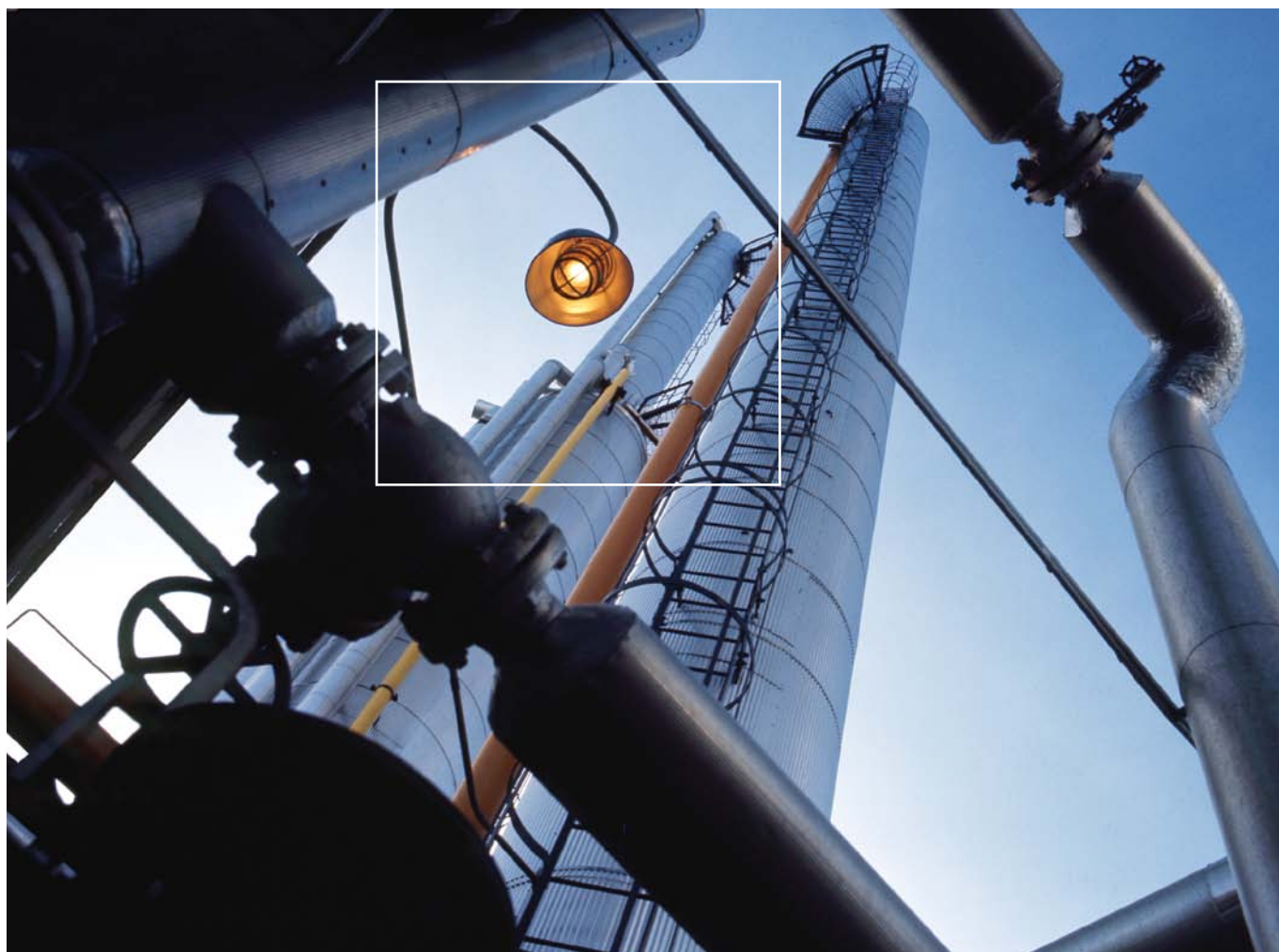


Process Safety Management

Services and Experience in HAZOP, SIL and QRA



Project experience to meet four challenges in the Oil & Gas Industry

At Arthur D. Little our main aim is to help you meet your performance, schedule and budget requirements. Our process risk group has delivered quality work to tight schedules – often facilitating multiple project teams working in parallel – to help the industry respond to four primary challenges.

