Asset Data Management for The Energy Sector

Risk-Based Inspection (RBI) Services

RBI is a **proven method** to determine the optimum inspection scope and interval using a **risk-based data-driven approach**. It improves equipment integrity, safe operational efficiency, and maintenance cost of both static pieces of equipment and piping.

Business Benefits

- Optimized **inspection and maintenance value** (reduced cost);
- Optimized and extended **inspection intervals**;
- Reduced **inspection scope**.
- Reduced **non-productive time**;
- Increased **equipment availability**.

KEEL APPROACH

> We provide not only the classical RBI services, but we also **implement the inspection program** directly to the CMMS.

RBI Implementation Services:

We take care of all additional steps to implement the developed inspection program into your maintenance system:

- **Implementation of the inspection program** directly into the CMMS:
  - Alignment and scheduling of **non-intrusive inspections** with current plant maintenance program;
  - Alignment and scheduling of all **intrusive inspections** with planned plant shutdown to optimize the equipment uptime;
- **Onsite data collection and verification**, line walks, CAD services, etc. (if required).

Additional Services

If required, we provide full stack of engineering, consultancy and other engineering support services to optimize your business, including:

- **Virtual support services:**
  - Plant operational support in ERP/EAM system;
  - Project, Procurement, Logistics, and Supply chain support.
- **Data cleansing services;**
- **Maintenance engineering services:**
  - Development of equipment maintenance strategies;
  - Plant Maintenance Optimization (PMO);
  - Reliability Centred Maintenance (RCM);
  - Equipment and inventory criticality assessment.
- **Warehouse and materials management and optimization.**

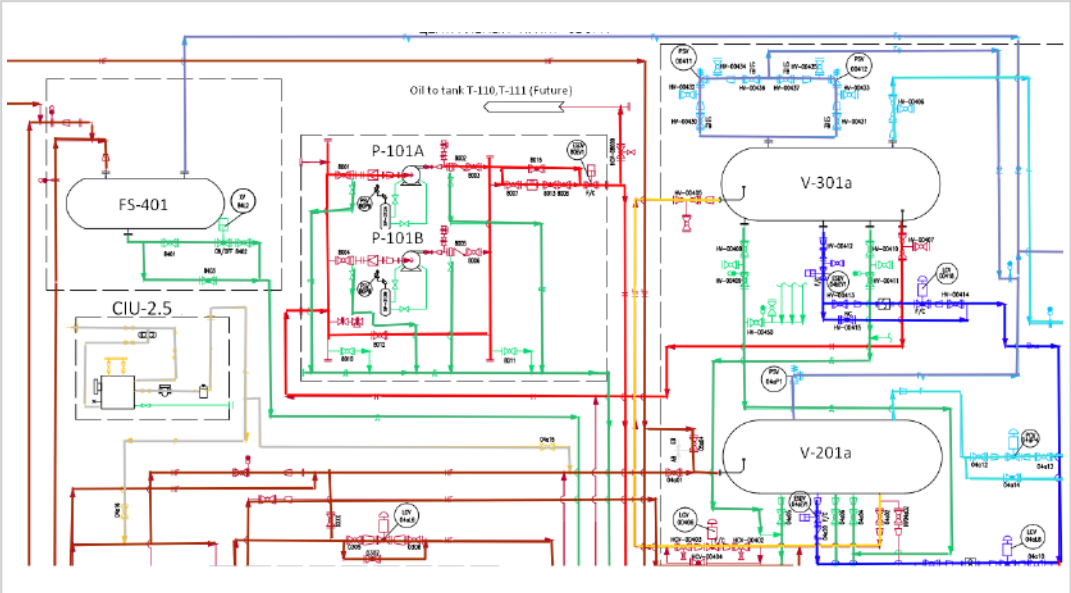
RBI PROCESS

	Initial RBI Inspection from scratch	Sequential RBI Using previous data
1 ▪ DATA	Collection & Evaluation	Review & Evaluation
2 ▪ CORROSION LOOPS ▪ DAMAGING MECHANISMS	Identification	Review
3 ▪ RISK ASSESSMENT	Initial Assessment	Re-assessment
4 ▪ INTEGRITY OPERATING WINDOWS FOR STATIC EQUIPMENT	Development	Review
5 ▪ OPTIMAL INSPECTION PROGRAM ▪ MITIGATION ACTIONS ▪ OPERATING PROCEDURES	Development	Review & Evaluation
6 ▪ INSPECTION PROGRAM IN CMMS	Implementation	Review & Adjustment

