

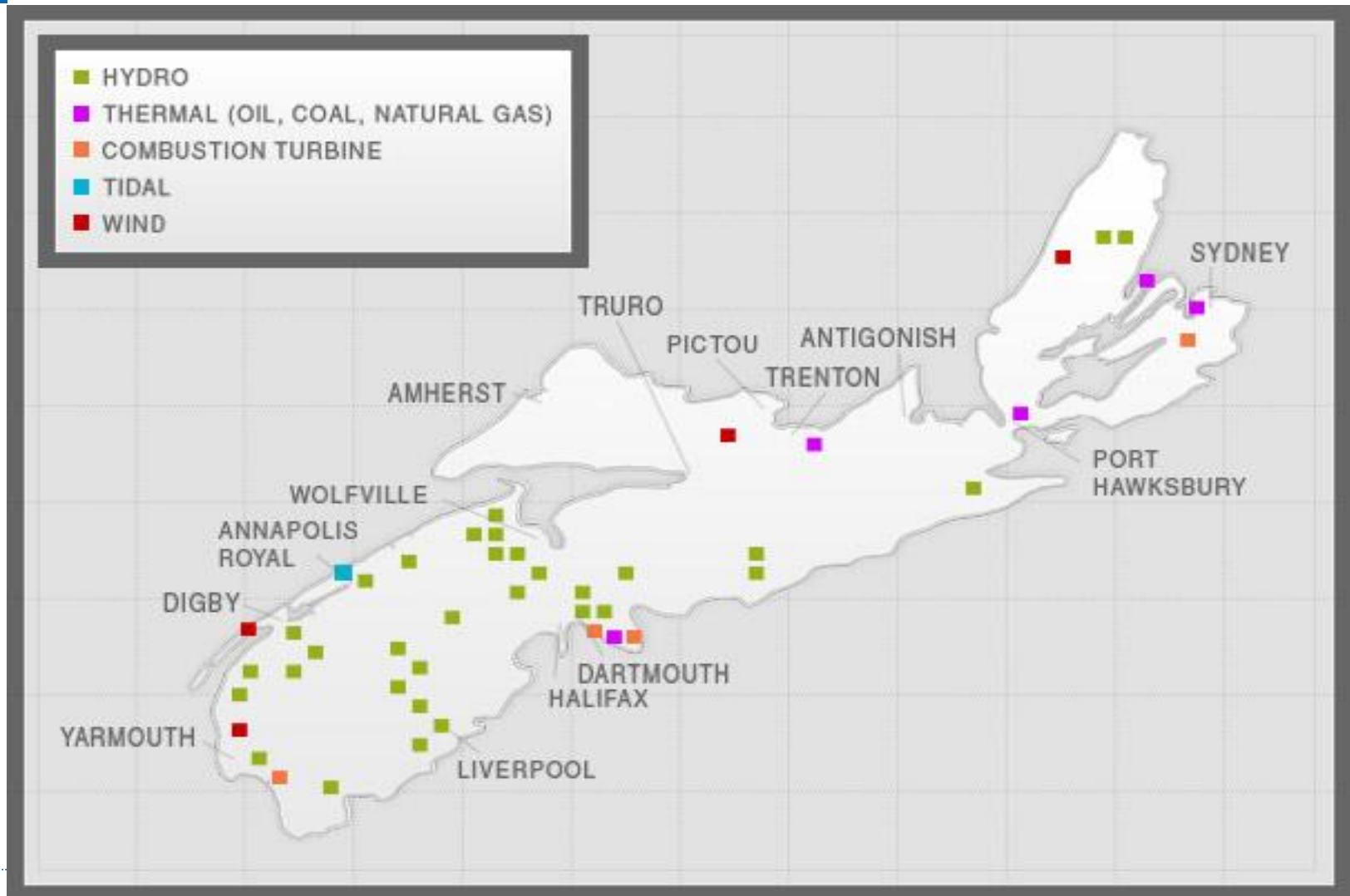
JAN. 2017

Nova Scotia Power:
Converging on Prognostics

Where We Operate



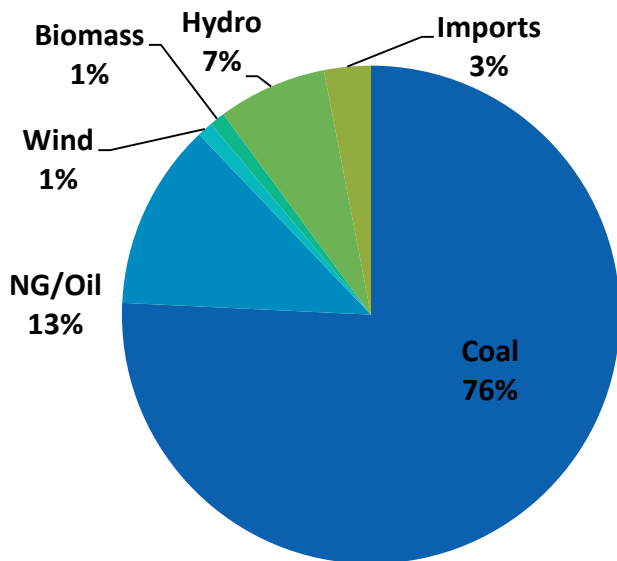
NSPI Generation



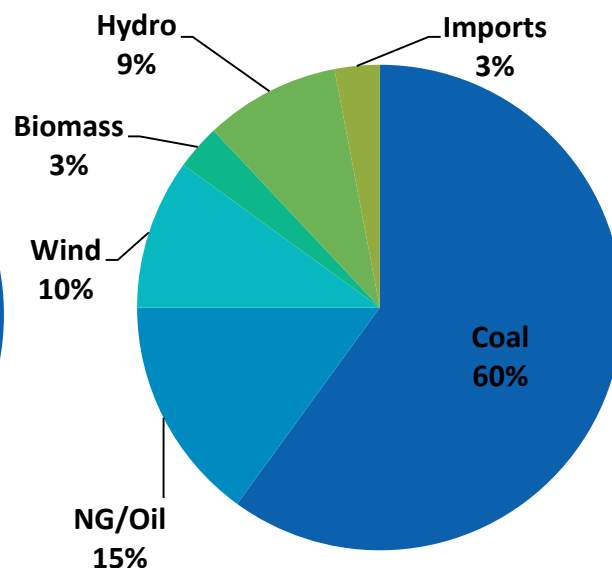
Nova Scotia's Renewable Energy Transformation

- 25% Renewable Energy by 2015
- 40% Renewable Energy by 2020
- Peak demand : 2100 MW
- Low load: 625 MW
- Wind Generation: >600 MW

