZ-124
CXX-000
DXX-000
EXX-000
FXX-000
.....

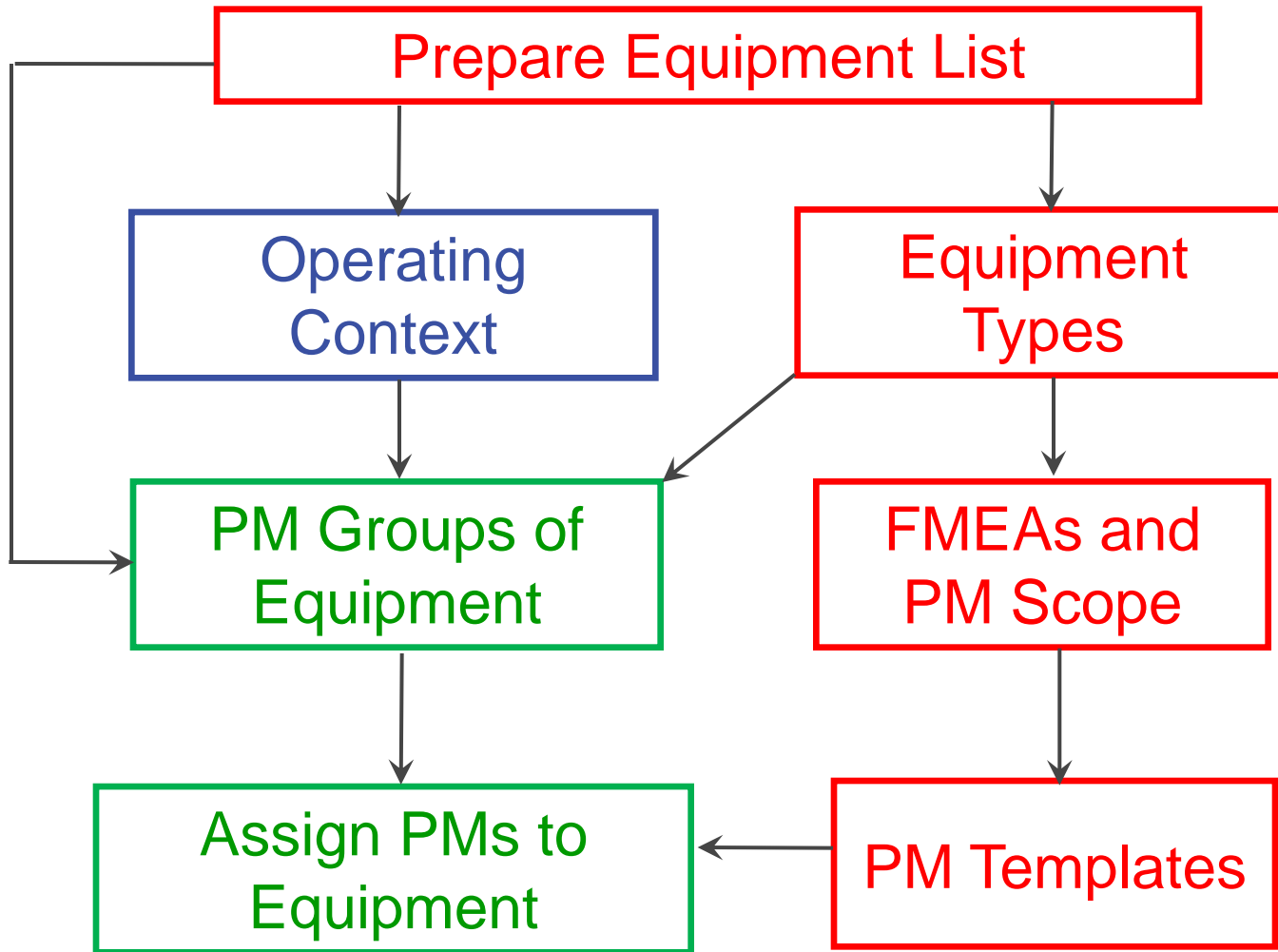
Same Equipment Type, various operating contexts

