2019 INSPECTION AND MECHANICAL INTEGRITY SUMMIT

JANUARY 28-31
GALVESTON ISLAND
TEXAS | USA

Brought to you by

energy API | AMERICAN PETROLEUM INSTITUTE

Case Study: Steam System Risk Mitigation Using RBI

Bio Slide

Robert Sladek

Asset Optimization Consultants (AOC)

Sr. Asset Integrity Consultant

- 30+ Years in Mechanical Integrity
- Field of Expertise: Inspection; RBI; Mechanical Integrity Management
- Industry Involvement: Chairman for API 581 Task Group(Vice-Chair 2012-2018)

What's the Problem?

Fifty-one (51) year old unit

Maintenance activity increasing over time and unpredictable

Limited inspection history

Needed a prioritized mitigation plan to request capital funding for increased reliability

Steam System Risk Mitigation using RBI

RBI was used to prioritize mitigation of steam related piping in an aged unit.

- Client's existing semi-quantitative RBI software was used
- Piping was systemized and circuitized
- Production consequence override was used
- Maintenance and Inspection plans were developed for mitigation

Scope

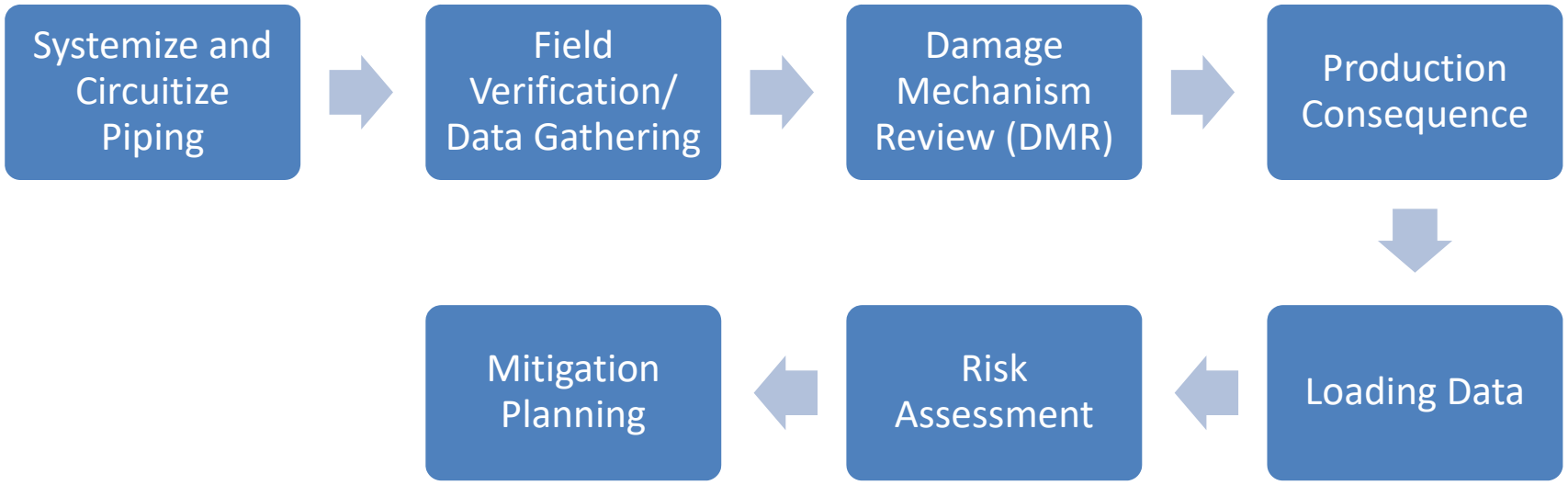
440 total piping circuits

5 steam systems

2 condensate systems

1 Boiler Feed Water (BFW) system

Project Planning



DMR Findings

- Boiler water/condensate corrosion
- Erosion/corrosion
- Inferior trim and packing on older valves
- Outdated torqueing procedure
- Majority of internal damage found in small-bore, saturated steam service

Default Semi-Quantitative Methodology

- Probability
  - Current state vs. original for base damage factor (DF)
  - Inspections can reduce DF
  - Credits for overdesign: current vs. design
  - Internal, external and cracking DMs
  - Qualitative modeling
- Consequence
  - Designed for PSM processes
  - Calculates for flammability, reactivity and toxicity
  - Allows upgrade based on production loss

Production Consequence Methodology

An A-E ranking system was developed.

A. Unit shutdown
B. Multiple section shutdown
C. Reduced rates for unit
D. Reduced rates for section
E. No effect on production

Values were assigned by site SMEs

Risk Results

Combined Risk Distribution

	Totals		E	D	C	B	A	
47.0%	207	1	0	179	22	0	6	
4.8%	21	2	8	6	4	0	3	
11.1%	49	3	5	22	15	0	7	
5.2%	23	4	2	0	12	0	9	
31.8%	140	5	10	12	21	0	97	
	440		25	219	74	0	122	Totals
			6%	50%	17%	0%	28%	

Internal Risk Distribution

Totals		E	D	C	B	A
196	1	0	170	20	0	6
16	2	4	7	4	0	1
58	3	5	29	17	0	7
24	4	2	1	11	0	10
146	5	14	12	22	0	98
440		25	219	74	0	122 Totals

External Risk Distribution

Totals		E	D	C	B	A
67	1	0	59	7	0	1
53	2	4	42	4	0	3
1	3	0	0	1	0	0
5	4	0	0	1	0	4
314	5	21	118	61	0	114
440		25	219	74	0	122 Totals

Maintenance Recommendations

- Repair/replace piping with clamps/leaks.
  - Due dates based on risk except A consequence
- Design and install bypass for A consequence
  - Due dates based on risk
- Update piping/valve specifications
- Update torqueing procedure to reflect PCC1
- Rework all flanges in A and C Consequence piping

Inspection Plans

Grouping of inspections was performed per site methodology.

Implementation methodology developed for past due inspections.

Project Results

- Provided a prioritized plan to address an aging steam system
- Consistent and documented approach
- Recommendations to improve site specifications and procedures
- Maintenance plans to improve reliability
- Inspection plans to address all known damage mechanisms