



Materials Group Asset Integrity Management

Maximizing Return on Assets while Minimizing Risk

2010

AIM Objectives

Asset Integrity Management, **AIM**, is a broad group of tools to maintain plant assets in a fit-for-service condition while extending these assets remaining life in the most **cost effective**, **safe** and **reliable** manner

OBJECTIVES

- maximizing return on assets
- maintaining stakeholder value
- minimizing business risks

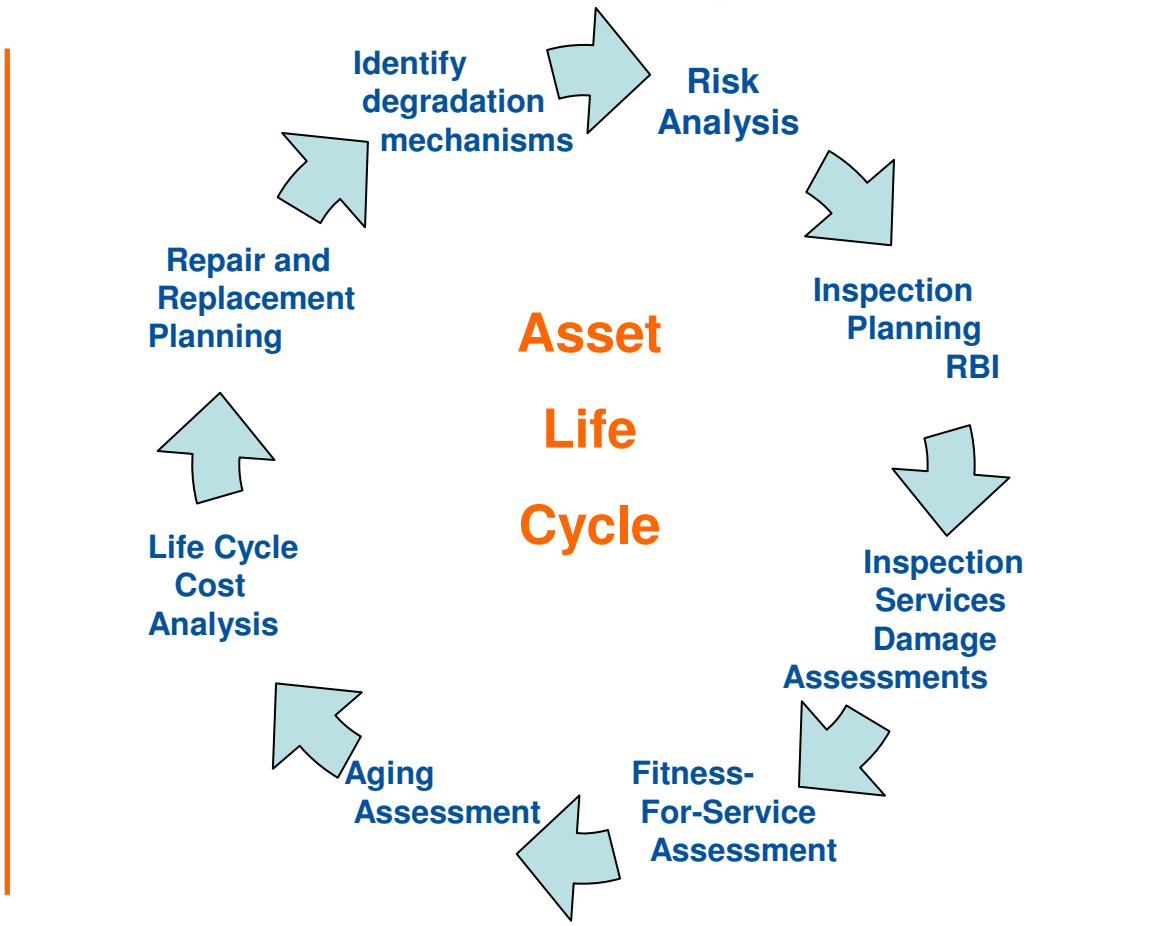


BPR-Bechtel-XPS materials group unique skill and experience base offers customized support at any level of AIM development and implementation process and through the full equipment life cycle using the latest know how in materials science

