ASSET INTEGRITY MANAGEMENT

PARTNERING TO achieve your inspection, engineering, data management and safety goals

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ASSET INTEGRITY MANAGEMENT – AIM

An asset has integrity when it is operated and maintained so that the combination of the likelihood of failure and the consequence of failure makes the risk to people, to the environment, and to the company as low as reasonably practical.

Plant integrity, safety, and reliability are major concerns to all plant operators and managers. The primary objective of Asset Integrity Management (AIM) is to maintain the asset in a fit-for-service condition while extending its remaining life in the most reliable, safe, and cost-effective manner.

In addition to regulatory and company requirements, operators of facilities and pipelines have the following business needs

- Maximizing production
- Reducing lost income due to unplanned shutdowns
- Optimizing inspection and maintenance costs
- Maximizing asset value
- Maintaining an auditable system

Most of our clients already have some form of Asset Integrity Management program in place. However, with increased regulatory oversight, increased operating costs, and limited available resources, implementation of a fully compliant program is increasingly challenging for most organizations.

SGS is able to effectively partner with our clients to help them overcome these challenges.

SGS AIM experts provide customized solutions at any level of the development and implementation process.

PROGRAM DEVELOPMENT

SGS has extensive experience in developing and documenting risk-based, time-based, and condition-based inspection programs for regions all over the world. Our programs meet API-580, API-581, PAS 55 and other appropriate requirements as applicable.

PROGRAM MANAGEMENT

SGS has experienced project managers and engineers who can oversee all aspects of the project. Our personnel are also able to handle the management of change process necessary to transition from time-based or condition-based to risk-based inspection programs.

RESOURCES TO IMPLEMENT THE PROGRAM

SGS can participate in implementation at any level, from turn-key program development and implementation to simple gap-filling services. Our inspectors are full-time employees trained in our safety and quality methodologies. We provide a full range of NDT services including advanced inspection techniques.

SGS experts provide a comprehensive scope of fitness-for-service assessments including determination of damage mechanisms. We can offer stand-alone CAD drawing packages to support client-based or third-party inspection programs and provide a unique set of value adding methodologies including data management services, electronic document management, and field inspection data collection tools.

PROGRAM GAP ANALYSIS

SGS experts assist our clients in identifying the gaps between their program needs and current implementation.

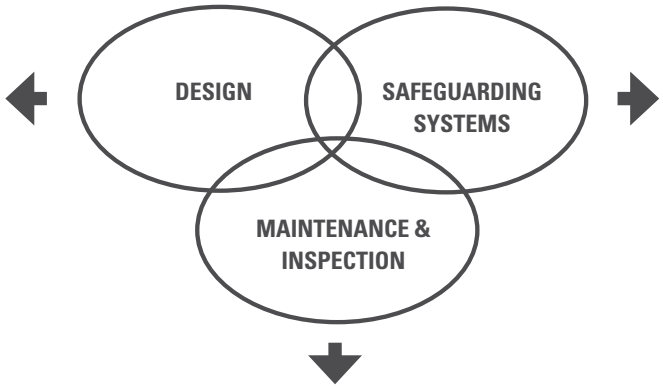
SGS understands the importance of insuring the availability of the real time Key Performance Indicators (KPI) that are critical to successful programs.

INTEGRATED APPROACH TO AIM

SGS has implemented hundreds of Asset Integrity Management programs worldwide, including nearly two hundred Risk-Based Inspection (RBI) programs. We have found that although there are similarities among all of the programs, no two programs are identical. We put our breadth of knowledge, born from our extensive experience, to work for each of our clients to provide customized solutions for their unique needs.

Successfully implementing an AIM system requires the right combination of design, engineering, and operational integrity. SGS partners with our clients to provide exactly the level of services they need. These services can range from complete turn-key program design and implementation to simple gap-filling to complement a clients existing AIM program. The diagram below shows the scope of services which SGS provides its clients.