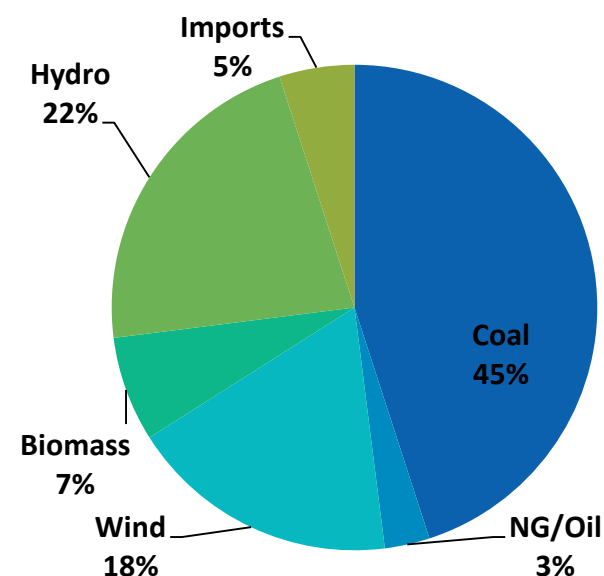
2007



2014



2020 forecast



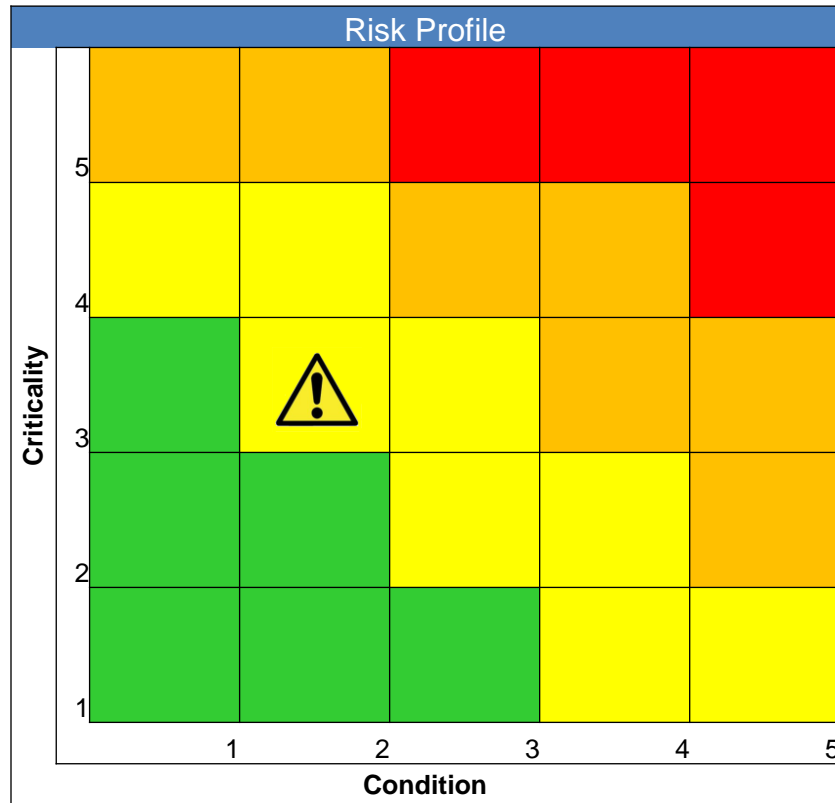
Asset Management: Strategic Drivers

- Changing Unit Utilization
- Planned Unit Retirement
- Demographics: Growing Knowledge Gap
- Due Diligence
- Growing Transparency Requirement
- Performance

Generating Fleet: Asset Management



Asset Management Mechanism:



Highest Risk

Mitigating Measures

Capital Replacement

Refurbish

Critical Spares

M&D

Re-Design

Operating Guides

Update

Maint. Strategy

Ops Surveillance

PMs

PdP

PdM/NDT

Health Assessments

Inform

Maintenance Strategy: Prescribed and Optimization

More effective

Less Effective

PDP

- Predictive Pattern Recognition

• Surveillance

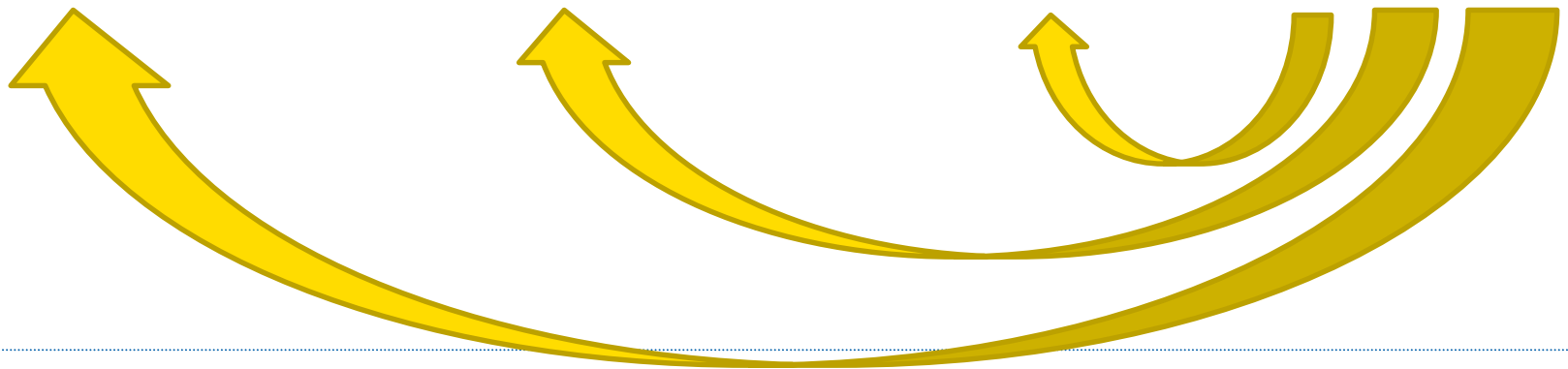
- Ops Rounds
- Maint Inspections
- Performance Testing
- HAs

• PdMs

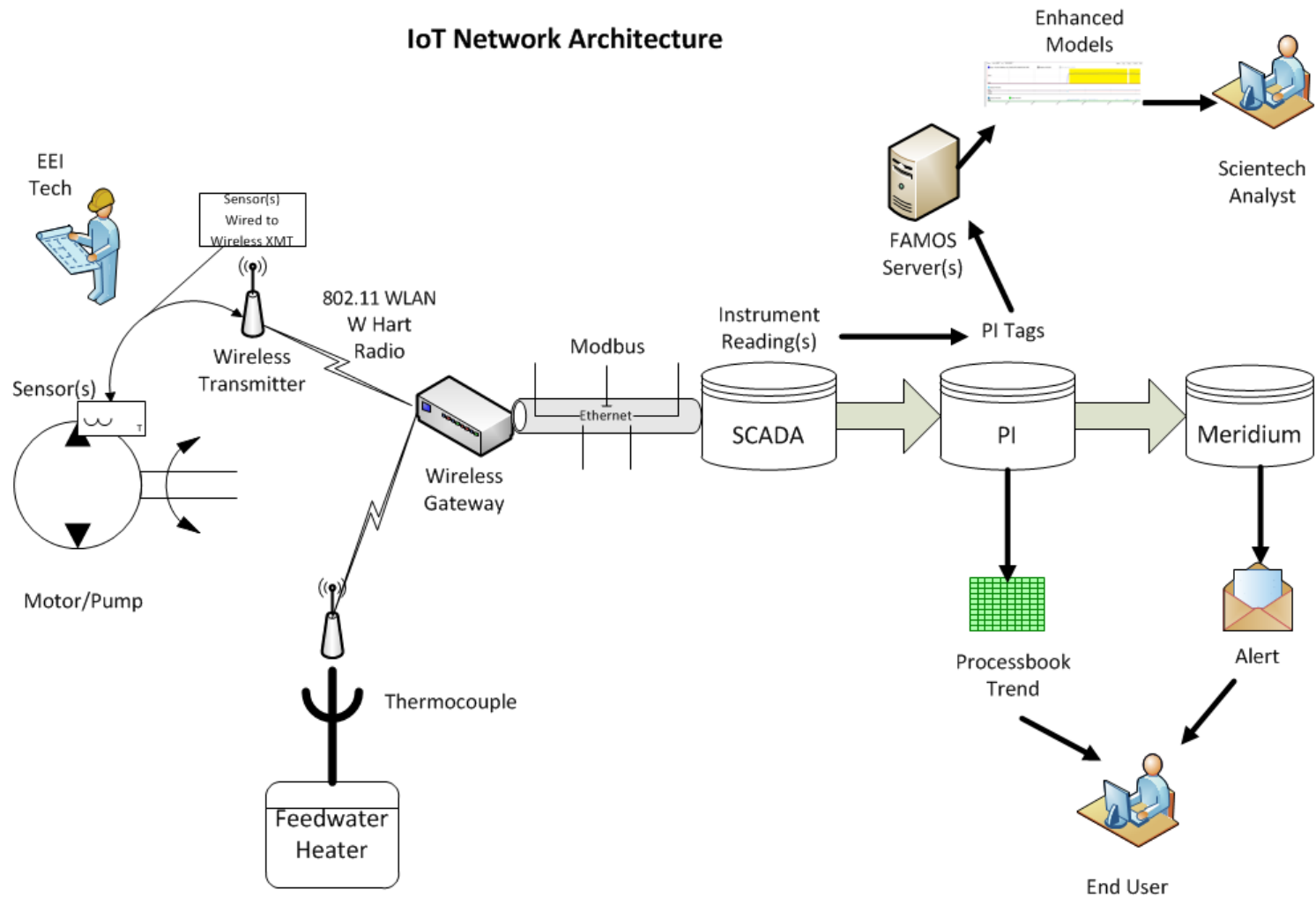
- Vibration
- UE
- IR
- MCM
- Oil Analysis

