

# Bob Roberts

## Risk & Reliability Engineer

Roberts & Roberts  
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### Capabilities

- **Asset Management:** production/processing facility top-down Reliability-Availability-Maintainability modeling and maintenance function optimization, process system simulation modeling, cost-estimating, cost-benefit analysis, economic feasibility analysis, loss protection of fixed capital assets, supervision of contractors and employees, regulatory compliance.
- **Risk Engineering:** hazards review (HAZOP, FMEA, FMECA, Safety Barrier Analysis), scenario development, scenario risk ranking, explosion, fire, and toxics dispersion modeling, quantitative risk analysis (FTA, RBDA, simulation modeling, Safety Integrity Level Selection (SILS) and Layer of Protection Analysis
- **System Safety and Process System Reliability Modeling:** fault tree analysis (FTA), Safety Integrity Level Selection(SILS), reliability block diagram analysis (RBDA), reliability data collection and analysis, top-down process system Reliability, Availability, Maintainability (RAM) modeling, process system capacity analysis, and process system RAM simulation, availability improvement methods such as Reliability Centered Maintenance (RCM).
- **Reliability Engineering & Maintenance Management:** operating strategy, maintenance strategy, maintenance budgeting and cost accounting, cost-benefit analysis, operational risk exposure, maintenance organization optimization, head count and task allocation, root cause investigation, mechanical integrity auditing and assessment, fitness-for-duty, cost-benefit analysis, bench marking, selection and application of best practices, effective use of computerized maintenance management systems, turnaround planning, scheduling, budgeting and management, LP optimization, data mining and analysis, report writing.
- **Process Safety Management:** all aspects of development, organization, and implementation of a PSM program, process safety information, process hazards assessment, operating procedure preparation and verification, operator training, emergency response planning, incident reporting and investigation, contractor management, auditing, regulatory compliance

**Qualifications**

Mr. Roberts has 15 years' experience in Risk and Reliability Engineering, Process Safety Management (PSM), Risk Management Program Plan (RMPP) preparation and compliance, and Risk Management Program (RMP) preparation, implementation, and compliance. He has organized and led many qualitative and quantitative hazard reviews, risk assessments, and Reliability, Availability, Maintainability (RAM) assessments for the energy, chemical, and transportation business sectors. Prior to 1990 he was employed as a chemical process engineer for Fortune 500 companies. He accumulated 18 years of industrial experience working in the energy, minerals, and metals resource sectors: TOSCO, AMAX, Rocky Mountain Energy Company (subsidiary of Union Pacific), and ARCO, accumulating 18 years of experience in exploration, production, transportation, processing, and refining.

He has lead, performed and/or reviewed over 200 HAZard and OPerability Studies (HAZOPS), process risk assessments, and process RAM analyses. Experience includes most refinery process units; ocean, highway, rail, and pipeline logistical systems; non-nuclear power generation, and chemical manufacturing. He has conducted hazard reviews and/or risk assessments and/or has operational experience in most commonly-encountered industrial facilities: co-generation, potable water treatment, industrial waste water treatment, foam rubber manufacturing, metal plating, specialty chemicals manufacturing, petrochemicals manufacturing, chemical warehousing, natural gas processing, LNG liquefaction, onshore and offshore hydrocarbon production, mining, milling, oil shale processing, metals refining, and industrial gas manufacturing. He has developed RAM models for production and processing facilities.

He has assessed accidental release, dispersion, air-transport, and potential human exposure of toxic organic and inorganic chemicals: anhydrous acids, anhydrous bases, hydrocarbons, solvents, pesticides, herbicides, biocides, and fumigants. He has assessed potential health effects of airborne carcinogens fractions (poly-aromatic hydrocarbons) resulting from combustion of heavy petroleum. He has prepared risk assessments for chlorine, ammonia, fluorine, hydrofluoric acid, sulfuric acid, oleum, sulfur dioxide, sulfur tri-oxide, hydrogen sulfide, and selected phosphates and per chlorates.

His client list includes RAMCO, BOC, Exxon (now ExxonMobil), Equilon LLC (now Shell Oil), Texaco (now ChevronTexaco), Phillips Petroleum (now ConocoPhillips), ARCO (now BP), Ultramar (now Volero), Unocal (now ChevronTexacoUnocal, Mobil (now ExxonMobil), Chevron (now ChevronTexaco), Kuwait National Petroleum Company (KNPC), Petroleos Mexicanos (PEMEX), Saudi Arabia Basic Industries Corporation (SABIC), Zurich America Insurance Company, Palmdale Water District, Dow Corning, University of California Santa Barbara, Van Waters & Rogers, Santa Barbara County Department of Environmental Health Services, and Johns-Manville.

He has taught seminars on process safety and risk management at the University of Southern California (USC), and has made presentations at AIChE meetings, the Mary Kay O'Connor Center for Process Safety Annual Symposium, and the Southern California Society of Risk Analysis.