Work Flow for PM Improvement Project

Task (and prerequisite)

1. Equipment list
2. Equipment Types and engineering characteristics (1)
3. Operating Context – criticality, duty, service conds. (1)
4. PM Groups of equipment ID's (1, 2, 3)
5. FMEAs and scope of each PM (2)
6. PM Templates (5)
7. Assign PMs to equipment in PM Groups (4, 6)

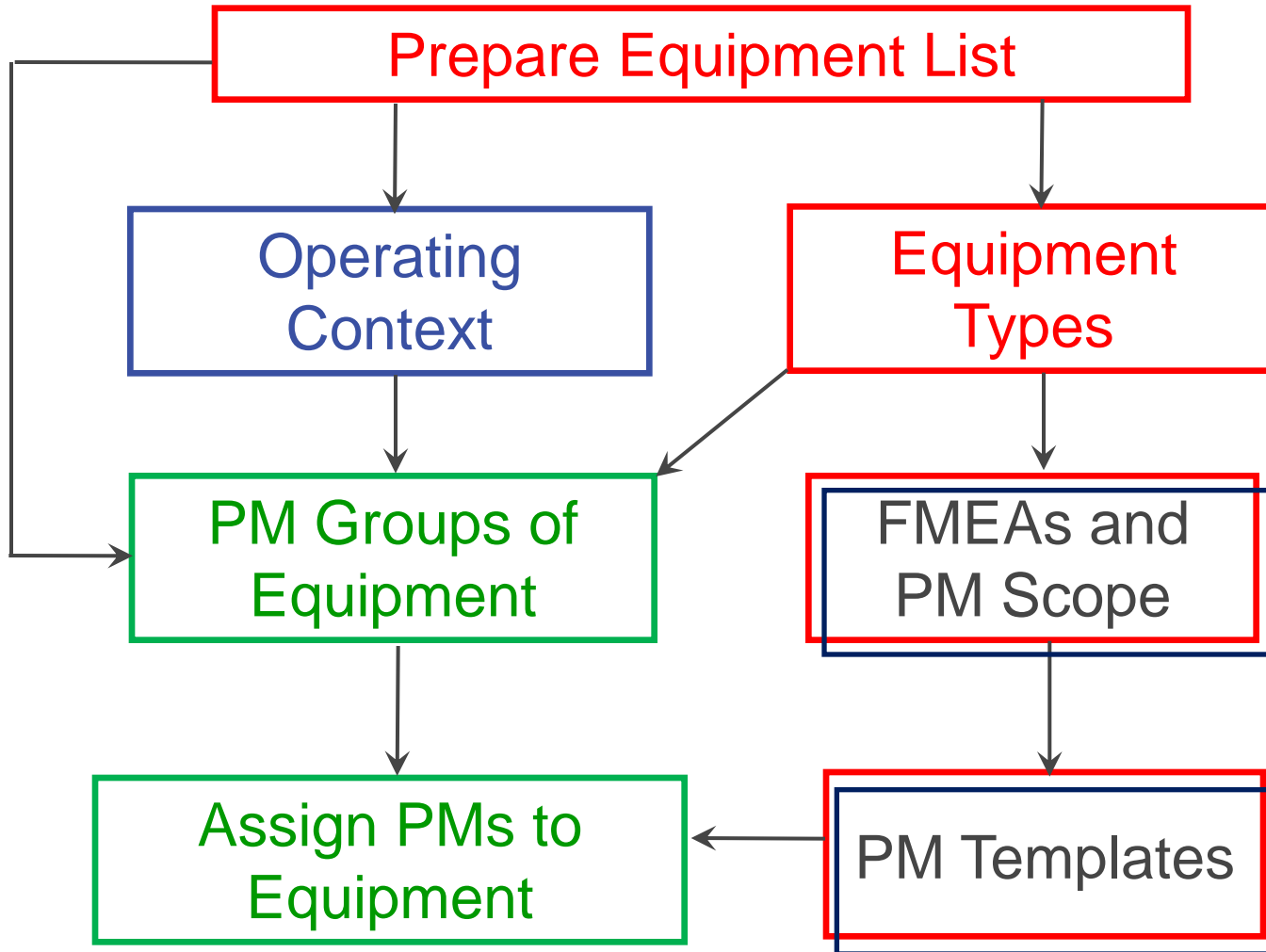
Work Flow for PM Improvement



Divide Team and Work Tasks in Parallel

- **Review of FMEA and PM Template library (tech. specialists and maintenance)**
- **Operating Context (operator and process engineer)**
- **Equipment list (tech. specialists and maintenance)**
- **Equipment types (tech. specialists and maintenance)**
- **PM Groups (contractor)**
- **FMEAs and scope of each PM (contractor)**
- **PM Assignments (contractor)**

Work Flow for PM Improvement



Use a Library of PM and Equipment Experience

- **You may be special (!) but you are not different**
- **Most FMEA's and PM Templates can be obtained elsewhere and some pre-worked**
 - ❖ Use established database from contractor
 - ❖ Will need to add some new equipment types
 - ❖ May need to review or update library of equipment types
- **Keep at high level but insist on pedigree content**
 - ❖ Does not need OEM and Model granularity
 - ❖ FMEA's must drive to level of cause that identifies failure pattern and time scale
 - ❖ FMEA's must map PM strategies to individual degradation mechanisms
 - ❖ FMEA's must contain effects of service stressors

Assignment of Operating Context

- **Do not waste time with an elaborate functional analysis**
 - ❖ Plants with well trained operators and expert process or system engineers can assign functional importance directly at equipment level
 - Use only facilitator, operator, and process engineer to work through the equipment list
 - At most, maintenance reviews the results off-line
 - Make notes on redundancy, duty cycle, service stressors, and seasonal variations, etc. as you go – use a simple scheme to speed progress, e.g. “1 of 2, alternated, not needed in winter, ~20% prod loss, adequate HC drain; C(B).”