• PMs

- Time Based
- Cycle Based
- Condition Based



Evolution of Equipment Information Systems



Maintenance Strategy: Leveraging Technology Advance

More effective

Less Effective

PDP

- Predictive Pattern Recognition

• Surveillance

- Ops Rounds
- Maint Inspections
- Performance Testing
- HAs

• PdMs

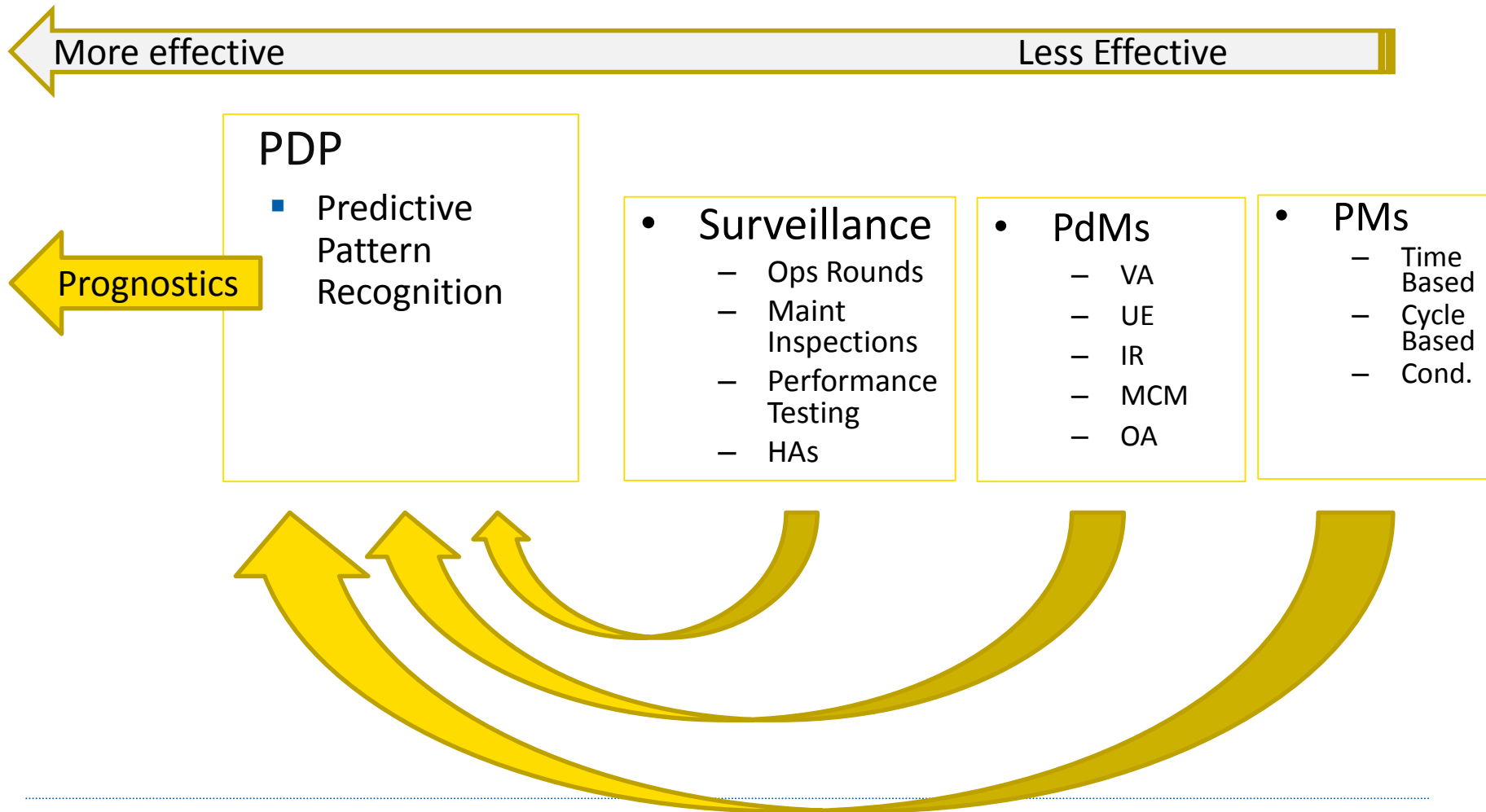
- Vibration
- UE
- IR
- MCM
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• PMs

- Time Based
- Cycle Based
- Condition Based



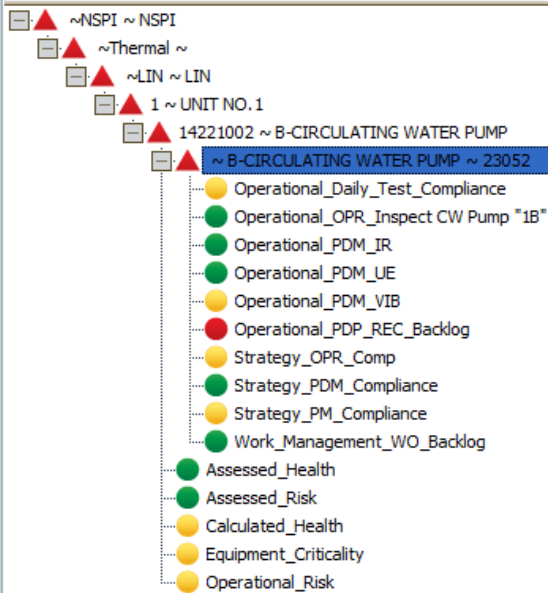
Maintenance Strategy: Evolution



Prognostics Requirement: Integration and Synthesis

Asset Health Manager - ~NSPI ~ NSPI

Health Indicator Explorer



X Hide Assets Without Health Indicators |

Clear All Filters

Add

Delete

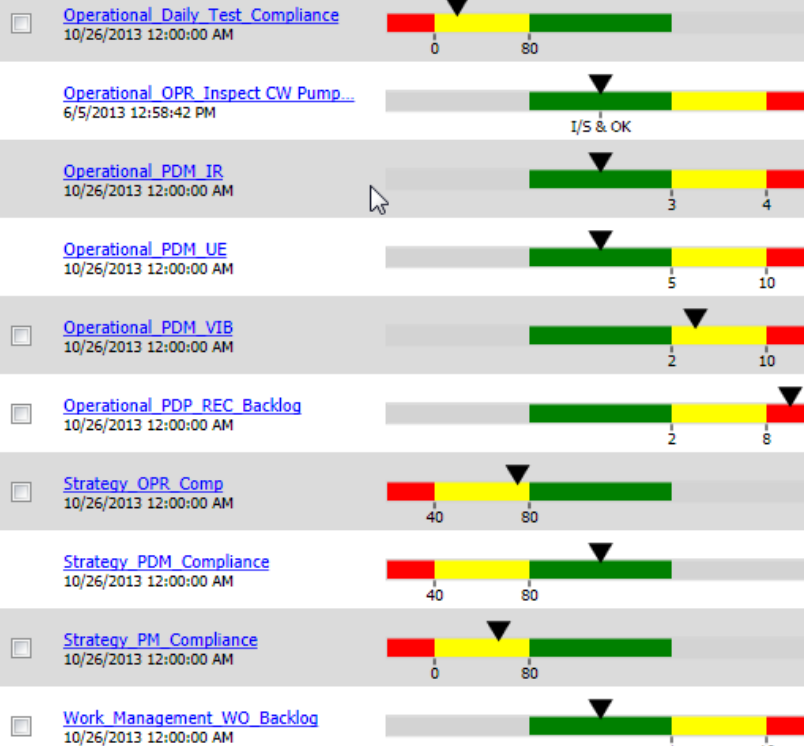
Summary

Policies

Recommendations

All

Indicators



TimeZone: Atlantic Daylight Time.

