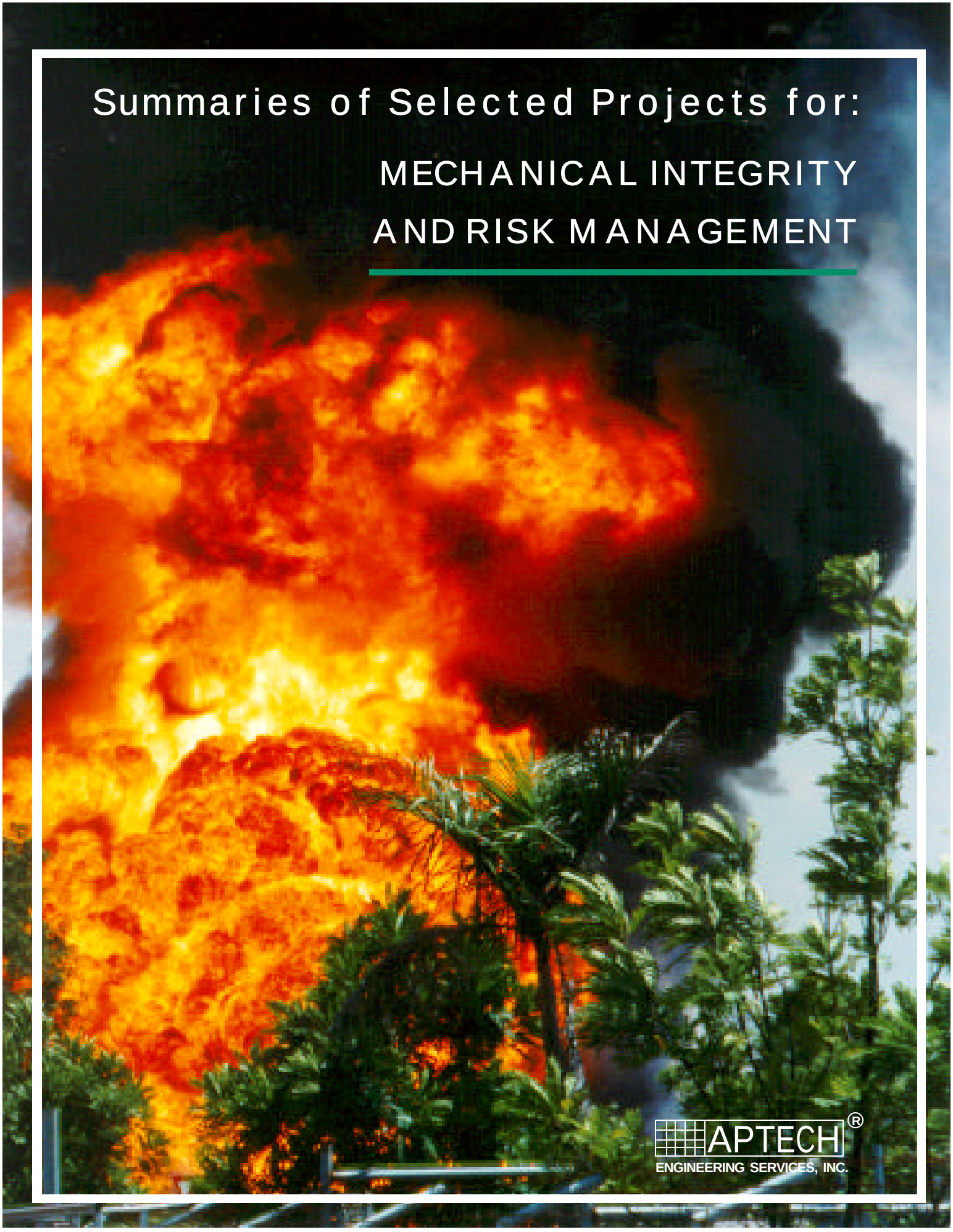
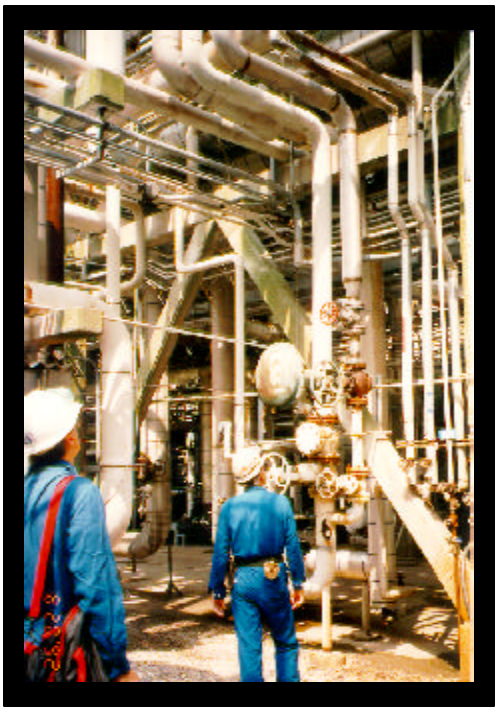
Summaries of Selected Projects for:

MECHANICAL INTEGRITY AND RISK MANAGEMENT



APTECH®
ENGINEERING SERVICES, INC.

