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KINECTRICS' DTRF/HWM 2005 LIFE CYCLE MANAGEMENT STRATEGY AND PLAN OUTLINE

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Kinectrics' DTRF/HWM 2005 Life Cycle Management Strategy And Plan Outline

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KINECTRICS

Darlington Tritium Removal Facility (TRF), and Heavy Water Management (HWM) Systems Life Cycle Management Strategy and Plan Outline

Kinectrics Report: K-011146-001-RA-0003-R1

June 2005

Steve Maloney
Applied Reliability, LLC

Kinectrics Inc has prepared this report in accordance with and subject to the Master Services Agreement (MSA) between Kinectrics Inc and Ontario Power Generation Inc dated January 1, 2002

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Life Cycle Management Strategy and Plan Outline

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June 2005

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KINECTRICS

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1 INTRODUCTION

1.1 LCM Background

Life cycle management (LCM) integrates plant engineering, operations, maintenance, aging management, regulatory, and economic planning to

- Manage plant conditions
- Optimize operating life
- Maximize plant value while maintaining plant Safety, Reliability (and Availability) and minimizing the cost of operating and maintaining the facility.

Life Cycle Management encompasses 3 key areas:

1. Periodic Assessment of the System, Component Health, and Vulnerabilities
    - Perform periodic assessments of system health and vulnerabilities. This activity analyzes the aggregate effect of various failures and trends of system performance, prioritizes corrective actions, and updates the long-term maintenance strategy.
    - Integrate system and component trends to develop overall indication of health.
    - Include operations and maintenance concerns to support management prioritization of equipment improvements.
    - Identify and prioritize vulnerabilities and ensure corrective action priorities are appropriate and that adequate progress is being made.
    - Assess the effectiveness of modifications or other corrective actions that have been implemented to verify that the desired improvements were realized.
    - Identify any aging or obsolescence concerns.
    - Identify specific actions, responsible persons or organizations, and target dates for completion.

2. Development and Updating of Long-Term Maintenance Strategy for Systems and Components

- Establish the optimal maintenance methods for each potential failure, and define the frequency for long-term condition-based maintenance, planned refurbishment, and replacement. Outage Management and Forced Outage Preparation are important facets of the plan. Long-term maintenance strategies for component types (based on Criticality) that exist in multiple systems should be included in each applicable system strategy for consistency.
- The following guidance is useful in determining the LCM Strategy:
  - Integrate the various maintenance tasks that have been established for each component type to group similar activities and avoid duplication of effort.
  - Look for opportunities to consolidate and integrate tasks, tests, and inspections.
  - Group predictive maintenance tasks to obtain overall health perspective (e.g., perform vibration, oil analysis, and thermography at the same time).
  - Adjust preventative maintenance (PM) and surveillance frequencies for optimal grouping (Functional Equipment Groups)
  - Align tasks for redundant components within the respective redundant trains (if possible).
  - Lay out major planned outage activities for multiple operating cycles.
  - Specify frequency for recurring activities that cannot be performed on-line.
  - Specify periodic requirements for infrequent activities (such as 10-year ISI, 5-year overhauls of major equipment, major PMs).
  - Ensure major modification plans are included in the design engineering department long-term schedule.
  - Use cross-discipline teams to help develop the plan; operations and maintenance personnel have important perspective and experience to contribute.
  - Lay out the time line and milestones for major activities.
  - Estimate resource and budget requirements.
  - Obtain management commitment to the plan.

3. Identification and Disposition of Aging or Obsolescence Concerns
   - Aging or obsolescence concerns that have been identified from the periodic health reviews, need to be integrated into the LCM Plan and a management strategy developed based upon the recommendations. The system and component improvement activities need to be input in the station business plan.
   - Some methods for identification of aging or obsolescence concerns:
     - Participation in industry groups such as Nuclear Utility Obsolescence Group (NUOG), CANDU owners groups[1]

[1] The DTRF is not a nuclear plant so the usefulness of these groups and the database data is limited. However the DTRF does contain a large number of common components such as non-cryogenic valves, liquid ring pumps, instruments etc. with the rest of the nuclear industry.