POSITION

1

+1.075

CURRENT LAP
1:24.052

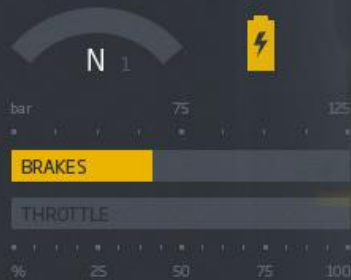
BEST LAP
1:23.781

TOP LAP SPEED

291 km/h

RACE
313 km/h

ENGINE



DRIVER

LEWIS HAMILTON

4

LATITUDE
45.61628

LOGITUDE
9.28078

ON SAFETY CAR
DO NOT PIT



EMPTY ON
END



NEXT PIT WINDOW LAPS

35 – 38

TYRE PRESSURE AND LIFE



TYRES AND LAPS RACED



PIT STOP TIMES
3.174 sec

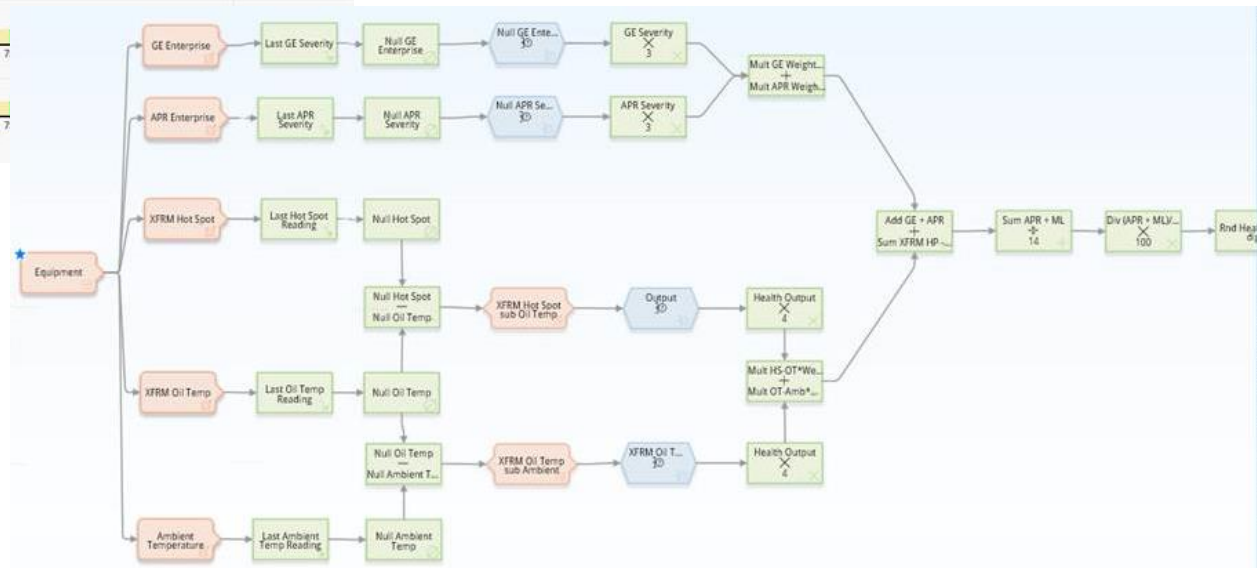
ON LAP
19

Operating: Health Calculations (Prognostics?)

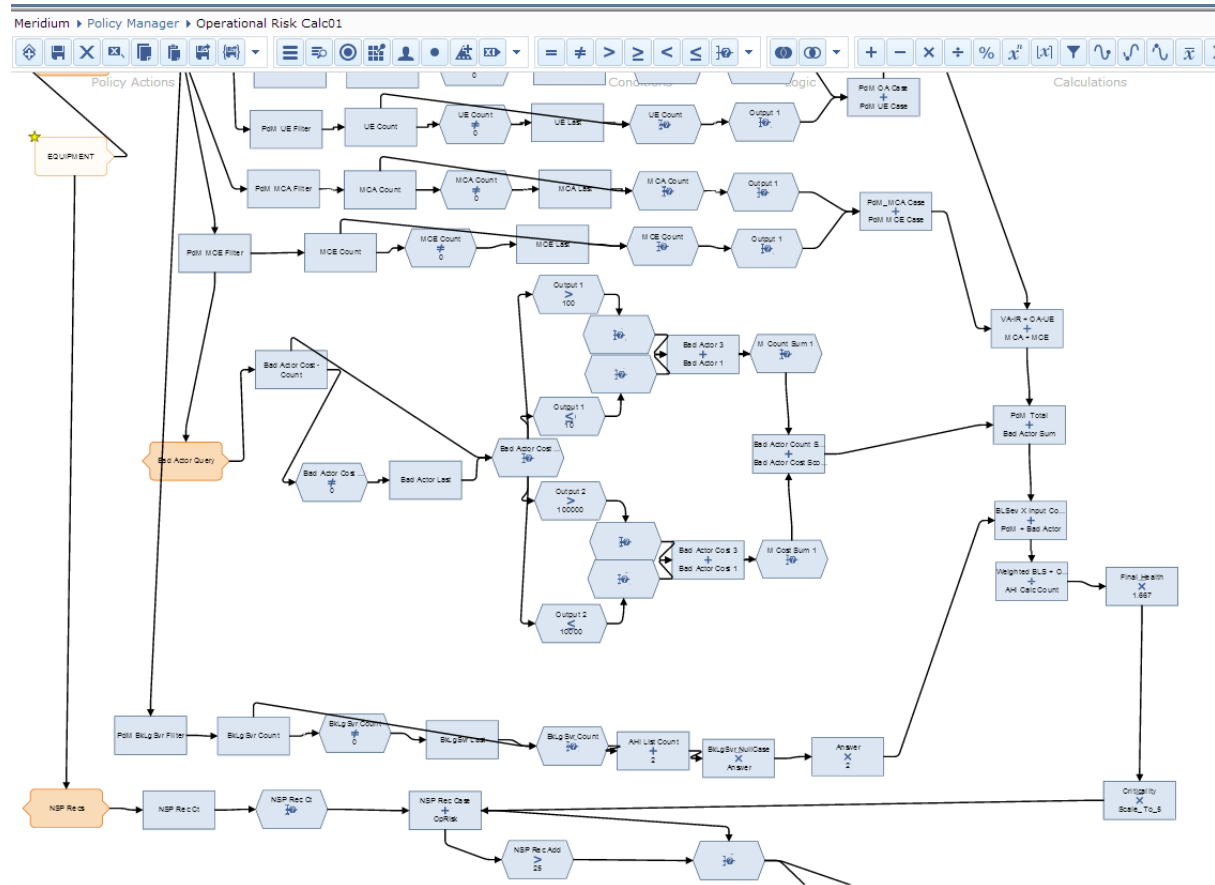
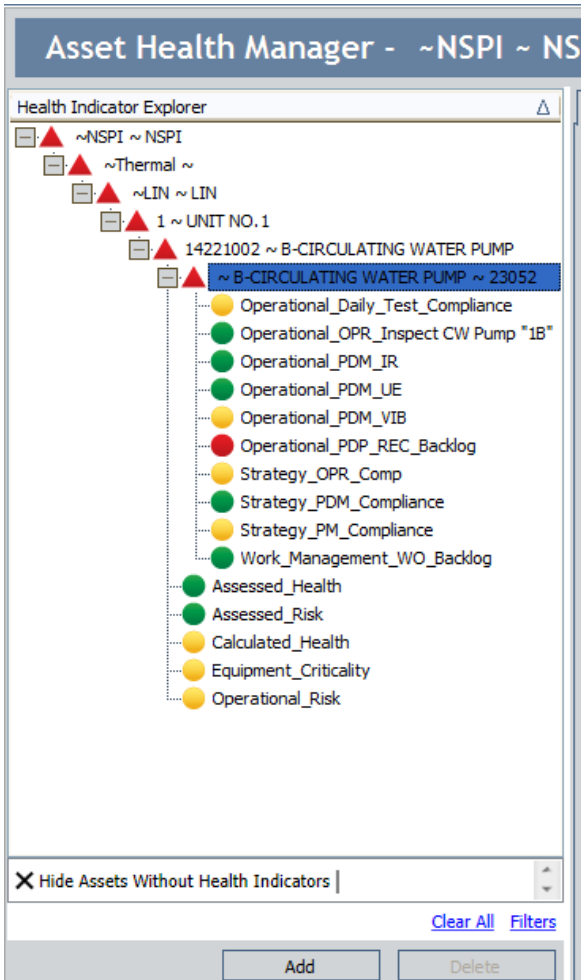
0 No Status 4 Normal 0 Warning 2 Alert