AIM services

Design

- Materials Selection
- Fabrication Specification
- QA in Fabrication
- Welding Procedure
- Process Review
- Design Verification



Support

- Fire and damage assessment
- Expert Witness
- Training
- Fracture Analysis
- Root Cause Failure Analysis
- Materials Testing for Corrosion and Wear

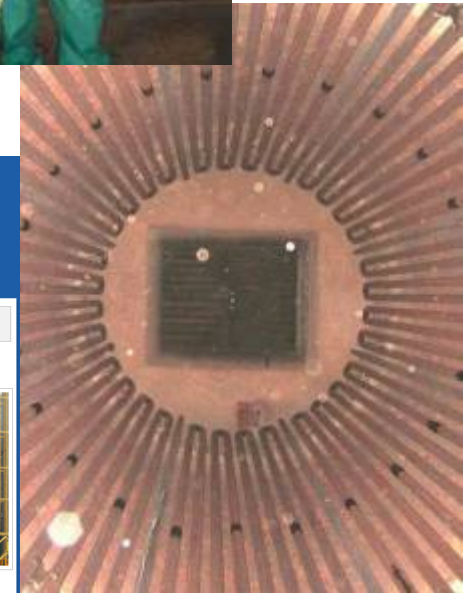
Inspection Services

- Acid Plant Inspection



- Risk-Based Inspection Program

- Tank Inspection Program



- RBIWeb for M&M

BPR BECHTEL

Site: OZinc > Department: Hydrometallurgy > Unit: Neutral Leach > Equipment: LN5

EQUIPMENT

Equipment Details

Add Edit Delete

LN5

Equipment Name:	LN5	
Equipment Type:	Process Tank	
Equipment Number:	21-335	
Construction Date:	1980	YYYY
Design Code:	API650	

Process

Process PH:	4.00	
Acid %:	%	
Process Temperature:	80	°C
Velocity:	m/s	
Solid:	<input checked="" type="checkbox"/>	



Acid Plant Inspection

Services:

- Inspection procedures and programs tailored to critical equipment
- Qualified inspection personnel



Clients:

CEZinc, Xstrata: Kidd Creek, Horne, Altonorte, Raglan

Some Results from our group

- At one site, the initiation of acid plant inspections aided in the improvement of plant availability by 5% - a savings of nearly \$3.5M.
- At another site, an inspection prevented the failure of an absorption column.

RBI Benefits

Increase:

Equipment reliability and safety
Intervals between inspection
Asset value
Production time
Auditability

Decrease:

Planned shutdown time
Unplanned shutdowns
Maintenance costs
Inspection costs

Typical maintenance cost savings are 10 to 15%

Some Results from our group

Refinery Crude Unit:

- inspection postponed or reduced to an external inspection for 52 out of 63 drums and exchangers.
- Average inspection interval for 51 Pressure Relief Valves (PRV) increased from 4.9 years to 7.4 years.