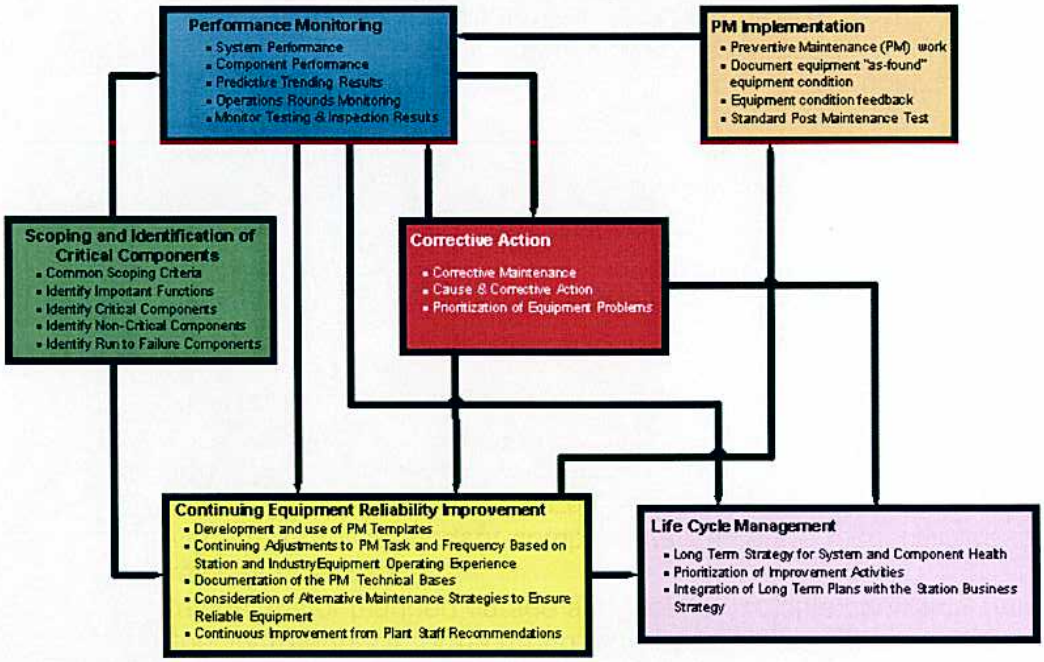
- Review of obsolescence and reliability databases such as EPIX and the Obsolete Item Replacement Database (OIRD) that is supported by NUOG
- System health reports and continuing equipment reliability improvement reviews
- Review the procurement process for any impact on equipment or parts purchases
- Vendor inquiries and notices
- Review of planned parts replacement in advance to ensure sufficient inventory and time for procurement, if needed
- Periodic review of approved ASME/TSSA suppliers list to determine if any pressure boundary material maintained in stock is traceable to a vendor not currently listed and thus requiring more extensive effort before use

These key areas require an alignment of goals across the entire station for them to be effective within the DTRF.

2 LCM PLAN GOALS

The LCM Plan will provide the structure for supporting the Equipment Reliability Process (depicted below) and consists of activities (PM, PdM, CM, MOD's, etc), schedules for those activities and projections of long-term expenditures. The LCM Plan is both a short and long term plan for Preventive (and Predictive) maintenance, replacement and or the redesign of SSC's important to safety and reliability that optimizes the SSC's contribution to the plant value. A review of the interaction of all constituents important to Equipment Reliability will provide the holistic capturing of the LCM process.

Equipment Reliability Process
Top Level Diagram



A well developed and properly implemented LCM plan

- Improves plant safety
- Improves plant reliability and availability
- Provides a framework to review aging mechanisms and their consequences for long-term plant life.
- Provides a method to address obsolescence.
- Integrates existing plant activities and programs such as Maintenance Optimization, RCM, Corrective Maintenance, Preventive Maintenance Basis and Equipment Qualifications.
- Captures Plant and Industry experience
- Links the plant and systems, structures and component deficiencies with the checkbook.
- Provides site ownership and empowerment of plant personnel. It is important that the Department Manager at the TRF own the LCM so that it can be driven from the highest level of the organization. The DTRF will also need to have similar types of staff that are found in the Generating Station, to address the LCM issues.
- Provides engineers with a methodology for performing equipment aging, obsolescence identification, performance and economic evaluations.