**Process Hazard Analysis**

HAZID/HAZOP/PHA leader in numerous original and revalidation studies on behalf of refining and chemical manufacturing. Mr. Roberts has led HAZID and HAZOP studies for most refinery process units,co-generation facilities, and numerous other industrial processes.

**Consequence Analyses**

Applied dispersion models (SAFETI, PHAST, CAMEO/ALOHA), and fire, and explosion models (TNT, TNO) models to estimate consequences of accidental releases in support of RMPP and RMP worst case and alternative case scenarios. Modeling results were used to support quantitative risk assessment (QRA), emergency response planning, and to evaluate plant layout and control-building siting. Mr. Roberts has used GIS and demographics of potentially-exposed populations to establish the location and sensitivity of receptors relative to toxic release. Likewise Mr. Roberts has combined modeling and point source sample collection to settle third-party insurance claims..

**Refinery Process Unit Risk Assessments**

Performed extensive comparative risk assessment of high hazard refinery process systems using fault trees populated with generic and subsequently with process system specific equipment component failure rate data: HF alkylation, high pressure hydro-cracking, and high pressure hydro-treating. Used QRA to design HF release detection, alarm, and water-spray mitigation system.

**Pipeline Risk Assessment**

Led a comparative risk assessment for refinery pipeline routing, Wilmington, California. Conducted Risk assessment of underground and under-sea liquid pipelines servicing Unocal Corp. offshore platforms in Cook Inlet Alaska. Performed a pipeline hazard assessment and consequence analysis for oil and gas production facilities along the Central Coast of California. Performed a quantitative risk analysis for routing 22 pipelines in a petroleum refinery in Kuwait.

**Facility Siting**

Performed control building facility siting and layout assessment for three sour crude oil refineries and an LNG plant. Assessment included consequences of fire, explosion, and airborne toxics resulting from equipment failure and accidental release of process material to atmosphere. Verified engineering design of a water curtain mitigation system for a hydrofluoric acid alkylation unit and relocated operator PPE change facility, Wilmington, California. Developed a plan for locating early warning detection instrumentation in and around a refinery hydrofluoric acid alkylation unit.

**Human Factors Assessment**

Prepared guidance document and assessment criteria for evaluating considerations of human factors involved in routine duties of outside operators, and maintenance mechanics. Participated in design of Distributed Control System graphic display information for centralized refinery process control system. Reviewed refinery training materials and made suggestions to improve learning rate and increase retention. Reviewed operating, maintenance, and emergency response procedures for two sour crude oil refineries to identify potential weaknesses or factors leading to errors in decision making and subsequent corrective action.

**Quantitative Risk Assessment**

Ultramar Corporation project manager for quantitative risk and reliability analysis of alternative design configurations for HF Alkylation unit Rapid Acid Transfer System. Managed a comparative risk analysis of three design alternatives for a landfill. Conducted plant reliability / control building siting studies for several refineries and a Liquefied Natural Gas (LNG) plant. Participated in preparation of process unit reliability models for Ultramar Wilmington and Equilon Bakersfield refineries, and a PEMEX offshore gas compression platform in the Gulf of Mexico. Mr. Roberts has used various fault tree and event tree software packages in performing these assessments.

**Assessment of Safety Critical Instrumentation**

Conducted assessment of safety critical instrumentation for a refinery hydrofluoric acid alkylation process unit and for hydro-cracking units at two California refineries using preliminary version of ISA -84-01 standard.

**Emergency Planning and Response**

Assisted in preparing and exercising emergency response and oil spill contingency plans. Was member of a management incident response team for Ultramar Wilmington, California refinery. Participated in emergency response and investigation of a tank fire, a direct-fired heater explosion, and a major natural gas release event that occurred when a large crane toppled over destroying a rail car, and damaging a nearby building and roadway bridge. Was responsible for anticipating range of consequences that might occur as accident events transpired within the refinery.

**Process System Modeling & Simulation**

Developed methodology for expressing HAZOP scenarios as statements of conditional probability in structured event tree format, thereby clarifying logic errors commonly incorporated in HAZOP reviews. Used this methodology to assess HAZOP recommendations, saving a California refinery over \$750,000. Developed process system reliability optimization model in conjunction with Dr. Steve Unwin. Used this model to demonstrate payback and develop strategy for replacement of compressor trains in offshore natural gas compression system. Demonstrated that client could sequence replace individual compressor trains without compromising production capability.

**Process Safety Management and Risk Management Plan Regulatory Compliance**

Prime contractor to refining clients, including ExxonMobil, Equilon, LLC, and Ultramar Corporation. Mr. Roberts was subsequently hired as an employee of Ultramar where he planned and implemented all aspects of a Process Safety and Risk Management Programs for that refinery. He likewise participated with the insurance department in establishing maximum loss and insurable risk.