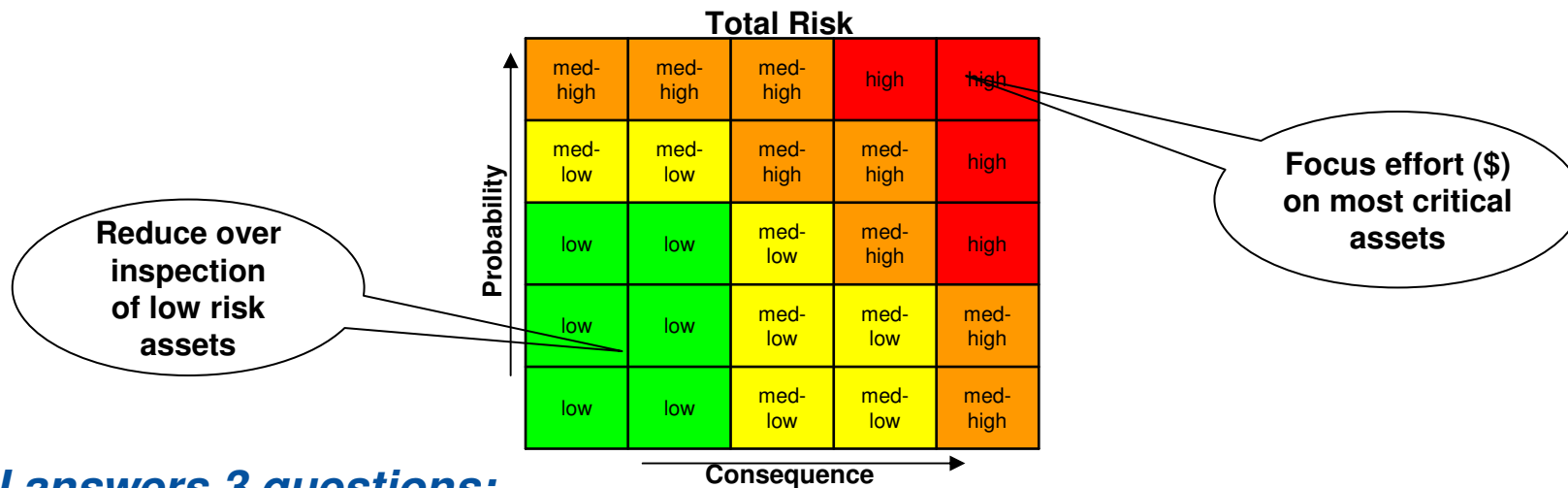
Zinc Hydrometallurgy plant:

- inspection postponed on 11 out of 18 tanks
- average interval increased from 7 to 12 years

Risk-Based Inspection (RBI) Principles

RBI is an industry recognized tool to plan inspection activities based on relative risk

Probability and Consequence of Failure are considered simultaneously



RBI answers 3 questions:

What?

Which assets need to be inspected



When?

The optimum interval between inspections



How?

Which technique and level of inspection are required



RBIWeb for Mines & Metals

*Simplifies and customizes
API 581 methodology*

- Damage mechanisms and consequences specifically adapted for the mineral treatment industry
- Web based simple to use platform
- Easy data collection and information sharing with existing management systems
- Can also be used in any other environment where damage and corrosion are a concern

The screenshot displays the RBIWeb application interface. At the top, the BPR BECHTEL logo is visible. The main content area is titled 'HOME PAGE' and includes a 'Welcome to RBI Web' message. Below this, there is a description of the application and an aerial photograph of an industrial facility. A sidebar on the left contains navigation links for Home, Welcome, RBI Manager, Reports, System Manager, and User Manager. Below the home page, the 'COMPONENT' section is active, showing a dropdown menu for 'Shell - Décanteur # 7'. A table displays the 'Risk (\$)' over a 16-year period from 2010 to 2025. The risk values are: 3,171 (2010), 4,205 (2011), 5,432 (2012), 6,848 (2013), 8,442 (2014), 10,200 (2015), 12,109 (2016), 14,157 (2017), 16,339 (2018), 18,660 (2019), 21,142 (2020), 23,827 (2021), 26,787 (2022), 30,128 (2023), 33,998 (2024), and 38,597 (2025). Below the table, the COF is listed as 785,000 \$ and the Next Inspection is set for 2025.