Greenfield and major new facility investment to meet domestic demand and develop export markets

Our safety studies include major infrastructure development projects in the Middle East which focus on maximizing value from domestic crude and gas production. Project experience includes:

- HAZOP and fire protection consequence modelling for worldscale petrochemical complex.
- HAZOP of all units for greenfield refinery.
- HAZOP and SIL studies for greenfield gas condensate refinery.
- Construction phase QRA for major petrochemical industrial complex.

Clean fuel specifications

We have a grasp of refinery economics, market positioning and the importance of high operating service factor. This background helps add value to the HAZOP study of debottlenecking and expansion projects. Project experience includes:

- HAZOP and fire protection consequence modelling for refinery fuels improvement project, South America.
- HAZOP for various refinery fuels improvement projects, Africa & Europe.
- HAZOP for several refinery fuels improvement projects, Middle East.
- HAZOP for refinery fuels improvement project, Central America
- HAZOP for refinery middle distillate products, Europe.

Exploiting major gas reserves

We have carried out safety studies on various LPG, LNG and GTL projects worldwide. We are familiar with the special requirements and challenges for cryogenic LNG service. Project experience includes:

- HAZOP and SIL for worldscale GTL project, Middle East.
- HAZOP and SIL for worldscale LNG liquefaction and export terminal, Africa.
- HAZOP and SIL for LNG liquefaction and export terminal, Oceania.
- HAZOP for LNG import and regassification terminal, Asia.
- HAZOP for LNG import and regassification terminal, Europe.
- QRA for onshore gas plant LPG export terminal, Oceania.

Residue conversion and heavy oil upgrading

Our process risk group features exceptional expertise in refinery technology. This enables us to achieve extensive technology transfer through HAZOP and SIL studies on the leading technologies such as delayed coking, residue desulphurization and hydrocracking. Project experience includes:

- HAZOP and SIL for new technology concepts such as heavy crude oil conversion project, South America.
- HAZOP and SIL with close attention to operability and smooth start-up for major refinery hydrocracker expansion, Africa.
- HAZOP where in depth examination of unfamiliar technology benefited the operations team of a heavy conversion project, Europe.

Project experience on asset expansion and safety improvement projects

Figure 1. Global reach of Arthur D. Little process safety services



Source: Arthur D. Little

Revamp, debottlenecking and process hazard analysis (PHA) of existing facilities

Improved safety performance hinges on the quality and motivation of staff as well as technology and engineering. When we undertake projects associated with safety improvement, revamping and debottlenecking of existing operating facilities, we focus on the human-equipment interfaces and equipment suitability, balancing administrative and engineering risk controls. Our Project experience includes:

- HAZOP, cost benefit analysis and prioritization of expenditures for existing units within an European refining group.
- HAZOP, PSM auditing and QRA for high hazard speciality chemicals manufacturers, Europe & Asia.
- HAZOP of existing ammonia, methanol, steam and power facilities, Middle East.
- HAZOP for high pressure polyethylene plant debottlenecking project, Europe.
- Major accident risk study for the expansion of an upstream onshore gas plant, South America.

Safety review of transportation infrastructure

The Arthur D. Little process risk group has an unbroken record of safety studies in onshore pipelines lasting 40 years. Our project experience includes:

- HAZOP for national export marine terminal and subsequent expansion, Middle East.
- QRA of natural gas transmission network, medium pressure distribution and associated metering and pressure regulating stations, Europe.
- HAZOP and QRA of LNG import pipelines for a new LNG import and regassification terminal, Europe.
- QRA for relocation of refinery LPG pipeline infrastructure, Europe.
- QRA study of ammonia ship unloading, storage and distribution facilities, Middle East.
- QRA study for chlorine storage and road transport activities, Middle East.

We provide a range of services focused on improving operational safety performance

Development of corporate safety management standards and systems

Our process risk group has worked with a number of different national oil & gas companies in the development of corporate safety management standards and systems. Project experience includes:

- Development of corporate process safety management requirements for a European refining conglomerate.
- Safety management system development for an emerging oil corporation, Europe.
- Strengthening of third party interface asset data management practices and lone working practices for a national utility organization, Europe.