- Design Verification/ Certification
- Regulatory Compliance
- Risk Assessment (Hazop)
- Fitness for Service (FFS) Assessment
- Material Properties
- Finite Element Analysis



Verification/Certification of
- Emergency Escape and Rescue System
- Emergency Shutdown System
- Fire and Gas Detection System
- Fire and Lightning Protection
- Security System

- Mechanical Integrity Management
- Pipeline Integrity Management
- Remaining Life Calculations
- Data Gathering and Field Inspections
- Risk Based Inspection
- Regulatory Compliance
- Inspection and Maintenance Planning
- Non-Destructive and Material Testing
- Document Management and Control
- Pas 55 – Asset Management System Certification

ENGINEERING SERVICES

SGS has been a leader in development and implementation of comprehensive programs to comply with OSHA's Process Safety Management standards since their introduction in 1992.

SGS' engineering staff at our Asset Integrity Management Competence Center are entirely focused on mechanical integrity services.

SGS engineers ensure that Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) are followed and provide assistance, inspection, and evaluation based on recognized standards

- ASME Boiler & Vessel Codes (Sec VIII Div I & II)
- ASME Piping Codes (B31.1, B31.3, B31.4, B31.8)
- Pressure Vessel Inspection (API 510)
- Pressure Piping Inspection (API 570)
- Pressure Relief Systems (API 520/526)
- Tank Evaluations (API 620/650/653)
- Risk-Based Inspection (API 580/581)
- Fitness for Service (API 579)
- Damage Mechanisms (API 571)

The Competence Center for Asset Integrity Management's engineering team specialize in a variety of disciplines and offer a complete range of engineering services, including the following

DESIGN SERVICES AND COMPONENT ANALYSIS

The SGS AIM team has a vast experience in new equipment design, pressure vessel component analysis and pipe stress analysis.

The engineers performing the analysis have extensive knowledge and experience in ASME and international standards, with capabilities such as

- Perform new equipment design and pressure vessel component analysis using popular software as per clients needs
- Analyzing pressure relieving systems
- Perform intense analysis as per Div II and include stress maps for the different components of the equipment using finite element analysis
- Customized engineering analysis

FITNESS FOR SERVICE ASSESSMENTS

SGS AIM Engineering provides customized and cost effective assessments for the FFS issues and challenges that are common in refining, upgrading, chemical, paper & pulp, and gas processing facilities.

Over the last five years SGS has conducted over 12,000 assessments of pressure vessels, piping, and storage tanks in accordance with API 579-1/ ASME FFS-1. Key features of our FFS assessments include

- The ability to utilize advanced techniques such as finite element analysis to assess equipment
- Industry leading turnaround for the FFS assessments meaning reduced shutdown time, and more effective remediation
- Extensive practical experience which allows SGS to recommend practical solutions to difficult FFS problems
- Identification of alternate service options which could allow operation with enhanced equipment performance
- Recommendation of effective remediation and repair approaches

RISK SERVICES

SGS Reliability and Risk Management Program (RRMP) can be linked with existing inspection programs both locally and globally.

The program provides improved effectiveness of existing programs through

- Providing emphasis on lean inspection strategies, safety compliance, failure prevention and focus on critical components
- Damage mechanism review and assessment
- Identify the existing risk category and provide cost effective measures through inspection program to reduce and contain the risk
- Review and compile historical inspection data in preparation for or in support of RBI implementation
- Assist in acquisition of Owner/User commissions

FIXED EQUIPMENT DEGRADATION MECHANISM SERVICES

SGS AIM engineering department includes engineers with experience evaluating damage mechanisms for equipment including pressure vessels, pressure piping, storage tanks, heat exchangers, heaters, and specialized equipment.

This includes on-stream assessment as well as investigation of root causes of major industrial accidents.

SGS AIM can provide support services for identification of fixed equipment degradation mechanisms

- Identifying degradation devices effecting the reliability of fixed equipment
- Recommending acceptable criteria for degradation devices to become effective
- Recommending lean inspection strategies, inspection plans and critical inspection locations
- Identifying internal as well as external corrosion ranges

ASSESSMENT AND ANALYSIS

- Defining effect of high temperature and erosion
- Preparing detailed reports describing type of degradation mechanisms, effect of degradation mechanisms, process streams, mass balance etc.
- Identifying active and accurate degradation mechanisms for implementation in risk-based inspection and fitness for service
- Provide customized reports to show the balance of cost and effectiveness for the degradation mechanisms under review

FINITE ELEMENT ANALYSIS (FEA)

SGS offers the complete range of FFS assessments from initial assessment through Level III (Finite Element) analysis, as well consulting for cause and effect analysis.