This Asset : 6 Indicators Subsidiary Assets : 0 Indicators

<input type="checkbox"/>	Status	Name	Health Indicator	Acknowledgment
<input type="checkbox"/>	Alert	T & D Power Trans Cooling 09/01/2016 12:13:28		
<input type="checkbox"/>	Alert	T & D Power Trans Load History 07/14/2016 02:30:03		
<input type="checkbox"/>	Normal	T & D Power Trans Insulation 07/13/2016 02:10:04		
<input type="checkbox"/>	Normal	T & D Power Trans Online Monitoring 07/13/2016 09:59:42		
<input type="checkbox"/>	Normal	T & D Power Trans Sealing and Connection 07/12/2016 02:40:03		
<input type="checkbox"/>	Normal	<< Overall >> T & D Power Trans 09/01/2016 12:13:32		

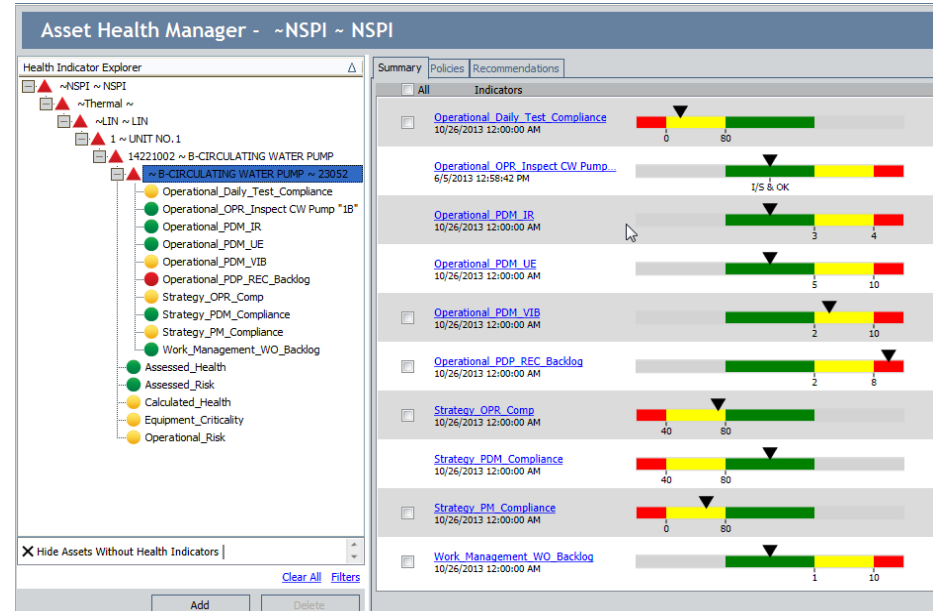
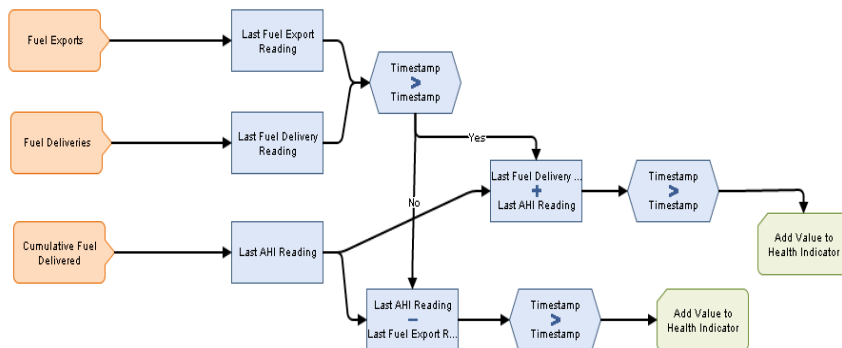
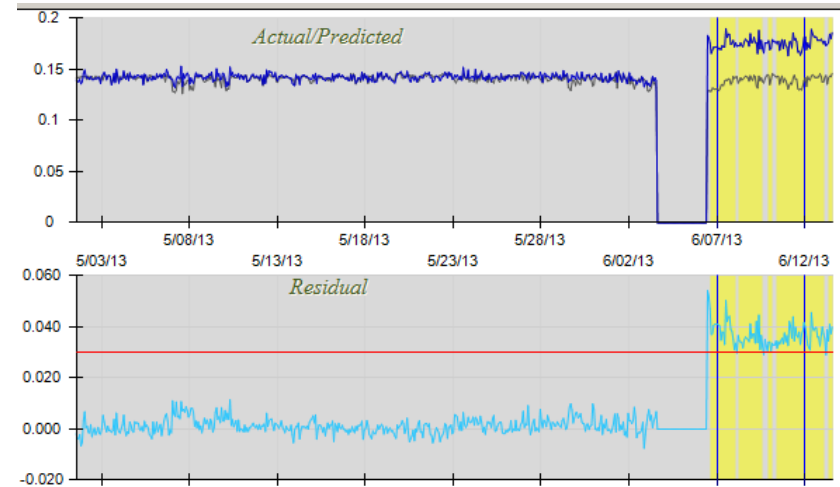
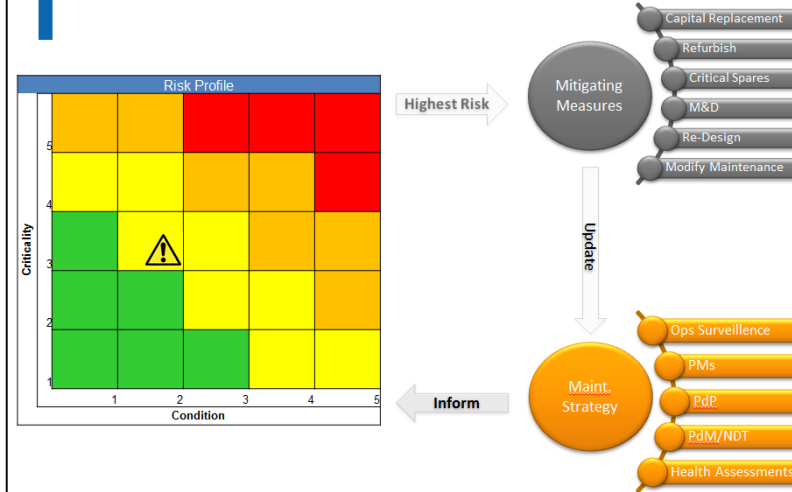


Operating Risk Calculation (Prognostics?)



Enabling Prognostics

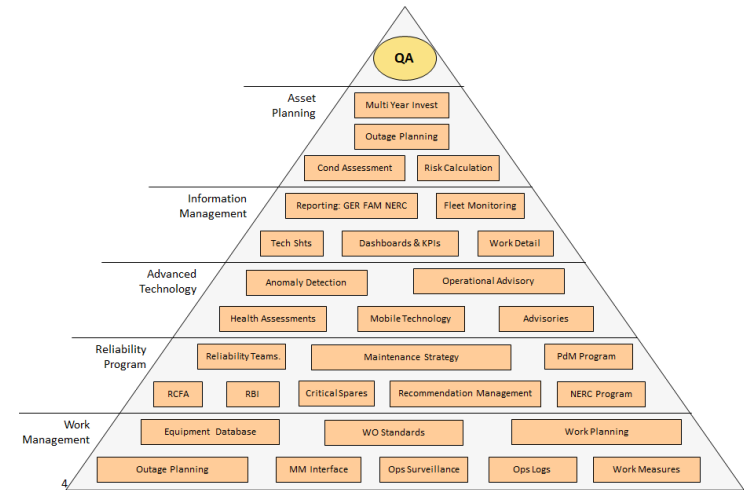
Asset Management Mechanism:



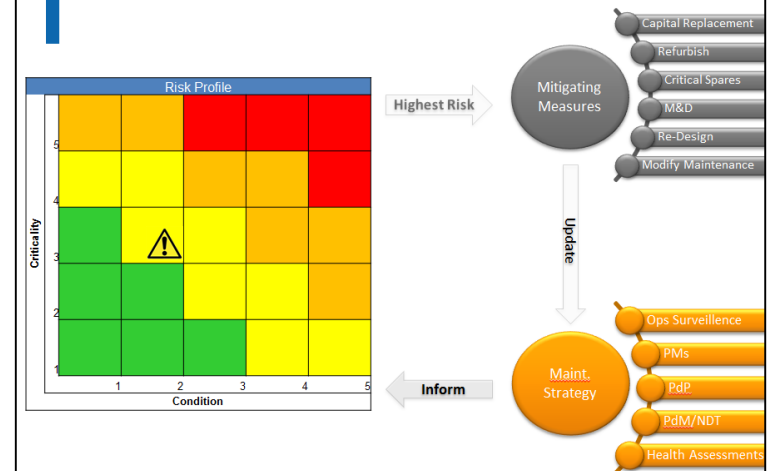
Value Discussion

- Risk Determination
- Decision Making:
 - Short Term Maintenance
 - Investment
 - Outages
 - Retirement Planning
 - Maintenance Strategy
 - Operating Guides
- Diligence
- Measurement/Reporting
- Management
- Performance

Asset Management Aspects



Asset Management Mechanism:



AHI(Asset Health Indicators)

Asset Health Manager - ~NSPI ~ NSPI

Health Indicator Explorer

- ~NSPI ~ NSPI
 - ~Thermal ~
 - ~LIN ~ LIN
 - 1 ~ UNIT NO. 1
 - 14221002 ~ B-CIRCULATING WATER PUMP
 - ~ B-CIRCULATING WATER PUMP ~ 23052
 - Operational_Daily_Test_Compliance
 - Operational_OPR_Inspect CW Pump "1B"
 - Operational_PDM_IR
 - Operational_PDM_UE
 - Operational_PDM_VIB
 - Operational_PDP_REC_Backlog
 - Strategy_OPR_Comp
 - Strategy_PDM_Compliance
 - Strategy_PM_Compliance
 - Work_Management_WO_Backlog
 - Assessed_Health
 - Assessed_Risk
 - Calculated_Health
 - Equipment_Criticality
 - Operational_Risk

X Hide Assets Without Health Indicators |

Clear All Filters

Add

Delete

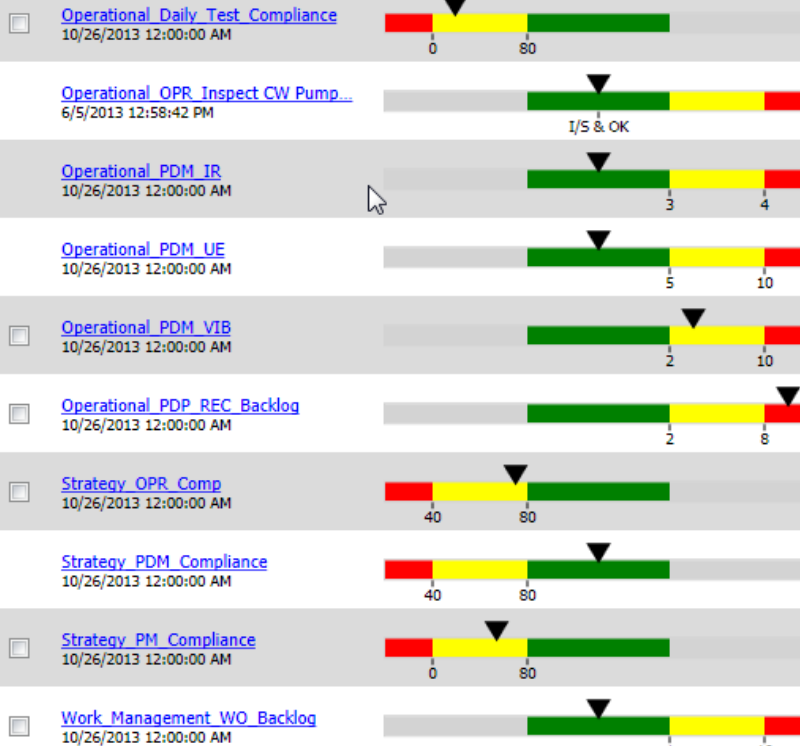
Summary

Policies

Recommendations

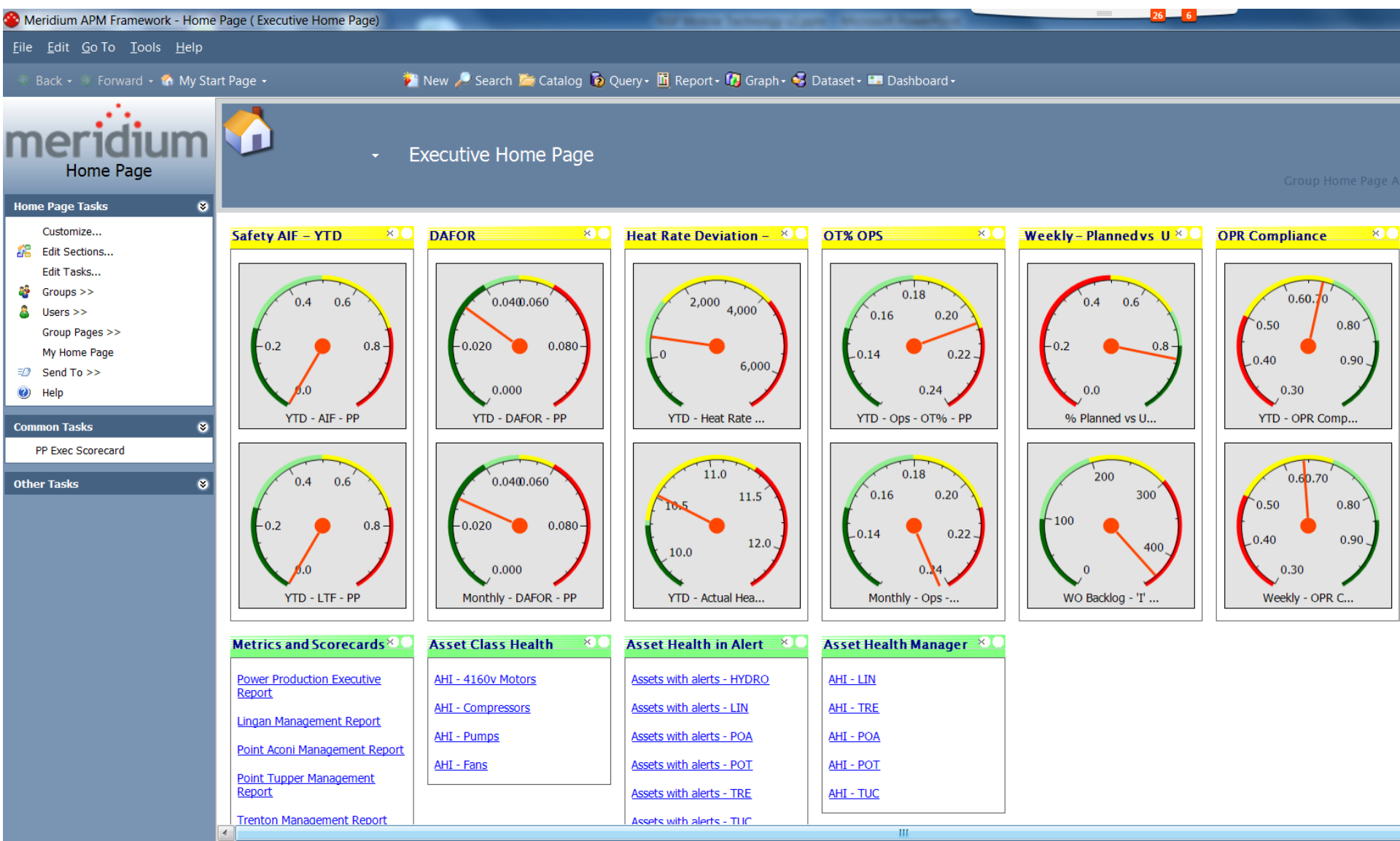
All

Indicators



TimeZone: Atlantic Daylight Time.