Development of staff process safety competencies

We have also developed a number of training courses to address key competencies. These training courses can be tailored to specific operating company requirements:

- Strategic safety management for senior managers and directors.
- Process safety management auditing.
- Process hazard analysis techniques.
- Accident investigation.
- HAZOP and SIL techniques for leaders, recorders and team members.

Process safety management auditing and operating safety performance benchmarking

At Arthur D. Little we have undertaken various projects with operating companies focused upon improving operational process safety management activities to ensure alignment with major process safety risks. Project experience includes:

- Interstate high pressure gas transmission pipeline owner and operator.
- Multinational petrochemical producers, Europe & South America.
- European refining groups, South America & Africa.
- Multinational petrochemical producer, Europe.

Implementation of operational safety performance recommendations

We are able to provide effective programme management and drive change. Our implementation planning system tool:

- Is a multi-project-management tool for complex implementation environments.
- Helps to structure implementation projects, and coordination across projects.
- Enables monitoring of implementation progress and risks.
- Supports quick, fact based decisions.
- Captures financial impact of implementation steps and synergies in a consistent way.
- Enables benefit realization tracking.
- Allows information sharing through document handling.

Feedback on Arthur D. Little process risk services

Services for hazard and operability studies (HAZOP) and safety integrity level (SIL)

Arthur D. Little's process risk group has worked extensively on HAZOP and SIL studies for the international refining and petrochemical industry, for a period of over twenty years.

"Found that there was much better mutual understanding than with others, much more cooperation, helped us reach our target..."

– Engineering contractor

During this time, we have completed studies throughout Europe, Asia-Pacific, Middle East and North/South America, evaluating a huge variety of projects including:

- Modification/upgrade/revamp of existing units.
- FEED stage and EPC project design of process and utility units.
- Almost every type of refinery processing technology and several complete green-field refinery complexes.

"Excellent service and prompt response time – even when dealing with queries and changes. Professional approach and advice..."

– Facility Owner

Process safety management (PSM) services

We have assisted in the development of numerous oil and gas operator safety management arrangements including:

- Development of corporate process safety management standards.
- Completion of corporate and compliance process safety audits and best practice benchmarking.
- Review of safety culture performance.
- Development and delivery of process safety training courses.

"Very helpful, many critical issues identified. Price higher than other bidders but other bidders would not have provided the same quality."

– Facility Owner

Consequence analysis and quantified risk assessment (QRA) services

We have undertaken consequence analysis modelling for use in FEED/EPC fire & gas detection studies, facility siting studies and quantified risk assessments for upstream and downstream onshore oil & gas infrastructure including:

- Upstream onshore production wells, gathering pipelines and gas plant facilities.
- Refinery and petrochemical unit operations.
- Speciality chemical isocyanate manufacturing facilities.
- High pressure natural gas transmission systems.
- LNG and LPG import/export facilities.

"Outperformed expectations for project delivery. Spanish language when required."

– Engineering contractor and Facility owner

"Spirit of collaboration, discipline, reliable, high quality of services provided."

– Engineering contractor

Our goal is to provide premium process risk services:

- We retain a pool of mature expert practitioners who consistently receive excellent client feedback for their knowledge, judgement and integrity.
- Our project approach and engagement focuses on owner objectives "on time, within budget".
- We aim to root out key weaknesses and offer practical, high added-value recommendations.



Arthur D. Little process risk services

Arthur D. Little is a respected provider of HAZOP, SIL, QRA and process safety management services across the oil and gas industry. Our experience from numerous worldscale oil and gas development projects brings us a true understanding of the engineering challenges and the safety requirements which need to be addressed.

Arthur D. Little

Arthur D. Little, founded in 1886, is a global leader in management consultancy; linking strategy, innovation and technology with deep industry knowledge. We offer our clients sustainable solutions to their most complex business problems.

Arthur D. Little has a collaborative client engagement style, exceptional people and a firm-wide commitment to quality and integrity. The firm has over 30 offices worldwide. With its partner Altran Technologies, Arthur D. Little has access to a network of over 18,000 professionals. Arthur D. Little is proud to serve many of the Fortune 100 companies globally, in addition to many other leading firms and public sector organizations. For further information please visit

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