Using the most current technology, SGS engineering experts have the ability to utilize advanced techniques such as finite element analysis to assess equipment. Our industry leading FFS assessments mean reduced shutdown time, and more effective remediation.

Key features of FEA

- Develop 2D and 3D models of pressure vessel and piping systems
- Analyze external loads on nozzles
- Evaluate load cases that contribute to failure in piping and pressure vessel components
- Analysis capabilities: Linear, material non-linear, steady state transient thermal, stress stiffening
- The nozzle evaluation reports include: allowable loads, flexibility factors, stress intensification factors
- Compare the results with acceptance criteria listed in ASME Sec VIII Div I & II
- Perform fatigue calculations for piping and pressure vessels
- API-579 Level 3 Assessment
- Self contained, 3D viewer is provided to the client for reviewing the results

ABOVE GROUND STORAGE TANK SERVICES

Our experience in engineering services include verifying new tank design constructed to API 650, API 620, UL-142 and API 2000.

Comprehensive analysis and reporting capability including

- Maximum fill height
- Settlement
- Uplift
- Wind loading
- Venting requirements
- Nozzle loadings
- Frangible roofs

DATA MANAGEMENT SOLUTIONS

Even moderate scale Asset Integrity Management programs produce massive quantities of data that must be effectively managed. Because the databases that result from AIM implementations can be so large, even simple data entry tasks can involve so many data points that they overwhelm even well staffed inspection departments.

Furthermore, most standard corrosion monitoring software packages are limited in their ability to accept, let alone correlate the full range of supporting documents and information required for compliance. And almost none of the standard packages can automatically link data in the database to CAD drawings or field sketches.

Another significant weakness of standard systems is that they typically only identify visual observations as open or closed, and provide no effective means to track whether or not the remediations are completed within the client's deadlines.

SGS provides services which can address these common data management issues. SGS data analysts provide expert corrosion data entry support to our clients using a wide range of commercial software packages including SAP, IBM Maximo, UltraPIPE, PCMS, Credo, etc. As a result, SGS has the flexibility to support our clients existing programs, rather than compel them to adopt a restricted corrosion monitoring software approach.

In addition, through specialized protocols, SGS data analysts have successfully linked the corrosion monitoring data in standard industry software to field sketches, CAD drawings, and even photographs. This process provides our clients' inspection and maintenance personnel with actionable drawings without having to go through the traditional process of hand marking inspection due and retirement due drawings based on paper inspection reports. This SGS method improves the accuracy of the resulting drawings relative to traditional methods while actually reducing the time to produce the required documents.

SGS can also provide a Mechanical Integrity Management System (MIMS) which interfaces with the client's existing corrosion monitoring software. The SGS MIMS is a web-based application which facilitates data entry, tracking of visual observations, reporting of key performance indicators, and electronic document management. The below figure shows the principle of our MIMS and gives an overview of data entries and output deliverances.

REGULATORY DOCUMENTATION
Entered into the MIMS system –
Available for verification and audit

CORROSION MONITORING INSPECTION DATA
Generated and entered into the MIMS system –
Actionable drawings can be readily created

VISUAL INSPECTION DATA
Entered into the MIMS system –
Allows tracking of findings and their remediation

EQUIPMENT DOCUMENTATION
Entered into the MIMS system –
Available to verify compliance with applicable requirements

INSPECTION DOCUMENTATION
Entered into the MIMS system –
Readily accessible by authorized users

INSPECTION DRAWINGS
Generated and loaded into the MIMS system
for immediate accessibility

FACILITY INSPECTION DRAWING PACKAGE
Available in the system in block style or single line isometric form –
Linked to facilitate access

KEY PERFORMANCE INDICATORS
Key performance indicators are an output of the MIMS
inspection program and remediation of program findin

The data entry portion of MIMS automatically distributes data into industry standard databases, effectively reducing repetitive data input. In addition, built-in error checking prevents common errors, such as accidental entry of duplicate circuits within a database, and thickness reading values inconsistent with standard piping sizes.

