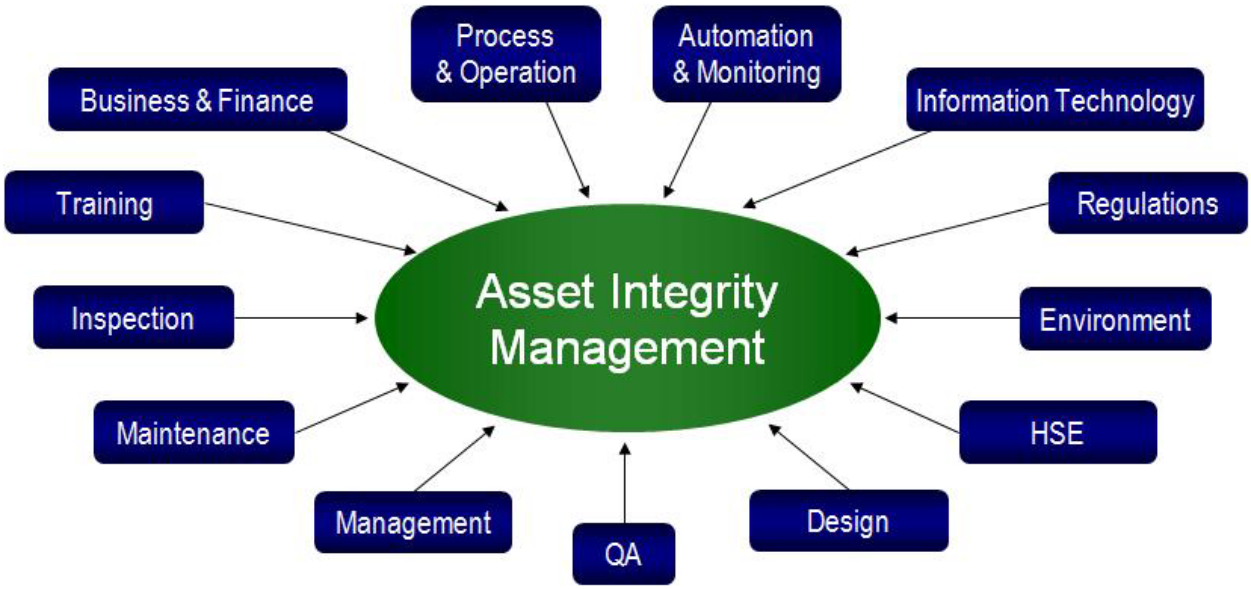
INTERTEK'S ASSET INTEGRITY MANAGEMENT PROGRAM (AIM)

Intertek AIM is a strategic management system consisting of specialized expertise, resources methodologies, and tools to assist production and process industries manage the integrity of their infrastructure, facilities and equipment. The goal of Intertek's asset integrity management program is to provide for the effective management of our client's corporate assets in order to gain maximum value while safeguarding personnel, the community and environment.

Intertek provides the resources, documentation, software tools and expertise to impact on all aspects of an asset integrity management program and thus provides a comprehensive, fully integrated, technical strategy, process, system and culture directed at gaining increased lifetime effectiveness, value, availability, profitability and return from production and manufacturing assets.

A complete **Asset Integrity Management** program incorporates design, maintenance, monitoring, inspection, process, operations, and management concepts, since all these disciplines impact the integrity of infrastructure and equipment.



Any AIM program should consider and include design, production and flow assurance, corrosion and metallurgy, root cause failure analysis, stress analysis, process optimization, safety and mechanical integrity management, hazard's analysis, inspection and maintenance planning, operational support, management solutions and risk and reliability analysis.

Intertek's AIM program is unique since it combines the understanding of process properties with a detailed knowledge of materials and equipment. Intertek experts have extensive understanding of design, processes engineering, production chemistry, corrosion and materials and their behavior in oilfield, refinery, and atmospheric environments. This expertise is supported by 30+years of experience of materials and chemical performance, operations and failure investigation. Our understanding of production chemistry and flow assurance issues include fluid properties, flow regime, composition and effect on operations and process conditions as well as the degradation effect on materials of construction, equipment and their life cycle.