These goals require organization and infrastructure to accomplish.

3 LIFE CYCLE MANAGEMENT PLAN STRATEGY

The LCM Plan Strategy will provide the DTRF with the governance for establishing the process for performing equipment aging, obsolescence and performance evaluations. The objective of life cycle and aging management planning is to establish a registry of rational plans and select the LCM plan for each SSC that produces the optimum level of safety, reliability and economics over the life of the facility. The optimum strategy represents a summation of inputs from information and work groups such as engineers and managers to make better use of current DTRF data, taking into account all applicable factors such as safety, reliability, cost, risk of failure, regulations, public attention, and overall station and company goals. Engineering and management judgment is important since it is difficult to assign absolute failure risks and costs for all the aforementioned factors.

The strategy suggested for the DTRF is outlined below. The current project has produced some of the recommended output already. In addition, the Plant Condition Assessment Report (K-011146-PCA-0001) produced during this study (with input and feedback from the DTRF engineering staff), has already given a recommendation on the priority that should be given to specific equipment at the DTRF. Life cycle management is a process, and is not specific to the equipment priority.

An important point is that the process does not stop with a single assessment but is an ongoing process of continuing improvement.

DTRF Life Cycle Management Plan Strategy

1 Facility Objective

1.1 Determine Aging Management process for Tritium Removal Facility

1.2 Implement process to incorporate station personnel into the information, data collection, report creation and recommendations to continuously improve aging management and LCM process at DTRF

1.3 Develop a process to incorporate aging management for DTRF to Optimize Plant Operation

2 Plant Operating Strategies

2.1 Operate Plant for remaining design life

2.2 Support CANDU facility operating limits.

3 Selections of Structures, Systems and Components for Evaluation

3.1 Develop criteria for identifying SSC's for LCM evaluation.

3.2 Criteria needs to be applied agreed upon by site personnel and consistently applied.

3.3 Utilization of existing initiatives by site personnel should be used for review.

4 Plant Specific Evaluation Process

4.1 Review plant and industry Operating Experience

4.2 Review DTRF program upgrades

4.3 Review Current Maintenance Programs

4.3.1 Preventive Maintenance

4.3.2 Planned Maintenance

4.3.3 Corrective Maintenance

4.4 Prepare aging matrix and perform preliminary aging assessment

4.5 Determine appropriate level of evaluation for parts and assemblies

4.6 Identify credible aging management alternatives

4.7 Obtain or develop failure rate data

4.8 Obtain or develop cost data

4.9 Perform performance and economic evaluations

4.10 Select optimum SSC level aging plan

4.11 Roll-up data into station budget and final aging management plan

5 Observations and outcomes at the Tritium Removal Facility

5.1 Review actual versus expected outcomes of LCM project plan.

5.2 Challenge results and determine if changes to LCM process are required

5.3 Revise LCM Plans as required based on DTRF business planning and long terms station goals.

4 LIFE CYCLE MANAGEMENT OUTLINE

The LCM Plan Outline will provide the DTRF with the format for performing and documenting equipment aging, obsolescence and performance evaluations. The optimum LCM plan may not be the one with the lowest cost. The optimum LCM planning approach is almost always a strong function of the planned life of the facility. In developing the plan, life expectancy is important, but consideration may also be given for early shutdown, and operating for longer than the specified original end of life.

The following sections provide an outline of the process steps that should be considered in a LCM Plan. Obviously this template can be changed but provides a standard approach for the LCM Plan.

DTRF Life Cycle Management Plan Outline

1 Executive Summary

1.1 Describe the LCM process for identifying the most effective and economical way to manage the aging and obsolescence of important systems, structures and components.