The recommendation tracking portion of MIMS tracks the status of each visually observed condition and recommendation. These can be searched and displayed by a wide variety of criteria including location (geographical, unit, GPS coordinates), priority, status (open or closed), specific condition, equipment type, maintenance class (maintenance or repair), and many others.

The Key Performance Indicator (KPI) portion of MIMS displays in real-time the status of the AIM program implementation using client defined measurements. Most clients find the display of the status of the visual observations and recommendations among the most useful KPI's. Typically these include a scorecard showing the status of recommendations resulting from the visual observations. The scorecard displays the total number of observations made by priority, the number of open conditions, the number of closed conditions, and the number overdue.

The electronic document management portion of MIMS provides rapid access to critical primary documents associated with pressure vessels and tanks. For pressure vessels, the system provides web-based data screens displaying key manufacturer's data and documents for the vessel, as well as an automated gap assessment for the completeness of the vessel's documentation. Similarly, for tanks, the system automatically provides a gap analysis as to the completeness and availability of regulatory agency required tank documentation. This MIMS feature substantially improves the AIM program's robustness for audit.

The MIMS system also works in cooperation with most RBI software programs to assist in the organisation of the data at the RBI program inception, as well as tracking of the data and inspections during the RBI implementation.

SGS AIM implementation experts are ready to assist our clients at their point of need with these data management solutions, without requiring a change in corrosion monitoring software or RBI systems.

S system. They provide a critical management tool to track the implementation of the
gs, which are not readily available through standard corrosion monitoring databases.

RECOMMENDATION TRACKING SYSTEM
Identifies, locates, prioritises, documents and tracks remediation for all visual observations

ELECTRONIC DATA MANAGEMENT
Provides organisation and immediate access to all primary documents

CORROSION MONITORING
Provides access to data by site, type, inspection activity and other client specific approaches

INSPECTION & MAINTENANCE PLANNING
Contains tools to automate formerly labor intensive processes and achieve significant cost and quality improvement

REPORTING
Provides comprehensive client customisable reports are available in the MIMS system

RISK-BASED INSPECTION – RBI

Risk-based inspection is an approach to Asset Integrity Management which seeks to optimize inspection activities based on the likelihood and consequence of failure of components and systems. Using this methodology, inspection frequency is highest for the highest risk systems, and the interval between inspections is lengthened for those systems which have the lowest risk. This common-sense approach to inspection can significantly increase a plant's on-stream availability, reduce costs and un-planned downtime.

The primary objectives in implementing an RBI program are to produce an inspection strategy that clearly states

WHAT: The equipment that needs to be inspected

WHEN: The optimum interval between inspections

HOW: Specify the right technique to detect the defects that a particular component is most likely to develop

SGS has implemented nearly two hundred RBI programs world-wide since 1989. Unlike most service providers who are tied to a single RBI software solution, SGS has implemented programs using nearly every major commercially available RBI software program. We match the program to our client's unique needs, rather than forcing them to adopt a solution which is convenient to us.

SGS partnerships with several established RBI software providers grant customized systems to deliver the most effective solutions for data gathering, management, and analysis. Of course, the solution SGS supplies is compliant with all applicable governing regulations and guidelines (e.g. API-580, PAS-55).

In a typical RBI project, SGS will

- Establish the qualitative or quantitative risk-ranking level of existing equipment, and determine the respective risk acceptance level based on standard industry practice and customer defined criteria
- Assess the process operations which impact production, mechanical integrity, and rates of corrosion or degradation
- Review technical specifications and materials of construction, and provide gap analysis, recommendations, and turn-around prioritization
- Identify risks associated with equipment degradation and corrosion rates using industry standards, such as API-580, API-579, and API-581
- Determine remaining life for each component, and determine the appropriate inspection intervals
- Specify the necessary inspection and maintenance tasks and intervals based on the risk profiles

FIELD INSPECTION CAPABILITIES

SGS provides clients with dedicated, full-time field inspectors who hold global and local certifications including API, EN, and ASNT. These inspectors are trained in SGS safety and quality methodologies to provide the highest level of service. SGS' world-wide AIM service network provides our clients with access to a full range of NDT services including Rope Access.