 - ❖ Management may need categorization of consequences
 - Usually faster to do off-line from notes
 - ❖ Work in table mode to be most efficient

Keys to Speed *and* Consistency

- **Use a library of FMEA and PM Template information**
- **Divide team to use specialized expertise for specific tasks**
 - ❖ Work tasks in parallel
- **Use a fast method for functional analysis (criticality)**
 - ❖ Capture duty cycle and service condition info. at same time
- **Organize equipment types to apply PM Template methodology to groups of equipment IDs**
- **Maximize use of databases and spreadsheets**
- **Result can be a reduction in use of your personnel time by a factor of ten or more**

FMEA and Template Libraries

- **The Electric Power Research Institute (EPRI) has worked for 13 years to prepare a database of such information**
 - ❖ Pedigree is from the foremost equipment experts in the industry
 - ❖ Is used by fossil and nuclear power plants (e.g. 84% of nuclear plants use it) and power transmission and distribution
 - ❖ Has been used successfully for O&G applications
 - ❖ Has ~250 equipment types for balance-of-plant infrastructure equipment, e.g. pumps, compressors, turbines, heat exchangers, valves, motors, switchgear, instrumentation, dryers, fans, transformers, batteries, cables, etc.
 - ❖ Available at a cost that is only a fraction of the resources you will spend to develop such information independently

Conclusion

- **Work smart at every step in PM improvement**
- **Failure to do this will most likely lead to project failure**
- **Save plant personnel time by:**
 - ❖ Allocating specific expertise to the right steps
 - ❖ Work tasks in parallel
 - ❖ Use a library of equipment FMEA and PM information and lessons learned to reduce work load
- **O&G could adapt the EPRI database, share PM info., and cooperatively add O&G-specific equipment**
 - ❖ There is nothing particularly proprietary about PM information
 - ❖ Increasing penalties for environment, health, and safety infringements make competitive issues relatively less important