Intertek offers a “one-stop-shop” for all AIM activities, including onsite data gathering, analytical service (worldwide lab network), data review (project engineers in each office) and interpretation, analysis, consultancy, and operational experience (knowledge centers). Our service is therefore comprehensive and integrated, with cross divisional teams structured to enable efficient and effective communication with knowledge centers strategically located around the world.

Since 2006 Intertek has acquired of a number of high end consultancy and testing companies including CAPCIS, Westport Technology Centre, Commercial Microbiology, Hi Cad and APTECH Engineering to complement the traditional analytical testing services offered by Intertek to clients in the oil and gas sector and to offer a more integrated Integrity Management capability to new and established clients.

Benefits of Intertek’s comprehensive Asset Integrity Management program include:

- Maximizing reliability, availability and maintainability of equipment
- Improved understanding of asset condition
- Improving safety and reducing risk
- Improved efficiency of asset management
- Enhancing plant operations, performance and profit
- Optimizing maintenance and inspection costs
- Improving personnel safety and performance
- Optimizing sparing
- Compliance with corporate and industry regulation and legislation
- Improving personnel know-how and expertise

INDUSTRY SECTORS AND EQUIPMENT LIFE CYCLE

Intertek’s AIM system pertains to the integrity management of infrastructure, facilities and equipment and is aimed at providing our clients with specialists and engineering support in all areas of Asset Integrity Management. The definition and urgency of AIM varies from one industry sector to another. The time to failure and the potential impact of a loss of integrity is dependant on the design, materials, degradation, the environment in which the materials are exposed and the risks of operation. An understanding of these issues enables an AIM strategy to be developed and implemented that is tailored to an industry, equipment and specific application. The following industry sectors are serviced:

- Oil and Gas
- Nuclear and Fossil Power Generation
- Production and Process Industries
- Renewable Energy
- Manufacturing Industries
- Utility (Water)
- Civil infrastructure

The impact of loss of integrity can be related to Health, Safety the Environment and Production. For each of the industry sectors serviced by Intertek AIM, the risk to HSE, and Production can vary, and this is recognized within our AIM program.

Intertek provides asset and life management support to infrastructure, facility and equipment through conception, design, construction, commissioning, operations, refurbishments, life extension and de-commissioning phases of a facility. The services and approaches used are usually different depending on the industry sector and what stage of life cycle a client facility and equipment has achieved. Intertek offers a unique understanding of these interactions.

AIM IMPLEMENTATION

As a strategic management system, Intertek AIM consists of several key areas:

1. Scope, Strategy and Implementation
2. Services
3. Data Management Tools
4. Documentation

Our strategy clearly states the function, performance, condition requirements of assets, and prioritizes and optimizes assets based on risk and reliability and includes all stake holders such as inspection, maintenance, engineering, HSE, QA, operations and management.

Intertek offers onsite data gathering, analytical service, data review and interpretation, analysis, consultancy, and operational experience. Our service is therefore comprehensive and integrated, with cross divisional teams structured to enable efficient and effective communication with knowledge centers strategically located around the world.

The Intertek AIM program can provide management with documentation, training, operational controls and software tools for the successful implementation of the system by qualified personnel following appropriate procedures, guidelines and work instructions. These codes of practice, specifications, guidelines and work procedures are described in the system documentation.

When implementing or offering an AIM program to our clients, the following tasks are usually applicable:

Task 1 - Audit (Gap Analysis) and Benchmarking

Task 2 – Development of Management System and KPI's

Task 3 – Design, Materials, Corrosion Review - Design Verification

Task 4 – Data Collection and the Development of Documentation

Task 5 – System, process, production chemistry, corrosion evaluation

Task 6 - Identification of Safety Critical Equipment (RBI, RAM)

