




APTECH Engineering Services, Inc. Petrochemical Group



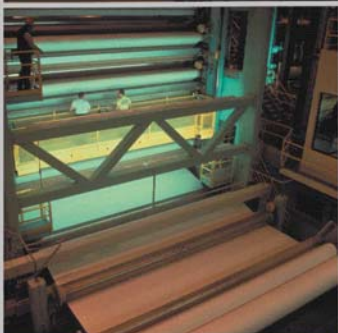
Risk Analysis and Mechanical Integrity Experience in the Ammonia, Nitrogen, and Hydrogen Industries



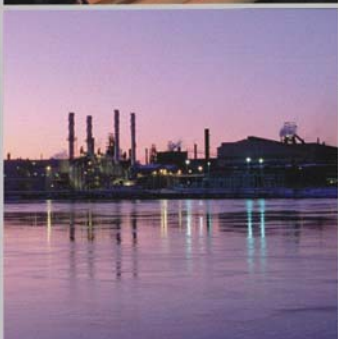
Aptech Engineering Services, Inc. (APTECH) is a leader in conducting risk analysis and implementing mechanical integrity programs at refineries, petrochemical plants, and related facilities throughout the world.

APTECH uses highly experienced engineers for all risk analysis work. Our experience level frequently identifies concerns missed by other, less experienced, service providers. Typically this experience allows us to complete projects in less time and with less support from our client's staff. As a result, our client's realize a larger cost savings in project execution.

APTECH Qualifications




APTECH is an internationally known consulting engineering services firm specializing in performance optimization of equipment and the prediction and extension of the remaining useful life (RUL) of refinery piping and equipment, petrochemical equipment, gas gathering vessels, boilers, turbines, and associated utility equipment, structures, industrial equipment, and materials. Our engineers and operations specialists have assisted a wide variety of clients in achieving optimum equipment performance and reliability, either through improved operating techniques and methods or by cost-effective changes or additions to design. APTECH predicts when systems or hardware will fail and analyzes why they have failed, and we have developed numerous methods to prevent future failures and extend the useful service life of the component, and thus the system.



Our company currently has 60 full-time employees and approximately 120 part-time employees engaged in projects spanning the following industries:

- ◆ Power Generation
- ◆ Nuclear Power
- ◆ Petroleum and Chemical Industry
- ◆ Litigation and Insurance Support
- ◆ General Industry



APTECH's corporate office is in Sunnyvale, CA (San Francisco Bay Area) with a regional office in Houston, TX. In addition, APTECH has representatives in many countries worldwide, including South Africa, Taiwan, Japan, Indonesia, China, Russia, Singapore, and India. Our offices are staffed by senior project management and performance analysis, mechanical, and nondestructive examination (NDE) personnel to allow us to respond quickly to our clients' needs in these geographical locations.

RBI Experience

Risk Based Inspection (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. RBI provides a systematic methodology for factoring risk into infrastructure maintenance and inspection decision-making.

APTECH maintains its own database of damage mechanisms and operational conditions that could cause degradation of materials. The objective of RBI is to focus and prioritize the inspection effort without doing additional work (other than the RBI study). Instead of baselining all equipment, it allows one to focus initially on the high-risk equipment items without jeopardizing plant safety.

APTECH has many years of experience in the development and implementation of RBI programs for process facilities worldwide. It is our experience that a complete RBI program should consist of the following elements:

- ◆ Training
- ◆ Software
- ◆ Data Collection and Management
- ◆ Likelihood of Failure (LOF) and Consequence of Failure (COF) Analysis
- ◆ Risk Ranking Analysis
- ◆ Reporting
- ◆ Risk Management – Dealing with High Risk Items
- ◆ Turnaround Planning
- ◆ Updating and Continuous Improvement

APTECH maintains a staff of recognized experts in metallurgy, RBI, plant inspection programs, and process safety management, among other things. APTECH developed the "Mechanical Integrity Supplement to the Maintenance Excellence Guide" under contract to the Chemical Manufacturer's Association (CMA) (now the American Chemistry Council) for the Responsible Care Program. With respect to RBI, APTECH began developing RBI technology and software tools in the mid-1990s and offers one of the leading software products in this field. Our Risk Directed Mechanical Integrity Program (RDMIP™) software meets the specific needs of both the chemical industry and refining, and it also meets the American Petroleum Institute (API) standards. Unlike other products available, RDMIP provides hazard information on over 1,600 chemicals. It is unique in that it is able to evaluate mixtures of both flammable and toxic chemicals.

The APTECH Houston office has a team of dedicated engineers who have many years of experience with RBI implementation. This implementation has included the API methodology, APTECH's in-house program, RDMIP, and other commercial RBI programs. APTECH personnel who have implemented RBI programs include experienced data clerks who are familiar with refinery operations and documentation. Process engineers who are experienced in refinery unit operations conduct the COF evaluations, and experienced metallurgists or corrosion engineers conduct the LOF analyses. The Houston office has NACE qualified corrosion experts who have many years of refinery experience and are familiar with all degradation mechanisms and corrosion problems associated with the petrochemical industry. In addition to this, APTECH has engineers who regularly conduct Level II and Level III RUL and fitness-for-service evaluations (API 579). These personnel are used if the RBI analysis and subsequent inspections merit such evaluations.

Additional information regarding our experience and skills may be found on our website at www.aptecheng.com or www.aptechtexas.com. APTECH's August 2, 1999 article in the Oil and Gas Journal entitled, "Risk Based Methods Optimize Maintenance Work Scope" and "The Implementation of RBI Programs" published in the January 2002, Hydrocarbon Processing magazine are informative on the overall approach process and benefits. APTECH's approach meets the requirements of the API's API 510, API 570, and API 580, and generally accepted good engineering practices.