Management Support: KPIs & Dashboards:



Management Score Cards

meridium
Metrics and Scorecards

Scorecard

- Designer
- Manage Privileges
- Change Period
- Select Columns

Common Tasks

- New Scorecard
- Open Scorecard
- Save Scorecard
- Save As
- Delete Scorecard
- Print Scorecard
- Documents
- Send To >>
- Help

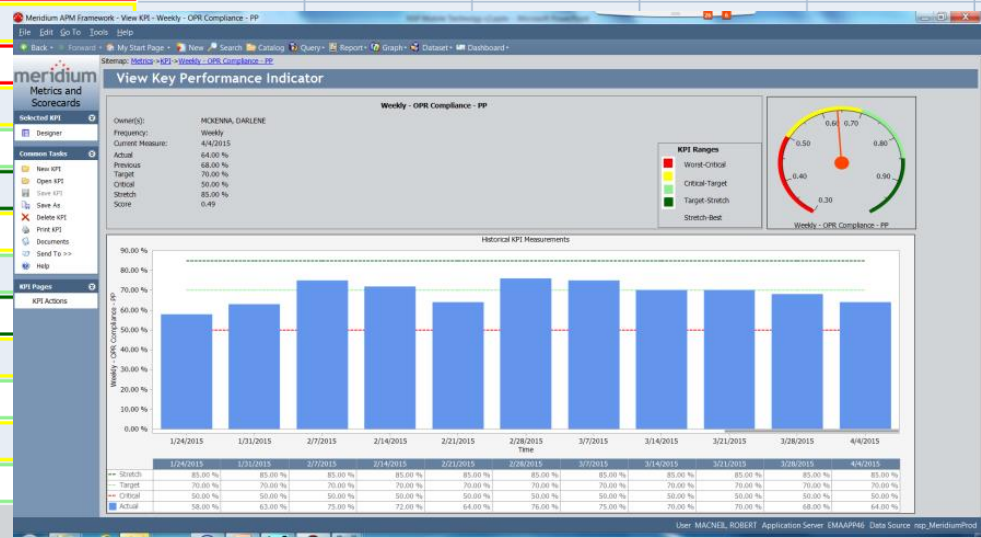
Scorecard Pages

- Heat Rate Deviation...

Sitemap: [Metrics](#)->[Scorecard](#)->[1. Power Production Executive Scorecard](#)

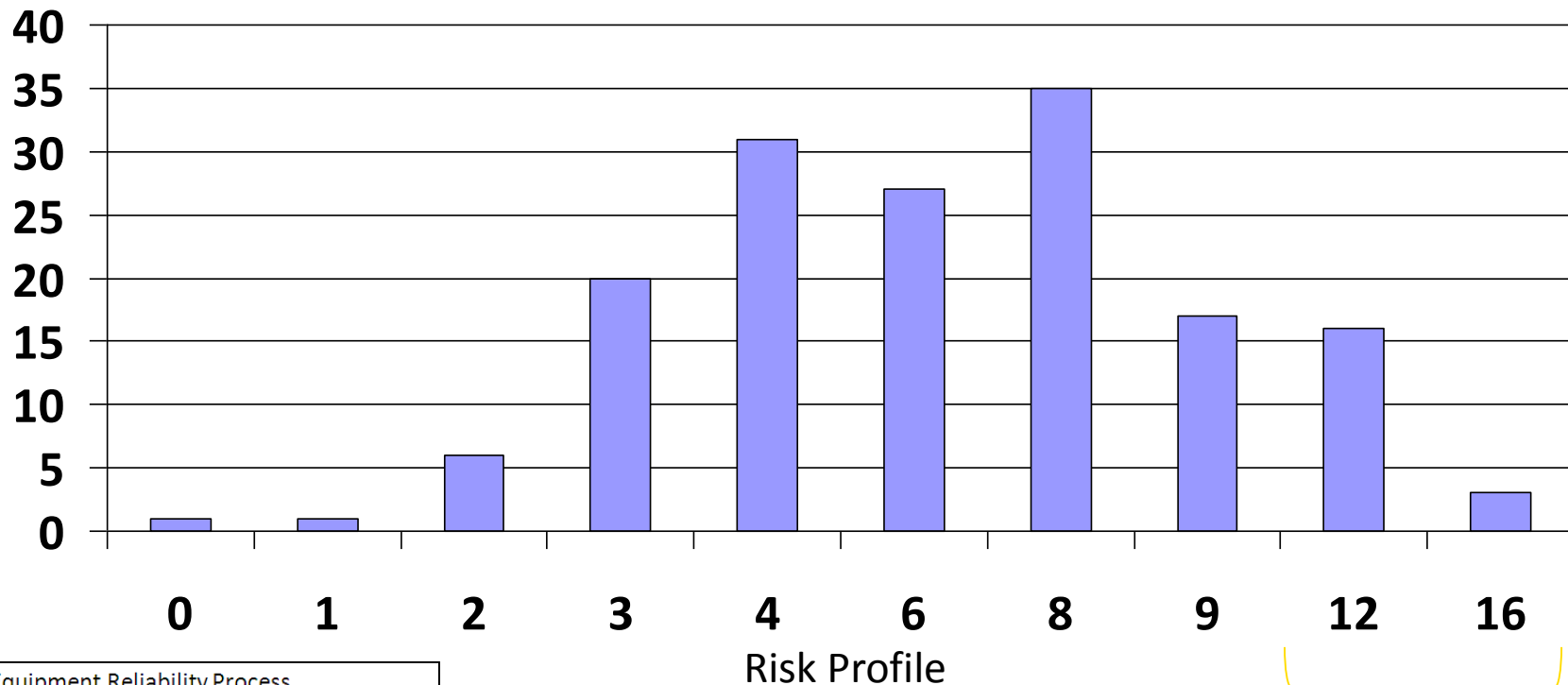
View 1. Power Production Executive Scorecard

	Actual	Event Date	Frequency	Previous	Target	Action
Asset Strategy						
Compliance to Strategy						
YTD - PM Compliance - PP	75.26 %	3/28/2015	Weekly	75.00 %	85.00 %	
Weekly - OPR Compliance - PP	64.00 %	4/4/2015 11:21	Weekly	68.00 %	70.00 %	
OPR Compliance BG	17.00 %	4/4/2015 11:21	Weekly	75.00 %	70.00 %	
OPR Compliance BIO	100.00 %	4/4/2015 11:21	Weekly	90.00 %	70.00 %	
OPR Compliance LIN	55.00 %	4/4/2015 11:21	Weekly	51.00 %	70.00 %	technical diffiuc
OPR Compliance POA	92.00 %	4/4/2015 11:21	Weekly	96.00 %	70.00 %	Outage in prog
OPR Compliance POT	83.00 %	4/4/2015 11:21	Weekly	97.00 %	70.00 %	
OPR Compliance TK	0.00 %	4/4/2015 11:21	Weekly	58.00 %	70.00 %	
OPR Compliance TRE	49.00 %	4/4/2015 11:21	Weekly	74.00 %	70.00 %	Apr 02: Improv
OPR Compliance TUC						
OPR Compliance TUCLM						
YTD - OPR Compliance - PP						
OPR Compliance YTD - BG						
OPR Compliance YTD - BIO						
OPR Compliance YTD - LIN						
OPR Compliance YTD - POA						
OPR Compliance YTD - POT						
OPR Compliance YTD - TK						
OPR Compliance YTD - TRE						
OPR Compliance YTD - TUC						
OPR Compliance YTD - TUCLM						
Critical PM Compliance - Non-Outage						



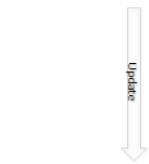
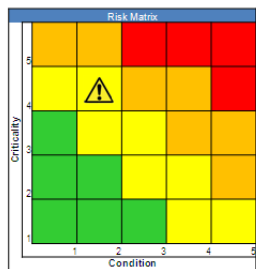
Risk Profile: Simple Asset Class