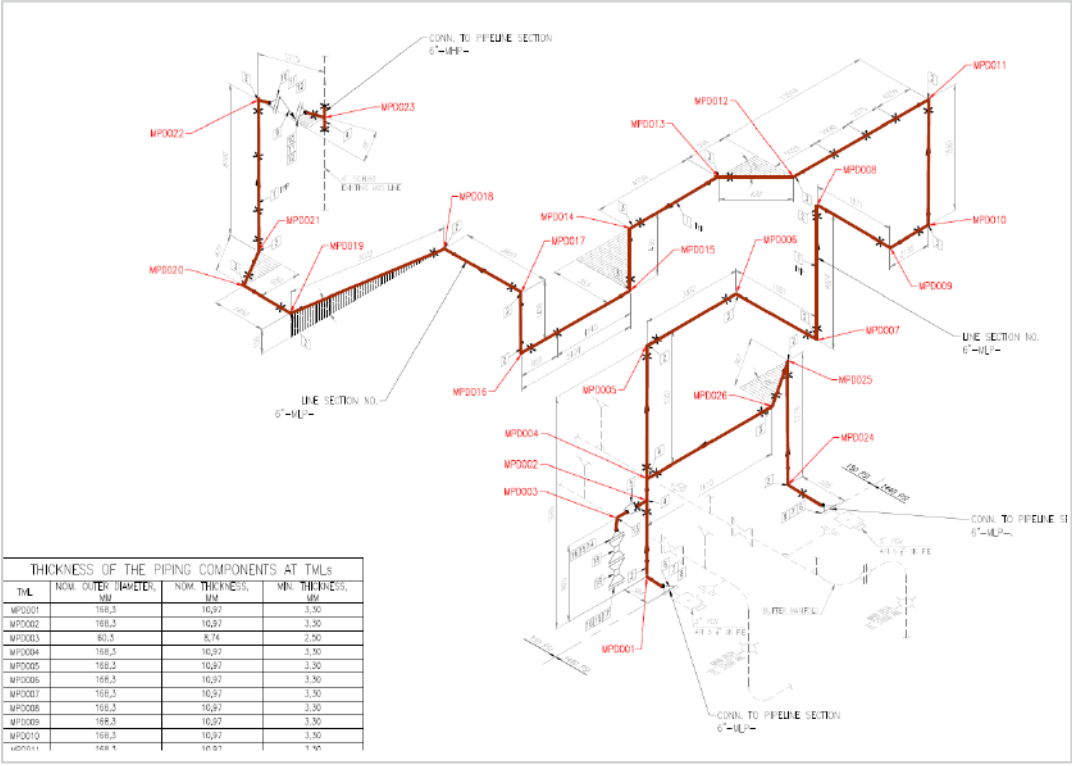
DOCUMENTATION EXAMPLES

For RBI, we use the principles and methodologies stated in the **API 580/581** and **API 579-1/ASME FFS-1** standards to calculate the equipment fitness for service.

Corrosion loops identification



Piping Inspection drawing with specified thickness measurement locations (TML)



THICKNESS OF THE PIPING COMPONENTS AT TMLs

TML	NOM. OUTER DIAMETER, MM	NOM. THICKNESS, MM	MIN. THICKNESS, MM
MP0001	168,3	10,97	3,30
MP0002	168,3	10,97	3,30
MP0003	60,3	8,74	2,50
MP0004	168,3	10,97	3,30
MP0005	168,3	10,97	3,30
MP0006	168,3	10,97	3,30
MP0007	168,3	10,97	3,30
MP0008	168,3	10,97	3,30
MP0009	168,3	10,97	3,30
MP0010	168,3	10,97	3,30

DOCUMENTATION EXAMPLES

WALL THICKNESS CALCULATION SHEET

PIPING COMPONENT: **6" 45° LR ELBOW, B.W. SCH.80, ASTM A234 WPB**
6" 90° LR ELBOW, B.W. SCH.80, ASTM A234 WPB
6" EQUAL TEE, B.W. SCH.80, ASTM A234 WPB

Ø6"

ID	ITEM DESCRIPTION	SYMB.	VALUE	UNITS	FORMULA	Reference
OPERATING CONDITIONS						
1	OPERATING TEMPERATURE	T	50,00	°C		[1]
2	OPERATING PRESSIRE	P	1440,00	PSI		[1]
MECHANICAL PROPERTIES OF PIPING COMPONENT						
3	GRADE	GR	ASTM A234 WPB	ul		
4	TENSILE STRENGTH	TS	414,00	MPa		[2]
5	YIELD STRENGTH	YS	241,00	MPa		[2]
6	STRENGTH REDUCTION FACTOR	K_s	1,00	ul		[3, 4]
7	ALLOWABLE STRESS	S	138,00	MPa		[16]
MECHANICAL AND CORROSION/EROSION ALLOWANCES						
8	EXTERNAL ALLOWANCES	C_o	N/A	mm		[6]
9	INTERNAL ALLOWANCES	C_i	N/A	mm		[6]
10	TOTAL ALLOWANCES	C	N/A	mm	$c = c_o + c_i$	[7]
GEOMETRICAL PROPERTIES OF PIPING COMPONENT						
11	NOMINAL PIPE SIZE	NPS	6"	inch		
12	SCHEDULE/DESIGNATION	SCH	80,00	ul		
13	NOMINAL PIPE THICKNESS	t_{nom}	10,97	mm		[8]
14	NOMINAL OUSIDE DIAMETER	D	168,30	mm		[8]
15	UPPER TOLERANCE LIMIT	tt_u	2,40	mm		[9]
16	MAX. OUSIDE DIAMETER	D_m	170,70	mm	$D_m = D+tt_u$	
17	INSIDE DIAMETER	d	146,36	mm	$d = D-2t_{nom}$	
18	CENTER-TO-END RADIUS (ELBOWS ONLY)	R_1	229,00	mm		[9]
19	EXTRADOS (ELBOWS ONLY)	I	1,29	mm	$I = [4(R_1/D)-1]/[4(R_1/D)-2]$	[11]
COEFFICIENTS						
20	THICKNESS COEFFICIENT	Y	0,40	ul		[15]
21	WELD JOINT STRENGHT	W	1,00	ul		[12]
22	QUALITY FACTOR	E	1,00	ul		[13]
MINIMUM REQUIRED THICKNESS (WORN PIPE)						
23	PRESSURE DESIGN THICKNESS	t	7,53	mm	$t = PD/[2(SEW+PY)]$	[10]

Learn more about our RBI Services >>

www.keelsolution.com