A P T E C H



On the Cover:
Ground flare in operation at gas processing plant after line pigging

Mechanical Integrity Guidelines

When OSHA 1910.119 subparagraph (j) on Mechanical Integrity was enacted, APTECH was chosen by the Chemical Manufacturers' Association (CMA) to document interpretation of the Mechanical Integrity Rule by the Inspection and Maintenance Task Group. This document provides guidance to the refining and chemical industries on "*What Mechanical Integrity is, and what it is not*." It has been used in numerous workshops by CMA as a cornerstone for the "workshop." It is presently considered an excellent reference for anyone interested in the basics of Mechanical Integrity and has been disseminated worldwide. As such, it provides an important reference on Mechanical Integrity, and, to a certain extent, represents consensus from key individuals from the industry on the subject.

Mechanical Integrity Training and General Consulting

Recognizing that a clear need existed for training and consulting on Mechanical Integrity, APTECH designed a three-day public workshop and training package to teach companies the basics. The workshop covers how to develop and implement a formal program using in-house resources. More than 100 companies with operations throughout the world have benefited from the workshop.

General consulting has been provided by APTECH to dozens of companies on Mechanical Integrity and assistance given to various aspects of client programs, including program strategies, procedure development, and specific training on maintenance and inspection (e.g., bolting practices, nondestructive examination procedures, fitness-for-service, etc.).

8-Step Technical Analysis to Document Covered and Excluded Equipment

Based on the requirements of the Mechanical Integrity Rule, APTECH recognized that not all components in the plant would have to be covered to address the central theme of the rule— that is, prevention of catastrophic failures. We formalized a set of procedures that have subsequently been used to provide the basis and documentation to exclude equipment that is not important to safety and does not need coverage by the rule. We have subsequently applied this process in numerous refinery and chemical plants.

Clients recognize significant benefits from this first-level hazard screen and can focus their attention on the equipment that can create most problems or systems which can mitigate disasters. In addition, our procedures have been used to document additional equipment our clients may want to cover (e.g., for reliability and availability).

Chemical Plant Life Cycle Management Program

This project was conducted several years before risk ranking for the purposes of Risk Based Inspection became an industry objective. A major chemical manufacturer of an extremely hazardous chemical requested APTECH's assistance with development of a program to deal with the fact the plant was over 40 years old, and management had major concerns due to aging of

equipment. A Task Group consisting of operations, maintenance, and engineering personnel was established in the plant, and APTECH was identified as the prime consultant to the effort.

Working with the Task Group, APTECH developed a decision analysis methodology to prioritize components for further evaluation. The methodology provides weighting factors to consider sometimes conflicting priorities or hazards with which the plant may be concerned (i.e., organizational conflict between business interruption and maintenance costs). The methodology considers the following factors for each piece of equipment addressed:

- Cost of Replacement Components
- Cost of Maintenance
- Cost of Lost Production
- Chance of Failures
- Risk to the Environment
- Risk to Personnel

The methodology successfully demonstrates the application of the 80/20 rule (i.e., 20% of the equipment normally creates most of the problems) and the client is continuing to use it to focus resources.

LNG Plant Life Extension Program

Japan receives Liquified Natural Gas (LNG) from the largest LNG plant in the world and has had a contract for this delivery for almost 20 years (the plant's original design lifetime). The contract was due for renewal, and concerns were raised about the ability for the plant to continue to reliably produce LNG for Japan for another 20 years. This plant requested APTECH's assistance with development of a program to address client concerns with plant reliability.

APTECH responded by developing a program to identify and prioritize the 54 major life-threatening issues to plant viability for continued reliable production. Detailed recommendations were provided for each element of the life extension program. Several potentially life-threatening problems were discovered as a result of this project, specifically:

- A major problem with incorrect material installation was discovered. Carbon steel piping had been installed in an application which required higher alloy material. This resulted in carburization and embrittlement of high-pressure, high-temperature steam lines that could have resulted in catastrophic failure and significant down time.
- Corrosion in the sea water cooling system was causing an unforeseen increase in maintenance costs during turnarounds.

> "20% of the equipment creates most of the problems"

APTECH continues in a consulting role to an established project team that is systematically providing solutions to all of the issues identified. As examples:

- APTECH developed a damage management plan to establish the ability of the plant to operate safely with the carbon steel piping in a less than desirable design application as described above. This included material sampling/testing, nondestructive examination, analysis, and continued monitoring to allow the plant to continue to operate in a non-conforming condition until piping could be replaced.
- APTECH developed a computer program for the plant to apply Bayesian statistics to predict where the plant should focus attention for inspections and repairs of the seawater cooling system during coming turnarounds.

Piping Inspection and Risk Directed Mechanical Integrity Program

A major refinery in the United States was concerned with the state of its Mechanical Integrity Program. The required compliance date was rapidly approaching and much remained to be done by the plant.