Risk (\$)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Risk (\$)	3 171	4 205	5 432	6 848	8 442	10 200	12 109	14 157	16 339	18 660	21 142	23 827	26 787	30 128	33 998	38 597

COF: 785,000 \$
Next Inspection: 2025

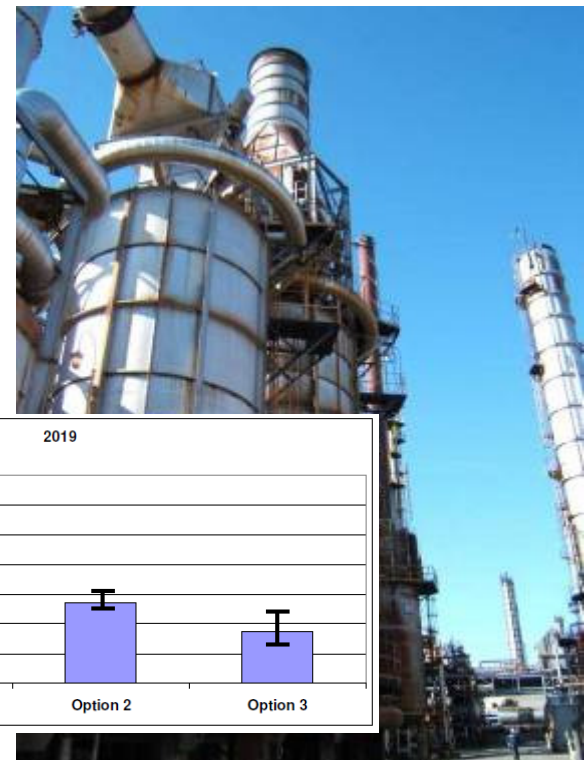
Aging Assessment

To effectively **optimize the risk-cost function of aging assets**

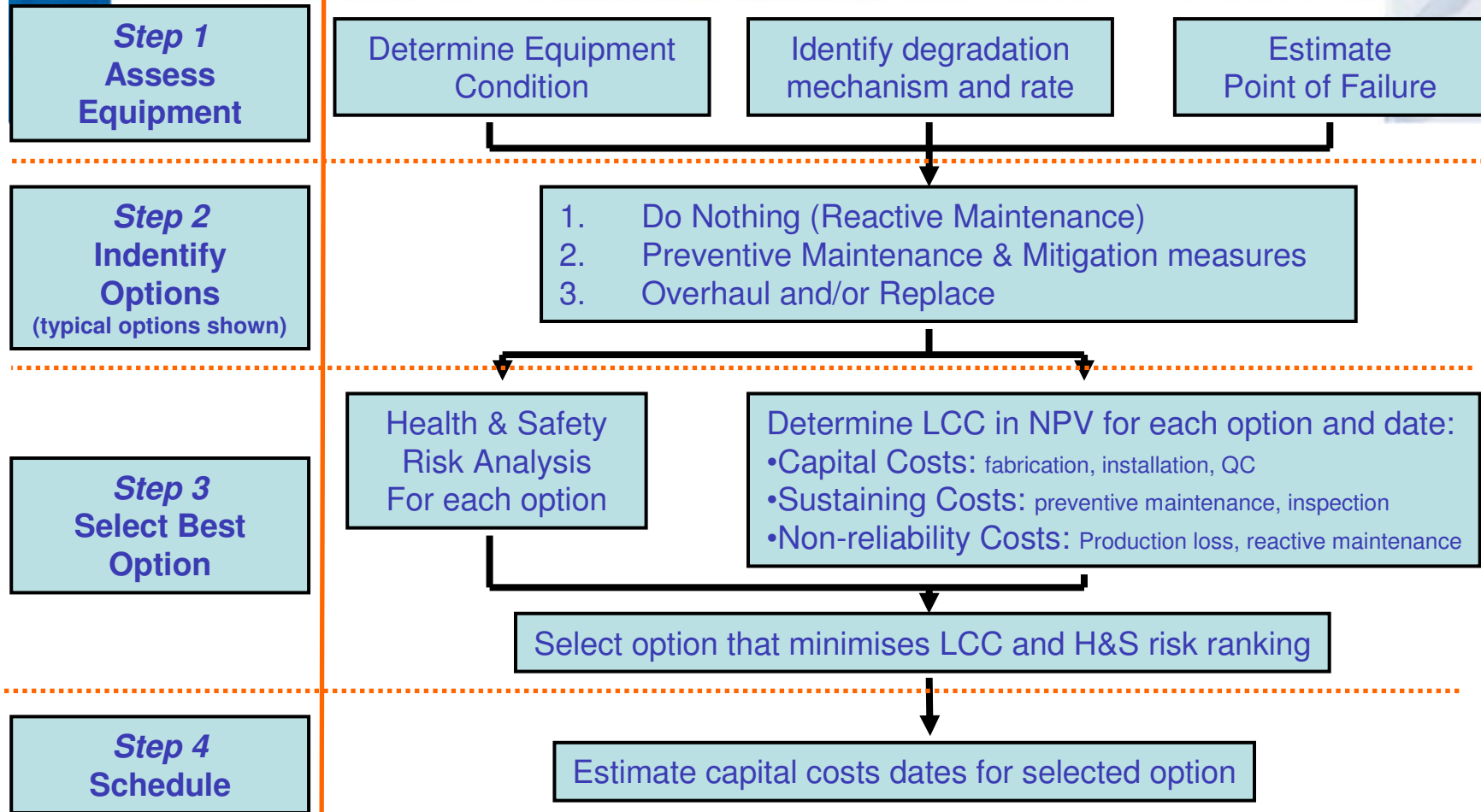
- For optimal timing in making key investment decisions in anticipation of equipment end of life
- For understanding and quantifying the risk and influence of critical variables on equipment failure rates during the useful service life

