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Date	Client Project Title	Scope	Brief Project Description
2007	Petro-Canada Oil Sands Inc. (PCOSI) Upgrader	HAZOP, SIL Determination, Risk Consulting	Conducted intermediate HAZOP and SIL Determination (LOPA) studies on behalf of PCOSI project management for all Ft. Hills Upgrader silos. Advised PCOSI on the PHA and SIL standards to be used for all silos.
2007	Husky Energy Coker	HAZOP	Facilitated a HAZOP for the Coker unit located at the Husky Upgrader in Lloydminster.
2007	TOTAL E&P Joslyn Creek	HAZID	Conducted a HAZID study on the Joslyn Creek North Mine Extraction plant in Fort McMurray, Alberta.
2007	INEOS Oligomers Joffre Plant	HAZOP, SIL Determination	Facilitated a HAZOP and SIL Determination session at the plant site. ACM then model potential SIF solutions, which enabled INEOS to proceed with risk mitigation plans.
2007	Petro-Canada Oil Sands Inc. (PCOSI) Froth Treatment	HAZID	Provided HAZID study services on the Fort Hills Froth Treatment Project. This study was required following changes to the original design.
2007	EnCana Weyburn Control Systems Upgrade	HAZOP, SIL Determination, Concept SIL Verification, SRS Spec, SIS Spec	Performed the necessary Safety Lifecycle phases in compliance with IEC 61511 to enable EnCana Weyburn to begin planning for their control system upgrade in 2008. This included performing a HAZOP on ‘critical’ sections of the plant, followed by a LOPA study, modelling of SIF solutions and preparing a Safety Requirements Specification and Safety Instrument System Specification for the critical areas.
2007	Agrium Carseland Control System Upgrade	HAZOP, SIL Determination, Concept SIL Verification, SRS Spec, SIS Spec	Performed all the necessary Safety Lifecycle phases in compliance with IEC 61511 to enable Agrium’s Carseland Nitrogen fertilizer plant to plan for the upgrade their 25 year old Swanson control system in 2008. A Guideline / Procedure document was also prepared which documented the detailed steps taken in executing the project.
2007	EnCana Steep Rock	HAZOP, SIL Determination, SIL Concept Verification	ACM utilized information and knowledge from the Phase 1 Steep Rock project to provide HAZOP and SIL services for the expansion of the project from one train to two trains.



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	Phase 2		
2007	Shell Canada Scotford Upgrader	HAZOP	Provided HAZOP facilitation for the Reaction Furnace, Tail Gas Incinerator and Pump Seal portions of the expansion.
2007	Athabasca Oil Sands BBF Project	Coarse HAZOP Scribe	Provided scribe services to Shell’s facilitator on the Bitumen Blending Facility (BBF) Coarse HAZOP.
2007	Canexus LLP Port of Vancouver Technology Conversion	Risk Assessment	Facilitate a discussion on the proposed design of the control and safeguard systems proposed by the hardware vendor for the Technology Conversion Project (TCP) to ensure the appropriate short and long term safety, reliability, operation, maintenance and testing issues have been adequately addressed in the design.
2007	PetroChina Guangxi Refinery	HAZOP, SIL Determination, SIL Concept Verification	Facilitated HAZOP studies for the Hydrocracker and CCR Reformer Process Units during the FEED phase. Once the LOPA study identified the amount of residual risk outstanding, ACM performed Concept SIL Verification with proposed solutions.
2007	PetroAndina CNQ-7A Pilot Plant	Design/Operations Review & HAZOP	Facilitated a Design / Operations Review of the CNQ-7A Pilot Plant located in Argentina. A HAZOP study then followed.
2007	Petro-Canada Edmonton Refinery	HAZOP / LOPA	Facilitated HAZOP and SIL sessions for Revamps, Utilities and Offsites, Coker, and Crude / Vacuum units of the Refinery Conversion Project (RCP1).
2007	Husky Energy Lloydminster Upgrader	HAZOP, SIL Determination	Facilitated a HAZOP studies during the FEED stage for Black Oils, Hydrotreating and Utilities and Offsites sections of the expansion project. A Safety Layer Matrix method was utilized to identify high risk scenarios for future LOPA consideration.
2007	Suncor Energy Millennium Vacuum Unit	HAZOP	Facilitated a supplemental HAZOP to determine whether there were any hazards or operability issues stemming from a new PSV and considering that the new HAGO Pumps 52G-100A/B would have to rely on 52PSV-100 as a recycle line.
2007	Petro-Canada HRU Revamp	SIL Determination	Facilitated a SIL Determination of various loops in the Hydrogen Recovery Unit (HRU) of the Petro-Canada Refinery located in Edmonton.