4160V Motor Risk profile



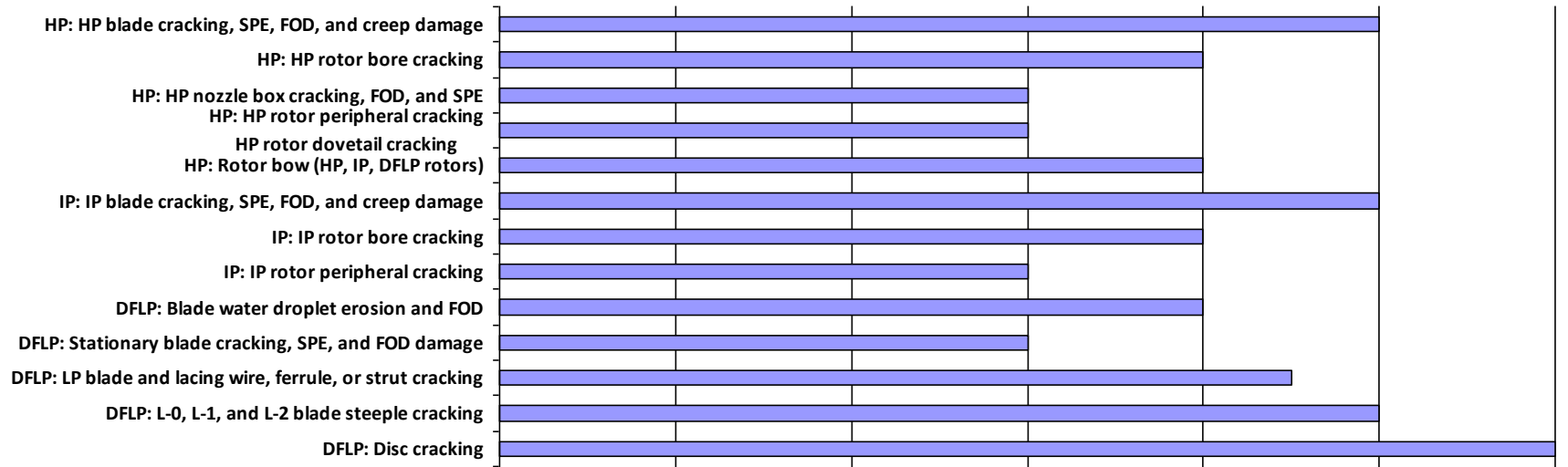
Target for Mitigation

Equipment Reliability Process



Risk Profile: Complex Asset Class

TUC2: Primary Issues Rating

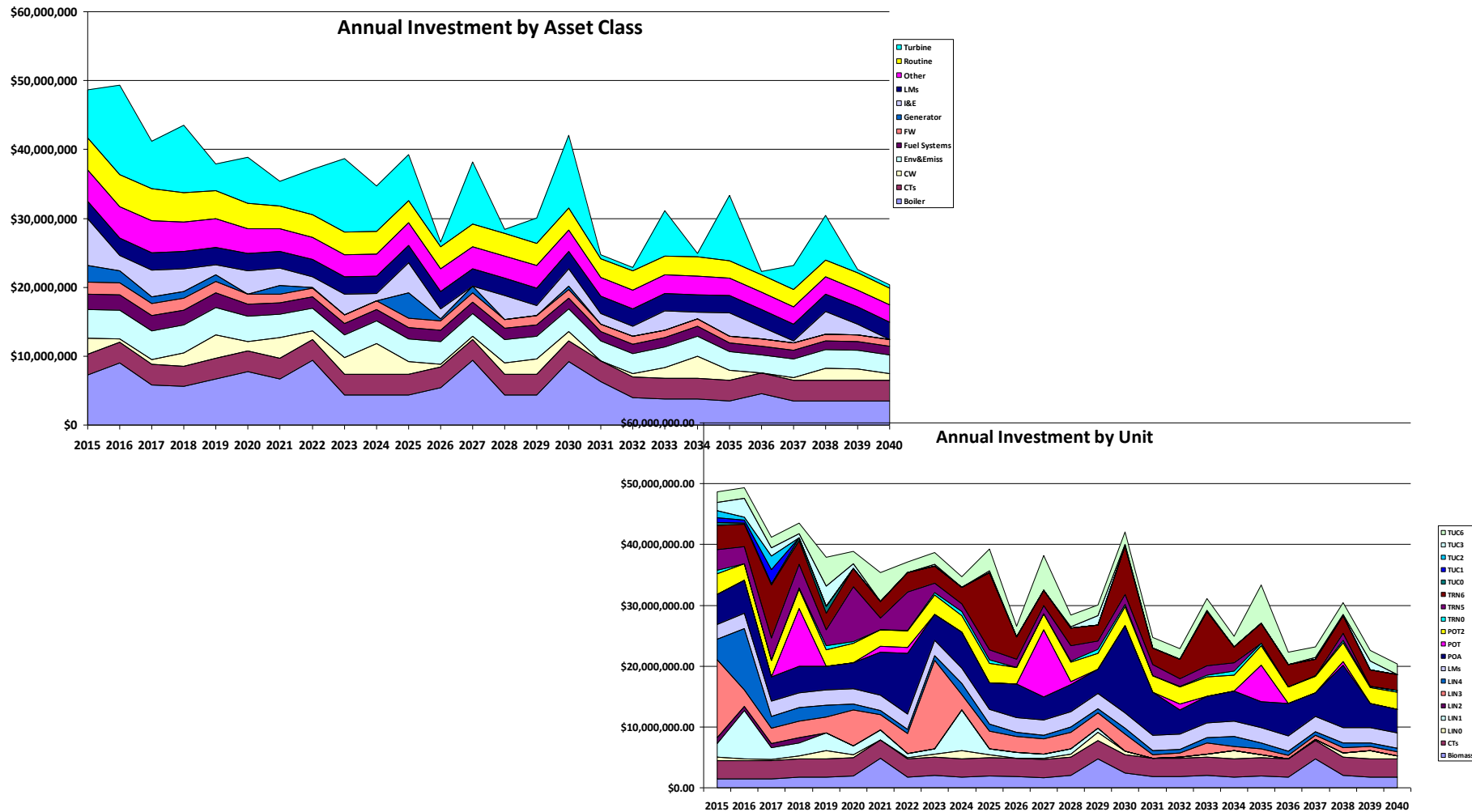


NSPI Equipment Reliability Process



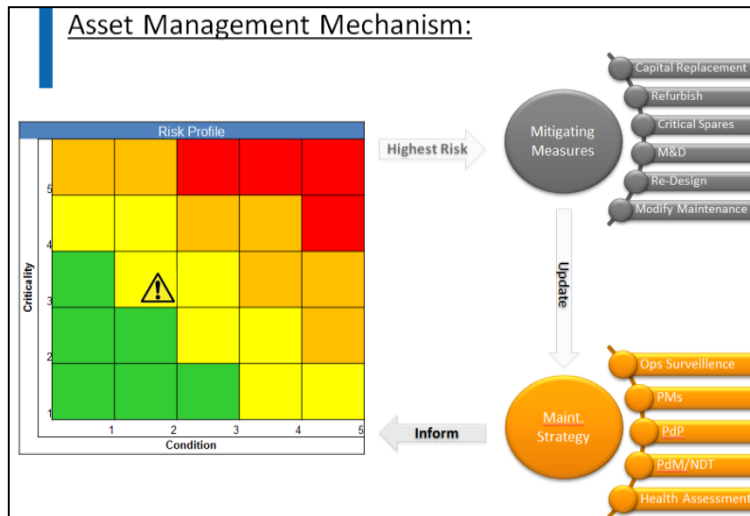


Strategic Planning: 20 yr Investment Projections



NSP Asset Management: Questions???

- Comprehensive methodology
- Design:
 - NSPI operational expertise
 - ISO 55000 (PAS-55)
 - Industry reliability orgs and experts
 - Industry relationships



Key features:

- Holistic
- Highly integrated processes
- Data integration and synthesis
- Fleet deployment
- Proactive programs and technology
- Engagement

Questions?