Task 7 – Inspection, Maintenance, Testing and Monitoring, Inspection Planning

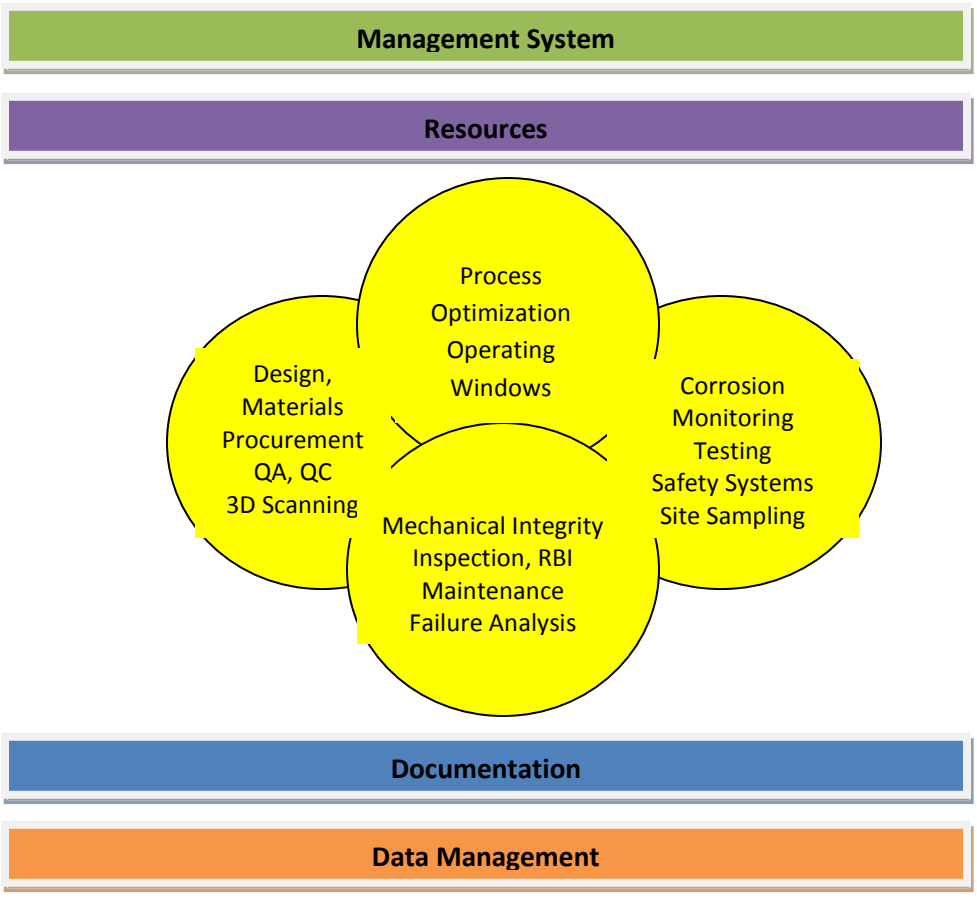
Task 8 – Risk Management and Deficiency Resolution, Evergreen, QA, QC

Task 9 – Integration of Key Elements, Prcoesses and Tools (including software tools)

Task 10 – Training

Consultancy, laboratory testing and field services can be delivered as separate items or as tasks within a specific project. This is usually dependent on the industry sector being served.

Intertek's AIM services are summarized below:



SERVICES

Our AIM services include the following:

Audits, Gap Analysis and **Benchmarking** are carried out to collect data, understand the operational threats and risks, identify gaps within the current system and benchmark operations. Specific audits that Intertek can carry out as part of the AIM include Asset Integrity, Design Reviews, Corrosion & Chemical Management Audits, Corrosivity Surveys (external and internal environment), Production Risk and regulatory audits for Process Safety Management and Mechanical Integrity. The results of an audit, gap analysis or benchmarking will be specific recommendations for improving a clients program so it is best in class.

Design Reviews: The purpose of a Design Review is to compare the design, materials of construction, fabrication requirements (e.g., welding, post weld heat treatment [PWHT], hardness controls), of the facility equipment to what is referred to as "generally accepted industry practice." For most facilities, generally accepted materials of construction, corrosion allowances, fabrication requirements, hardness controls, etc. are intended to provide minimum service life. A design review can confirm conformance with current industry codes and standards, make recommendations on materials for alternate operating conditions and assist with the extension of remaining useful life of equipment.

Design Verification: Intertek provides a design verification methodology for pressure vessels and piping components to ensure increased operational safety and jurisdictional compliance through engineering review. This Methodology ensures the accuracy of the "discard thickness" T (min) calculations (or "minimum thickness") for pressure vessels and piping components by applying Code calculations, (i.e. ASME Section VIII, Div. 1 and ASME B31.3) and "Site specific" requirements (such as wind loading, Zick Analysis, structural minimums, etc.).