1.2 Provide established Goals of LCM Plan relating to long term reliability, availability and economic value

1.3 Review results and recommendations of LCM Plan

2 Introduction and Background

2.1 Describe background of LCM process

2.2 LCM Integrates engineering, operations, maintenance, regulatory, environmental and economic planning.

2.3 Discuss LCM optimization of operating life.

2.4 Discuss how LCM will maximize plant value while maintaining value

3 Identify Structures, Systems and Components (SSC's) important to safety, availability and economics

3.1 Example criteria of SSC Selection for determining if an LCM plan is required – i.e. if any questions are answered "Yes" than LCM Plan is required; otherwise LCM plan is not required.

3.1.4 Is the SSC Risk Safety Related?

3.1.5 Can SSC cause the DTRF to trip or significantly lengthen the Outage schedule?

3.1.6 Is the failure of the SSC very costly?

3.1.7 Can the failure of the SSC lead to a Regulatory concern?

3.1.8 Is the SSC subject to significant degradation?

3.1.9 Is there an Obsolescence issue, or are parts hard to get, for the SSC?

3.1.10 Is the SSC a chronic maintenance problem?

4 Determine appropriate LCM evaluation level

4.1 Critical SSC's requiring in-depth LCM planning

4.2 Important SSC's requiring LCM planning

4.3 SSC's for which maintenance plans are adequate and formal LCM is not required

4.4 SCC's for which no maintenance plan is required

5 System Description

5.1 Safety and Operational Significance

5.2 SSC Functional Boundaries (*determined by the permit and blocking schemes of the site*)

5.3 SSC Design and Operating Parameters

6 Component Groupings

6.1 Groupings are SSC's that have common design features and are subject to similar service and environmental conditions.

7 Operating and Maintenance Experience

7.1 Review plant operating and monitored performance history

7.2 Review current maintenance plan

8 Industry Operating Experience

8.1 Review industry operating and performance history

8.1.11 Kinectrics, EPIX, OPEX, EPRI, COG, NRC, INPO, WANO, NEI etc.

8.1.12 PM Template Review of similar components

8.1.13 Performance Reviews

9 Determination of Maintenance Activities

9.1 Detailed review of Maintenance effectiveness

9.2 Reviewing Corrective Actions that were deficiencies in maintenance standards

10 System Performance Issues

10.1 Assess condition and performance

11 Aging Management Evaluation

11.1 Identification of the structure / components and its principle materials (*main materials of construction)*

11.2 Characterization of the expected operating environment

11.3 Identification of aging effects and their associated aging mechanisms

11.4 Review of any existing aging management programs previously performed

11.5 Perform technical obsolescence assessment (*is aging leading to the obsolescence of the SSC, is the unique nature of some of the custom components leading to obsolescence)*