APTECH was awarded a contract for development, management, and implementation of the piping inspection program at the plant. Discussions identified the need for APTECH's assistance in development of a project to help provide prioritization to the plan and a risk-based (or "risk directed") inspection planning process for the plant.

APTECH and the client agreed to collaborate on a development effort. Due to our focus on heavy equipment mechanical integrity, along with our practical experience with incident investigation and litigation support, APTECH was able to apply our knowledge to develop our program for "Practical Application of Risk Based Technology," effectively an Evergreen Program for the client.

A B S T R A C T S

The client is now successfully implementing a "Risk Directed Inspection Program" using principles embodied in the CMA's concept of continuous improvement.

APTECH and the client agreed to future cooperation on development of this technology which will be accomplished through a users' group. The technology is presently being successfully implemented on five projects and continually enhanced by client input. The users' group has been established, and future plans include risk directed software that is fully integrated with an established inspection tracking program.The American Petroleum Institute (API) has been working on developing a risk-based inspection methodology for some time, and we are assisting with that effort.

Chemical Plant Risk Directed Inspection Program

A major chemical producer in the United States approached APTECH with the desire to develop a project to address inspection intervals and mandated inpections at the plant. Some jurisdictions in the United States have mandatory inspection intervals for all pressure containing equipment at specified maximum intervals (for example, two years).

Using procedures and an interrelational database developed by APTECH, over 400 fixed equipment items were evaluated and inspection plans developed. A presentation to the state inspection authorities resulted in a tentative agreement to allow extensions to the mandatory two-year inspection interval based on the program developed by APTECH and the client. This will result in very substantial cost savings during the coming years.

APTECH continues in a consulting role to the client and is assisting with other fixed equipment and piping inspection concerns.

Refinery Safety Assessment

APTECH is presently applying the technology discussed above at one of the largest refineries in the world. Utilizing our procedures and database, our experts on refinery conditions and process metallurgy are developing analyses and reports on likelihood and consequence of failure.

In addition, remaining useful life calculations, fitness-for-service analysis, and additional inspection planning protocols to address actual metallurgical and process conditions are being developed. A similar project has begun on a "sister" chemical plant in the same country.

Mechanical Integrity Program for Complex of Chemical Plants

A major corporation requested APTECH's assistance when one of seven plants was named by the Taiwan Environmental Protection Agency as the plant having the worst safety record in Taiwan. The plant was ordered to fix the problems or remain shut down. In addition, the plant had never operated at greater than 40% process capacity.

(Continued on back)

A B S T R A C T S

APTECH assisted the President of the company by developing an organizational plan and functional job descriptions for the plant's employees. After the reorganization, APTECH personnel arrived at the plant to implement training on process safety management and mechanical integrity. Particular attention was initially paid to fixing maintenance and operations problems at the plant, as well as various hardware issues. Training was provided on mechanical integrity, the inspection program, deficiency resolution, safe work practices, etc. Both mechanical and instrumentation/controls and electrical equipment were addressed.

Following completion of on-site work, a system of long-distance consulting was set up and continues to function. Questions regarding process, maintenance, and inspection problems were e-mailed or faxed to APTECH on a daily basis. By the time plant personnel arrived at work the next day, APTECH had provided comments and solutions which could then be implemented. This method of 24-hour engineering is one currently being implemented with other clients as well. After APTECH worked with the plant for about nine months, the plant had reached over 90% of its nameplate capacity and had risen to a B+ safety rating versus the D rating it held prior to our team providing assistance.

Software for RBI Analysis

APTECH has spent over 5 years developing and testing state-of-the-art software for Risk Based Inspection (RBI). Our RDMIP™ software allows for rapid consequence and failure-potential analysis of highly complex processing systems. The software currently covers process vessels and piping. It is suitable for oil & gas, refining, petrochemical, chemical and related facilities.

The RDMIP™ software includes advanced features to handle complex chemical mixtures as well as exotic metallurgy. These capabilities far exceed those of competing, software products.

Additionally, APTECH has experience using other software tools including API RBI software as well as others. We can insure that the right software product is used for your RBI project. And, we can provide the training, installation, and services that you may require, regardless of the software selected.

For More Information

Please contact the APTECH office or representative nearest you.

Headquarters
P.O. Box 3440
Sunnyvale, CA 94088-3440
Phone: (408) 745-7000
Fax: (408) 734-0445
Toll Free: (800) 477-2228
Email: aptech@aptecheng.com
Website: www.aptecheng.com

Regional Office
12012 Wickchester, Suite 120
Houston, TX 77079
(281) 558-3200
Email: aptechtexas@aptecheng.com

www.aptecheng.com

Additional Services

- Remaining Useful Life and Condition Assessment
- Life Extension and Mechanical Integrity
- Reliability and Risk Analysis
- Failure Analysis and Incident Investigation
- Explosion and Fire Services
- Accident Investigation and Reconstruction
- Claims and Litigation Support
- Technology Development
- Process Safety Audits