Tools used:

- Life Cycle Cost,
- Payback Time
- Remaining Life Prediction
- Fitness-For-Service



Life Cycle Cost (LCC) Methodology Outline



Fitness-For-Service

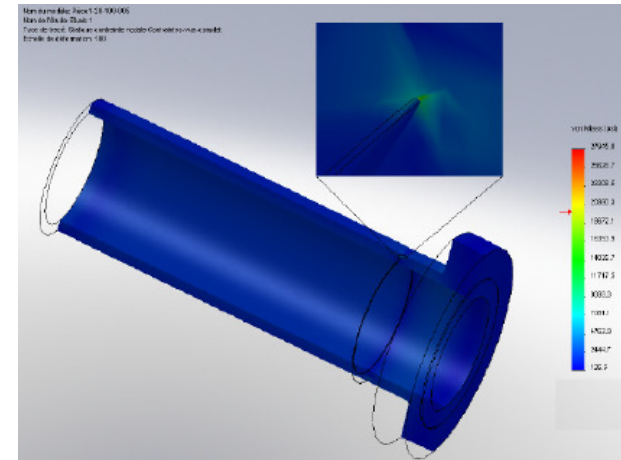
*FFS ensures that damaged equipment will **operate safely and reliably** for the desired period of time*

Level 1, 2 or 3 assessments:

- API 579
- ASME FFS

For all types of equipment including:

- Pressure vessels
- Piping
- Tanks



Based on its 30 years of in plant engineering experience
BPR-Bechtel-XPS team provides practical and cost sensitive solutions
to challenging FFS problems to help **improve your plant's reliability**
and provide **major savings in unnecessary repairs**

Design Phase Services

*For the **best return on plant assets investments** opt for
a team with a vast experience and a*

unique set of skills

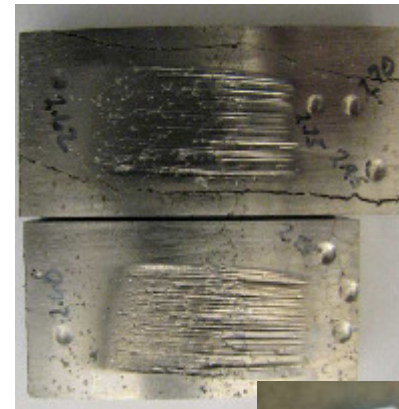
- **Material Selection**
- **Fabrication Specifications**
- **QA/QC in fabrication and installation**
- **Welding Procedures**
- **Process Review**
- **Design Verification**
- **LOPA/SIL analysis**