SGS has developed several value adding methodologies and tools which can significantly improve the quality and cost-effectiveness of the inspections. One of these methodologies is the use of pre-approved terms for visually observed conditions and corresponding recommendations for inspections.

Using this approach, SGS inspectors and engineers work together with our client's inspection, engineering, and maintenance departments to define a set of typical visually observed conditions. In most cases, approximately 95% of the conditions for API-510, 570, and 653 inspections can be described by as few as 150 to 200 distinct conditions. The conditions are then prioritized with respect to likelihood and consequence of failure, and the time required for remediation defined by the client.

For each prioritized condition, a standard recommendation is developed which is consistent with the client's maintenance philosophy. This approach provides several significant advantages. Since each inspection finding is not treated as an independent finding, the process of prioritization, classification, and recommendation is significantly accelerated. Furthermore, standardized conditions allow analysis of the data, revealing systemic mechanical integrity issues.

SGS has also developed an advanced field data collection system utilising field hardened tablet computers. Inspectors equipped with these systems can load photographs, field sketches, or CAD drawings of the equipment being inspected into the tablet computer. Thickness readings and visual inspection data can then be entered into the tablet either using handwriting recognition, or an on-screen keypad. The data collected is linked to the monitoring locations on the images. When photographs are used, the locations of the readings and visually observed conditions can be unambiguously identified. In addition, by using standardized conditions, the software prompts the inspector to provide the complete information needed to fully address the situation. This both improves the quality of the data that is collected, and reduces the project cost by eliminating the need to return to the inspection site to collect the required data. The data collected using this system can be exported to standard software packages, including MS Excel, computerized maintenance management systems like SAP and IBM Maximo, as well as standard corrosion monitoring databases, such as UltraPIPE, PCMS, Credo, etc.

In addition to standard inspection methods, SGS special examination and consulting teams are at your disposal for complex non-destructive testing requirements. Our broad range of experts and equipment offers the most cost-effective and technically appropriate methods for your unique needs.

Rope Access techniques provide a cost effective alternative to traditional access methods, such as scaffolding or mobile elevated working platforms. Using Rope Access, inspections can be carried out quickly and safely with minimal disruption to other services. All SGS rope access training and operational work is conducted in line with International Guidelines. SGS is member of and accredited by IRATA (Industrial Rope Access Trade Association).

NON-DESTRUCTIVE TESTING SERVICES

Non-Destructive Testing (NDT) is the most effective and applied testing method of examining the integrity of an object, material or a system without reducing its longevity. In alignment with our multidiscipline approach to Mechanical Integrity Management, SGS offers Radiographic Testing (RT) to our list of NDT services.

Understanding that talent, service and responsiveness is conveyed at the local level we strive to provide best in class NDT services to our regional partners. SGS Technicians are local, full-time employees, prepared to provide you with the highest level of professional customer focused service in the industry. Their goal is to provide you with timely, thorough and accurate inspections with repeatability.

SGS uses current up to date technology to service your radiography needs. Using industry leading radiography equipment and exposure devices, and a fleet of fully customized portable x-ray labs, we can offer our clients the best service and results, the industry has to offer.

SGS is committed to providing NDT services for fabrication, pipeline, plant construction & maintenance, chemical & petrochemical plants, conventional & nuclear power plants. We can offer fully functional and locally managed offices, strategically located to offer customer centered NDT services for our clientele.

NDT SERVICES

- Radiographic Testing (RT)
  Detects surface and subsurface defects with a permanent record
- Ultrasonic Testing (UT)
  Detects surface and subsurface defects and measures thickness
- Penetrant Testing (PT)
  Detects surface defects with contrasted visual inspection
- Magnetic Particle Testing (MT)
  Detects surface and subsurface defects for contrasted visual inspection
- Positive Material Identification (PMI)
  Determines elemental composition of unknown materials

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