12 LCM Planning Options

12.1 Develop operating strategies that are consistent with business plan, decommissioning time frame, etc.

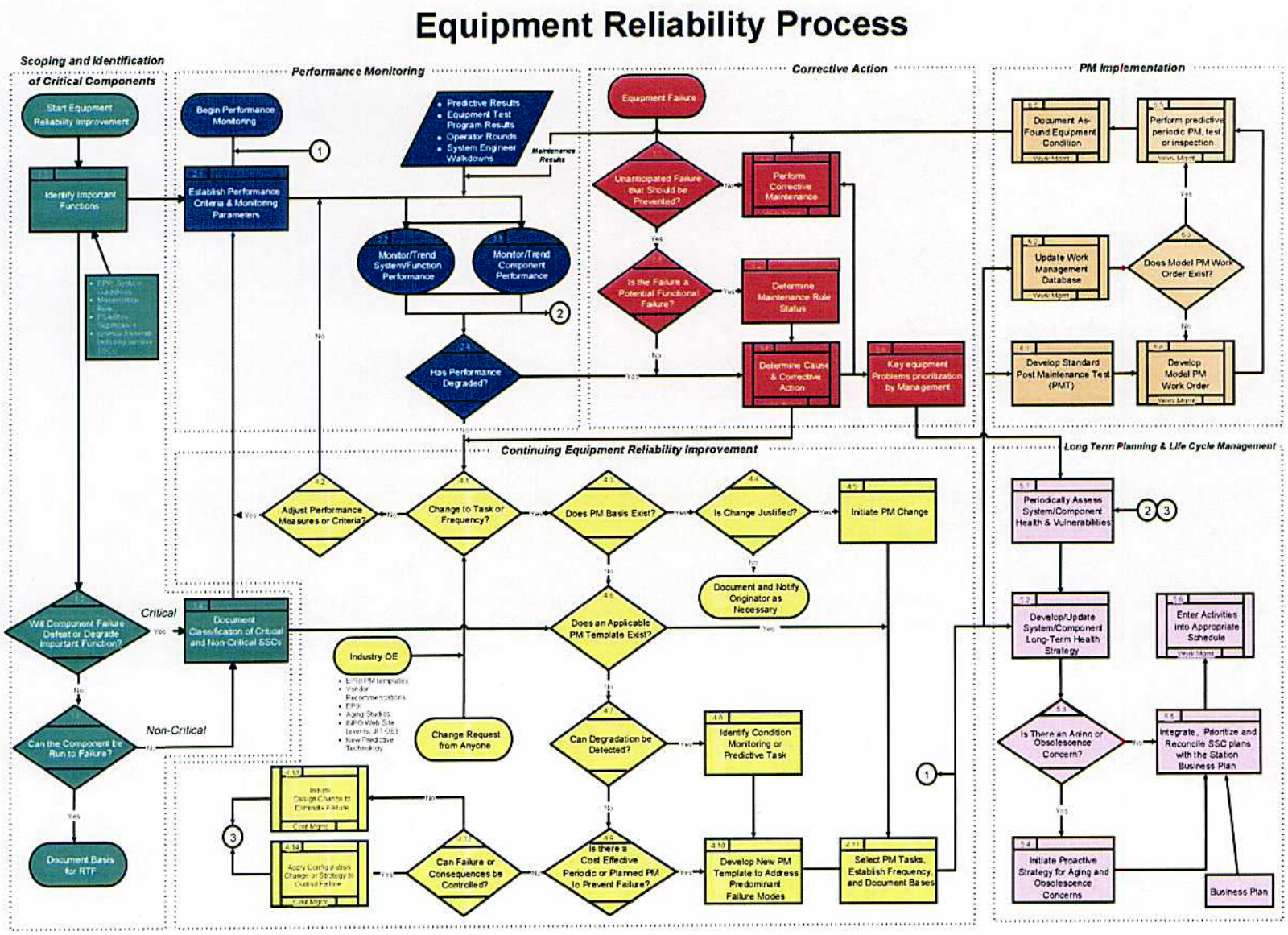
13 Summary of Results and Conclusions

14 Reference Materials

5 GLOSSARY

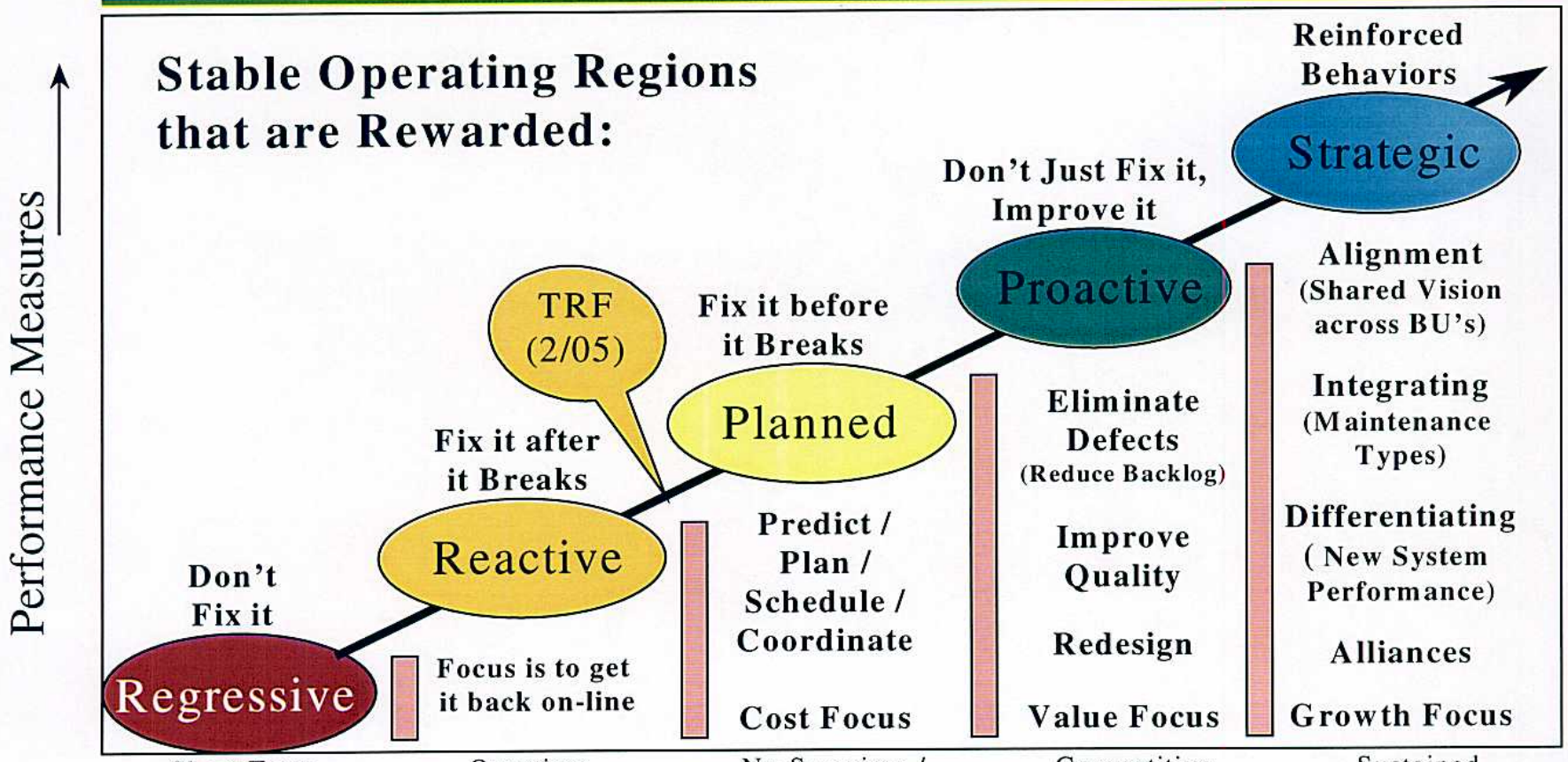
ASME	American Association of Mechanical Engineers
CM	Corrective Maintenance
EPIX	Equipment Performance Information Exchange
INPO	Institute of Nuclear Power Operations
ISI	In Service Inspection
LCM	Life Cycle Management
MOD	Modification
NEI	Nuclear Energy Institute
OPEX	Operating Experience
PdM	Predictive Maintenance
PM	Preventative Maintenance
RCM	Reliability Centered Maintenance
SSC	Structures, Systems and Components
TSSA	Technical Standards & Safety Authority
WANO	World Association of Nuclear Operators

6 APPENDIX – EQUIPMENT RELIABILITY DETAILED PROCES



7 APPENDIX – THE JOURNEY TO STRATEGIC MAINTENANCE

The Journey to Strategic Maintenance



Rewards:	Short Term Savings	Overtime Heroes	No Surprises / Competitive	Competitive Advantage	Sustained Life
Motivator:	Meet Budget	Breakdown Excitement	Efficiency, Cost Reduction	Documented Org. Successes	Growth & Profit
Behavior:	Allowing Decay	Responding	Planning	Organizational Discipline	Organizational Learning