Lab capabilities

Optimal material selection and process control through materials testing for Corrosion, Wear and Structural Applications

- Corrosion immersion tests and electrochemical tests: corrosion rates
- Electrochemical tests: coating performances
- Wear tests: resistance to abrasion and erosion
- Mechanical tests: hardness, tensile, impact



Fracture Analysis Root Cause Failure Analysis

Prevent recurrence by getting to the root of your equipment failure

With a broad industrial experience our materials engineers and metallurgists can help prevent another failure of pressure vessels, piping, rotary equipment and infrastructure in:

- pulp and paper industry
- refineries
- LNG plants
- mines, mills and smelters

Our Risk Analysis experts have extensive field experience with Bow-Tie, Tripod and Tap Root.



Fire and Explosion Damage Assessment

With a multidisciplinary team, our AIM group can quickly evaluate the integrity of your plant assets following an incident




- Metallurgical engineers
- Structural engineers
- Mechanical engineers
- Electrical Engineers
- Inspection technicians
- Root Cause specialists





Typical Mandates

	<p>Xstrata-Nickel Raglan Mine Concentrator Aging Assessment</p> <p>High level of corrosion and mine life extension required a complete aging assessment of all process equipment to plan sustaining capital requirements for the next 5 years and ensure safe and reliable operation of the plant until 2032. A Life Cycle Cost methodology was used to select the best option for each equipment.</p>	<p>AIM Aging Assessment 2010</p>
	<p>CEZinc RBIWeb implantation</p> <p>Review of CEZinc inspection program for 100 tanks using a Risk Based Inspection methodology developed by BPR-Bechtel. The Web based program can be updated by the inspectors. Average inspection interval increased from 7 to 12 years.</p>	<p>AIM RBI program 2009</p>
	<p>Suncor Soda Wash Drum Fitness-For-Service Assessment</p> <p>Finite Element Analysis of a damaged Soda Wash Drum skirt using API 579 level II methodology. Thickness loss and perforation was caused by Corrosion Under Insulation. The assessment asserted that the skirt was fit-for-service.</p>	<p>AIM Fitness-For-Service Assessment 2008</p>

Typical Mandates

	<p>Xstrata Copper Canada Critical Piping Inspection Program</p> <p>A complete inspection program for all critical piping was developed to prioritise inspection activities including: sort all circuits per criticality, create inspection forms, calculate minimal thickness for each circuit and prepare a repair and maintenance procedure. The program allows for improved asset management and significant maintenance savings</p>	<p>AIM Inspection Program 2010</p>
	<p>CEZinc Acid Plant Inspection Program</p> <p>As an integral part of the shutdown team, provide complete inspection services, recommendations, detailed procedures for maintenance and repairs and quality control during repairs for all acid plant shutdowns.</p>	<p>AIM Acid Plant Inspection 2007-ongoing</p>
	<p>Ultramar Ltd. Tank Inspection Program</p> <p>Develop a complete Inspection Program for all tanks in Ultramar's Montreal Terminal per API 653 methodology, including preparation of inspection forms, database system, complete inspection services, recommendations and repairs.</p>	<p>AIM Inspection Program 2009-ongoing</p>

Typical Mandates

	<p>Suncor Using Equity's API-RBI software, implement a complete RBI program for all pressure vessels and PRVs at Suncor's Montreal Refinery. First results show a substantial increase in average inspection intervals for PRVs, and important reduction in required inspection activities for pressure vessels.</p>	<p>AIM RBI implementation 2009-2012</p>
	<p>Sonatrach LPG Plant Rhourde Nouss Integrity Assessment of various equipments following a fire and explosion of one of three trains of the LPG plant. Damage mechanism and extent was evaluated for all equipment including pumps, drums, exchangers and towers.</p>	<p>AIM Fire and Explosion Damage Assessment 2010</p>