Corrosion Mitigation Specification: In addition to offering the design and design verification of corrosion monitoring and cathodic protection systems, Intertek offer comprehensive chemical and materials testing to justify material selection or define chemical injection strategies to mitigate corrosion.

Laser Scanning and 3D Modeling: Intertek offers a unique CAD integration service that delivers high resolution 360-degree images for 3D modelling of structures. Our digital capture techniques can gather a large amount of field information in a very short space of time. The process works by capturing a series of 3D photographic imagery on-site which can be processed simultaneously, allowing the collected data to be exported immediately for analysis. Our dimensional control service can be applied to variety of projects such as existing status survey of current facilities, fabrication surveys for steelwork and pipe work survey, alignment surveys, specialist equipments reviews involving survey of drill equipment and production lines and clash surveys for the replacement of components or installation of new equipment.

Technical Inspection, Procurement and Quality Assurance: Intertek assists companies in the area of Engineering, Procurement and Construction (EPC) Intertek has a long history of working with the EPC market supporting operators in managing and delivering projects on time

and to specification. Services include; vendor assessment, inspection and expediting, site and fabrication inspection.

Fitness for Service Evaluations: Intertek provides Level 1, 2 and 3 fitness for service evaluations according to API 579-1/ASME FFS-1, JUNE 5, 2007 (API 579 SECOND EDITION) and ASME Section XI guidelines. Intertek engineers are familiar with and use various industry software programs such as NOZZLE Pro, ANSYS and CodeCalc for FFS evaluations.

Material Review and PMI: For a new or operating facility, it is helpful to conduct a design and materials review to ensure the correct materials have been used for the various process conditions on the facility. This will typically involve a corrosivity assessment and then provide a baseline for future inspection activities on the plant. In addition to this, a materials review may be required if process and operating conditions are changing over time, such as changing feedstocks or moving from a sweet to more sour environment.

Corrosion Management Strategy: This includes Management Documentation (strategy, policy, philosophy, procedures) as well as the development of Data Management Tools (Software), and training to ensure full implementation of the system by either a 3rd party or the owner/operator. Intertek's Corrosion Management Strategies are based on the UK Health and Safety Executive (HSE) guidelines OTO/044 and the American Petroleum Institute's (API) API 571 guidelines and these can be used to either set up new systems or upgrade existing systems to develop a fit for purpose management strategy.

Corrosion Maps/Loops and Management Manuals: These documents identify which degradation phenomena (corrosion, cracking, and embrittlement mechanisms) that are probable within each area of the facility and to define their location and severity of degradation to aid the integrity management activities such as inspection, fluid process and corrosion monitoring. Corrosion maps are typically process flow diagram (PFD) that show the location(s) of the various corrosion mechanisms and are linked to the corrosion management manuals.

Chemical Testing and Fluid Analysis; Intertek conducts regular analyses of process fluids to which materials are exposed. This provides valuable data that is then fed into the integrity assessment program. Intertek's worldwide analytical laboratories can provide field chemist and laboratory assessment on a wide range of fluids and products.

Microbiology has an important role to play in AIM. Bacteria can cause problems (such as corrosion, generation of toxic gas, product contamination and reservoir souring), as well as causing health and hygiene problems. However in some industry sectors it can make a positive contribution (such as microbial enhanced oil recovery (MEOR), treatment of offshore facilities to be abandoned, and the bioremediation of oily drill cuttings. Intertek offers consultancy, field testing and laboratory analysis of fluid samples.

Reliability and Risk Based Inspection: Reliability and RBI programs provide a structured method for identifying and assessing the potential impact of deficiencies on an operating plant, as well as ascertaining inspection methods to mitigate these deficiencies. RAM modeling calculates reliability of equipment and highlights the cause of operational downtime. RBI

provides a systematic methodology for factoring risk into infrastructure maintenance and inspection decision-making. RBI studies provide detailed understanding of potential hazards and failure mechanisms related to the possible loss of pressure containment in pressure vessels and piping. This information can provide an excellent Mechanical Integrity (MI) program resulting in properly managed hazards.