Benefits from a RBI program include improved mechanical integrity (MI) with better identification of probable damage mechanisms at work. The appropriate inspection program can then be developed to manage them. Inspection programs can be developed based on risk (not time based), and priorities can be set according to the LOF and the possibility that certain damage mechanisms will occur. Plants with current RBI programs report an \$8 to \$20 return on investment for every dollar spent to establish the program. This return is the result of improved inspection definition and associated labor and plant downtime cost benefits. Additional benefits include less thickness monitoring locations on low risk equipment items and improved turnaround planning. During the analysis, specific recommendations are made relating to operational, corrosion, and inspection needs that address identified

damage mechanisms in equipment. All decisions are documented, allowing management to make informed, defensible decisions based on risk.

Partial Project List

APTECH has significant experience in risk analysis, risk management, RBI, reliability analysis, RUL analysis, and MI projects. We have completed over 6,000 projects in the past 25 years for approximately 1,500 clients, including risk based programs at world-class facilities, in over 25 plants. A partial list of reliability and performance improvement projects follows:

Chemical Industry Experience

APTECH prepared the “Mechanical Integrity Supplement to the Maintenance Excellence Guide” for the American Chemistry Council (1994). This guide assists plant owners and operators in achieving maintenance excellence by developing and implementing MI programs related to the Occupational Safety and Health Administration (OSHA) OSHA 29 CFR1910.119, Process Safety Management, paragraph (j), Mechanical Integrity. The supplement describes, through illustrations and industry samples, methods that can be used to meet these requirements. Equipment covered includes pressure vessels, storage tanks, relief systems, vent systems, piping, and pumps. APTECH developed this document in close coordination with a subcommittee of the CMA.



Nitrogen, Ammonia, Hydrogen Plant Experience

Apache Nitrogen Products – APTECH developed and wrote the MI document for Apache Nitrogen, as well as the QA manual for the facility. APTECH is currently developing an inspection strategy based on RBI and in the future will provide inspection training and manage the MI program for the plant.

Coastal Chem (Cheyenne, WY) – APTECH conducted a process investigation concerning the cause of the failure of primary reformer catalyst in Coastal’s ammonia plant. We recommended the installation of additional equipment items, including control interlocks, to prevent recurrence of the incident.

Dakota Gasification Company’s (DCG) Ammonia Plant – APTECH determined the fitness for service for numerous heat exchangers in DCG’s ammonia plant. Using heat exchanger design data and NDE data, we developed a model of the remaining life of the tubing using conservative estimates of the maximum flaw size and flaw growth rates. APTECH suggested additional tests, if the estimated remaining life was not satisfactory to provide confidence for future exchanger service (e.g., until the next turnaround, or for the desired service life of the exchanger, etc.)

Ammonium Nitrate Plant – APTECH conducted extensive investigations of a fire and explosion in an ammonium nitrate plant. We concluded the incident resulted from a design defect of the neutralizer vessel (Terra Industries).

Suncor Energy Refinery and Hydrogen Plant – APTECH conducted a life assessment study for major classes of equipment, such as columns, pressure vessels, heat exchangers, fired heaters, compressors, tanks, and piping. The majority of this equipment had been in continuous operation in Ft. McMurray, Alberta for about one design lifetime. Major degradation modes evaluated included creep rupture, stress rupture, corrosion, stress corrosion

cracking, high temperature hydrogen attack, wet H₂S cracking, and fires and explosions. APTECH identified those pieces of equipment with limited remaining life and for which the current maintenance program did not make adequate provisions. Using the results of prior risk assessments conducted at the facility, APTECH identified a list of unusually critical equipment, which upon failure would result in a lengthy production loss.

Refinery Hydrogen Plants – APTECH's MI and RBI scope includes the steam methane reformer (typically), high and low temperature shift converters, CO₂ removal, and methanation. Many of these components are common to ammonia producers.

Our refinery hydrogen plant experience includes the Tesoro refineries in Hawaii and North Dakota, the Caltex and Engen refineries in South Africa, the OMV Refinery in Germany, and the PREMCOR refinery in Memphis.

CO₂ Removal Vessel Environmental Release – APTECH investigated a chemical (Catacarb) release from a refinery hydrogen plant. The facility continued to operate a pressurized column after a leak in the column was discovered by its personnel. We reviewed design, operating, startup, shutdown, and maintenance records, and conducted a plant visit.

Partial Client List

- ◆ Abu Dhabi Gas Industries (GASCO)
- ◆ Apache Nitrogen Products, Inc.
- ◆ Arco Chemical Company
- ◆ Caltex Chemical Company, US
- ◆ China General Plastic Corporation
- ◆ Cargill Fertilizer
- ◆ Eastman Chemical Company
- ◆ Engen – A Division of Engen Petroleum
- ◆ Firestone Polymer
- ◆ Fluor Daniel, Inc.
- ◆ FMC Corporation
- ◆ Hampshire Chemical Corporation
- ◆ H.B. Fuller Company
- ◆ Huntsman Chemical
- ◆ Lion Oil Company
- ◆ Louisiana Pigment Company, LP
- ◆ Marathon Oil Company
- ◆ Montell USA, Inc.
- ◆ Occidental Gas
- ◆ PREMCOR Refineries
- ◆ Rohm & Haas
- ◆ Samsung Chemicals
- ◆ Seadrift Coke
- ◆ SGS Industrial Services
- ◆ SK Chemicals
- ◆ Sunkyong Industries (formerly Yukong, Ltd.)
- ◆ Sunoco (formerly Aristech Chemical Co.)
- ◆ Taiwan Vinyl Chloride Monomers Plant, CGPC
- ◆ Tesoro Petroleum (formerly BHP Petroleum)
- ◆ Valero Refining Company

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