**Safety and Regulatory Compliance Audits**

Conducted Process Safety Management and Risk Management Plan compliance audits and reviews for Equilon, LLC, Ultramar Corporation, Mobil Oil Corporation, Chevron Corporation, Van Waters & Rogers, Palmdale Water District, University California Santa Barbara, Johns-Manville, and Santa Barbara County Department of Environmental Health Services. Conducted safety audits for SABIC chemical plants in Saudi Arabia.

**Expert Testimony  
For Litigation**

Presented analyses and expert testimonies to OSHA and EPA on behalf of Ultramar Corporation. Provided expert opinion for Texaco Corporation regarding hydrogen sulfide / sulfur dioxide exposure of offsite public because of a Hydrocracker explosion. Provided expert testimony for Zurich Insurance Company regarding fire explosion event at a power generating facility.

## Education

Mr. Roberts has attended four universities and holds degrees in science, engineering, and business:

- **Degrees**

- MBA-Finance, San Diego State University, 1988
- Post Graduate Work, Corrosion/Welding Engineering, The Ohio State University, 1971-72
- MS-Metallurgical Engineering, Colorado School of Mines, 1971
- BS-Geology, Colorado State University, 1967.

- **Courses, Workshops, and Certificates**

Mr. Roberts has extensive training in process safety, risk and reliability engineering:

- *Local Planning Guidance on Tsunami Response*, California Office of Emergency Services, San Diego, California, 2001
- *Equipment Reliability, Availability, and Maintainability*, University of California at San Diego (UCSD) Extension, 1996
- *Risk Management Program Rule: A Compliance Workshop*, Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA), San Francisco, California, 1996
- *Zurich Risk Engineer and ZHA Team Leader Certificates*, Zurich American Risk Engineering, Schaumburg, Illinois, 160 hours of instruction, 1994-1995
- *OSHA Process Safety Management Certificate*, Occupational Safety and Health Administration, Illinois, 10 hours of instruction, 1993
- *Chemical Safety Auditing Certificate*, Environmental Protection Agency, 40 hours of instruction, 1990
- *PHA Team Leader Certificate*, NUS Corporation, 40 hours of instruction, 1990
- *Environmental Technician Certificate*, UCSD Extension, 160 hours of instruction, 1989-1990
- *OSHA Hazardous Materials Worker Certification*, UCSD Extension, 40 hours of instruction, 1989

## Professional Society Memberships

Mr. Roberts maintains memberships in the following professional organizations:

- American Society of Chemical Engineers (AIChE)
- National Association of Corrosion Engineers (NACE)
- American Society of Metals (ASM)
- Instrumentation, Systems, & Automation Society (ISA)
- American Society of Mechanical Engineers (ASME)

## **Selected Articles and Publications**

*Relating Profit Risk Management to Reliability Management*, Process Plant Safety Symposium, 1998. Authors: S. D. Unwin and R. R. Roberts

*Development and Application of Risk Evaluation Methods for a Bay of Campeche Offshore PEMEX Platform*, Paper and Presentation at the Offshore Technology Conference, 1998. Authors: Mario Chavez, D. Hopper, R. Roberts, R. Bea, Victor Valdes, and Oscar Valle

*An Application of Risk-Based Design Criteria: HF Alkylation Rapid Acid De-Inventory System*, Paper and Presentation at the Mary Kay O'Connor Process Safety Center 1998 Annual Symposium. Authors: S. D. Unwin and R. R. Roberts.

*HF Alkylation Unit Acid Isolation and Evacuation System: Comparative Risk Assessment of Design Options*, AIChE 1996 Risk Management Symposium, February 1996. Authors: S. D. Unwin, R. R. Roberts, and B. Weber.

*A Reliability Analysis Supporting Regulatory Response*, Proceedings of the Fourth International Conference on Process Plant Reliability, Houston Texas, November 15-17, 1995. Authors: S. D. Unwin, R. R. Roberts, and B. Weber.

*Using HAZOP and HAZAN Methodologies as a Quantitative Risk Assessment Tool for Risk-Based Regulatory Compliance*, Southern California Chapter of Society for Risk Analysis (SCSRA) Seventh Annual Workshop: Current Issues in Risk Management and Human Health, 1994. Author: R. R. Roberts

*HAZOPS as a Basis for Reliability Management*, Proceedings of Second International Conference on Improving Reliability in Petroleum Refineries and Chemical and Natural Gas Plants, Houston Texas, November 15-18, 1993. Authors: S. D. Unwin and R. R. Roberts.

*Risk Management Plans: An Opportunity for Communication*, Proceedings American Nuclear Society Topical Meeting on Risk Management – Expanding Horizons, 1992. Authors: R. R. Roberts and S. A. Hudnall

*Management of Change*, Chemical Process Safety Report, Thompson Publishing Group, 1992. Author: R. R. Roberts