Inspection Plans: Based on reliability and risk analysis, specific inspection plans can be developed for each equipment item or subcomponent. These plans detail identified damage mechanisms, the Likelihood of Failure and what, how, when, and where visual and NDT inspections should be conducted. Inspection planning spreadsheets are usually developed to track inspections, highlighting turnaround inspection dates and whether internals or externals, or both, are required.

Condition Monitoring: This is used to monitor degradation rates where inspection is not practical. Intertek offers audits, consultancy, modeling and site support to ensure that the most suitable corrosion monitoring devices are installed. This includes a range of monitoring techniques of the oil and gas, nuclear and infrastructure sectors, including electrochemical noise and stray current, concrete durability and condition monitoring of rotating equipment.

Flow Assurance: Process flow does not generally lead to a loss of containment, but does impact on production capacity and can result in reliability related failures. Intertek provides consultancy, modelling and laboratory testing and simulation related to production chemicals. This covers flow issues such as hydrocarbon wax and aspheltene, as well as scale, biocides, and corrosion inhibition.

Materials and Corrosion Testing: Intertek is uniquely equipped to conduct tests in all oil and gas related environments, whether the simulation requires high pressure / temperature or dynamic testing our laboratories are equipped to handle a wide range of production scenarios.

Process Optimization and Operational Support. Intertek provides Operational Support including Fitness for Purpose Assessments, Annual Integrity Reviews, CO_2, Microbial, O_2 Corrosion and Erosion Modelling, Predictive Condition Assessment Modelling, Evaluation of corrosion monitoring and Cathodic Protection systems.

Training. Successful implementation of any Integrity Management system requires a comprehensives program of Training and Client Support. Intertek offer a variety of levels of support from simple handover to full responsibility of integrity management activities through call off contracts and secondment of engineers. Specific Training course on all areas of AIM are delivered by our technical experts. These courses are delivered for clients as well as conference and public courses.

DOCUMENTATION

The Intertek AIM documentation underpins the strategy and service offering, it enables best practice to be implemented for each operator and a system that is tailored for each industry sector, contracting structure and operating environment. Our documentation hierarchy consists of three tiers:

Tier 1 - ***System Elements and Management*** (Policy and Strategy, Organization, Plans, etc)

Tier 2– **Procedures** (Process Safety Management, Mechanical Integrity, Scheme of Examinations, etc)

Tier 3 – Work Instructions (Inspection, Maintenance work instructions. Visual, UT, etc)

DATA MANAGEMENT TOOLS

The management and implementation of Asset Integrity Management programs require that much data be collected, analyzed, and stored. Many software programs exist for these tasks; however, many of them are standalone and communication between different disciplines is rare. For the program to work effectively, all data should be stored, analyzed, managed, and acted upon either from a single source or within systems that are interfaced with each other.

The following software tools and modules may be applicable:

- Design Modules
- 3D Modeling
- Corrosion Modelling
- MoteCarol Simulation software
- Equipment Database
- Inspection Data Management
- Damage Mechanisms
- Fitness for Service (FFS)
- Risk Based Inspection (RBI)
- Reliability Centered Maintenance (RCM)
- Risk Assessment Methodology(RAM)
- Computerized Maintenance Management Systems (CMMS)
- Inspection Planning
- Work Order System
- WisTrac

Commercial software tools and systems may include:

- Compress, CADWorx, Nozzle Pro, CodeCalc, ANSYS
- AutoCad, FLI

- PCMS, UltraPipe
- Cassandra, ECE, Norsok
- Hysis, PipeSims, Multiflash, MultiScale, Olga
- Idecide, @risk, Crystal Ball
- CORAM, STaPCoM, RDMIP,
- API, Meridium, Metegrity, ACET, CREDOSoft, Amulet, Matrix
- Titan
- SAP, Maximo

Intertek engineers have a detailed knowledge and expertise in the recommendation, implementation and integration of many of these systems and tools.

REGULATORY COMPLIANCE AND INDUSTRY CODES AND STANDARDS

Intertek engineers have implemented AIM programs in many countries, giving them a unique combination of experience and perspective on government regulations and the implementation of compliance programs. This includes programs such as the UK safety case and scheme of examinations, European Seveso II and the US PSM programs. In addition to this Intertek's AIM program follows generally accepted engineering codes, standards and practices. These include ISO, PAS 55, API, NACE, NFPA, ASME etc.