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2007	Husky Energy Sea Rose HIPPS	HAZOP, LOPA, SIL Concept Verification	Provided HIPPS and alternate solutions for the Husky Sea Rose project in terms of hardware and functionality. ACM also assisted Husky, CNOPB, and DNV with presentations and reports.
2007	Suncor Energy Firebag Stage 4	HAZOP & SIL Determination	Performed studies across Firebag Stage 4 to determine the hazardous scenarios that may result by adding new equipment to an already designed facility. Firebag Stage 4 has been designed to supplement Stage 3 treating facilities.
2007	Athabasca Oil Sands Downstream Expansion	HAZOP	Facilitated a HAZOP of the remaining P&IDS for the Atmospheric and Vacuum (A&V) unit of the Shell Athabasca Oil Sands Project (AOSP).
2007	Suncor Energy Firebag 3 Tie-ins and Emergency Flare	HAZOP	Facilitated a HAZOP to determine the Hazardous scenarios that may result from the design modifications made since the original HAZOP as well as the potential hazards resulting from adding new lines/equipment to an existing designed facility.
2007	Suncor Energy Steepbank Pipeline Crossing	HAZOP	Facilitated a HAZOP of the 4” pipeline crossing of the Steepbank River to determine whether there were any hazards or operability issues stemming from the new Diesel Booster Pump and new pipeline system design and envisioned operation.
2007	Suncor Energy Hydrogen Plant MRU	HAZOP	Performed the second part of the HAZOP study (1 st part in 2006). This HAZOP particularly addressed the deferred nodes concerning the pressure swing adsorbers (PSA) and the hydrogen compressors.
2007	Kinder Morgan Trans-Mtn Pipeline	HAZOP	Facilitated a HAZOP for the Kinder Morgan pipe line pig traps and mainline valving project.
2007	MEG Energy Christina Lake	HAZOP	Facilitated a HAZOP for the remaining process systems for MEG Energy Corporation’s Christina Lake Phase II project in Ft. McMurray, Alberta.
2007	Hatch Energy N-Solve Pilot Plant	High Level HAZOP	Performed a High Level PHA Study for N-Solve’s Pilot Plant, which incorporated unique technologies for a facility processing Ft. McMurray bitumen.



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2007	VRB Power Flow Battery Project	Product Certification & Risk Assessment	ACM helped VRB Power with certification planning for a new product platform upon which multiple commercial products will be developed. The flow battery is an electrical energy storage system based on a patented process.
2007	Suncor Energy Firebag 3 Oil Removal and Tank Farm	HAZOP / LOPA	Facilitated a HAZOP / LOPA of the Suncor Firebag 3 Oil Removal & Tank Farm Vapour Recovery Units to determine the Hazardous scenarios that may result by adding a new vapour recovery unit to an existing designed facility and make recommendations to mitigate those hazards.
2007	Suncor Energy MNU Water Treatment	HAZOP	Facilitated a HAZOP of Suncor Edmonton’s Water Treatment System for the Millennium Naphtha Unit (MNU) Project.
2006	Agrium CO ₂ Removal Unit	HAZOP	Performed a Hazard & Operability Study (HAZOP) on the CO ₂ Removal Unit in the Agrium Carseland Ammonia Operations Plant.
2006	Sinopec Gathering Station & Pipeline Terminal	High Level HAZOP	Performed a High Level HAZOP, using Process Flow Diagrams, on a sour gas collection and processing system, located in China.
2006	Albian Sands Non-segregated Tailing Pilot Plant	HAZOP	A HAZOP was performed on the design stage of the Albian Sands’ Non Segregated tailings (NST) Pilot Plant. The NST will receive Thickened Tailings from the Muskeg River Mine Plant. The end product NST will be stored in large cells on the grounds.
2006	Albian Sands Flare Related Equipment	SIL Determination, SIL Verification & SRS Specification	Performed the three steps as part of the initial phase to upgrading of the existing Muskeg River Mine’s critical control and safety system.
2006	Kinder Morgan Kingsvale Pump Station	HAZOP	A HAZOP was conducted on the Kingsvale Station of the Trans Mountain Pipeline – a low vapour pressure petroleum liquids pipeline from Edmonton, AB to Burnaby, BC.



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2006	Suncor Energy Voyageur Bitumen / Naphtha Storage	Inherently Safer Design Review	The Inherently Safer Design Review used drawings which were a modification of a previous design, which was already reviewed. This review only considered what was changed from the previous design.
2006	EnCana Weyburn CO ₂ Plant	HAZOP	Performed a Hazard & Operability Study on the expansion to an existing EnCana CO ₂ Injection plant. The project involved increasing the compression to the existing REDA pumps by 50%.
2006	Agrium Joffre PLC Replacement	PLC / SIS Replacement & Upgrade	ACM developed a detailed cost estimate to replace the existing PLC system. Scope included developing Cause & Effects Drawings, Logic Diagrams, a Critical I/O List, SIS Requirements Spec, PLC Requirements Spec, Architecture Options, SIS / PLC Upgrade Execution Plan & Schedule and finally a Cost Estimate for AFE purposes.
2006	Athabasca Oil Sands Downstream Expansion	HAZOP	Facilitated several months of HAZOP reviews for the Shell AOSP Downstream Expansion Project, which concerned the construction of a new 90,000 bcd bitumen upgrader located at Shell Canada's Scotford Complex.
2006	EnCana Steep Rock Gas Plant	HAZOP, SIL Determination, SIL Verification, SIS Design & Engineering	Performed the HAZOP, SIL Determination and SIL Verification studies and prepared a Safety Requirements Specification for the SIS for EnCana's Steep Rock Gas Plant in North-eastern British Columbia. An Uptime Assurance study was done to greatly reduce the number of plant trips and creates a safe window of time by using operator response procedures and/or redundant devices.
2006	Albian Sands Closed Loop Cooling Water System	SIL Determination	Facilitated a LOPA session to determine if the unmitigated risks developed in the Final HAZOP had been mitigated completely and if not, what SIL level should be assigned to any Safety Instrumented Functions (SIF) that was recommended.
2006	Shell Canada Scotford Upgrader	HAZOP	Conducted a coarse HAZOP or “What-if?” type of study for the Plant Optimization Project (POP) Project; reviewed the PFDs so that recommendations could be carried into detailed engineering for SRC and U&O sections of the plant.
2006	MEG Energy Corp. Christina Lake Phase II	HAZOP	Facilitated a HAZOP for the MEG Energy Corporation's Christina Lake Phase II project in Ft. McMurray, Alberta.
2005	Petro-Canada Hanlan Robb	SIS Replacement & Upgrade	ACM acted as the project manager, guiding the replacement of the existing PLC system at Petro-Canada's Hanlan Robb Sour Gas Plant with a certified high reliable system from ICS



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	Sour Gas Plant		<p>Triplex. ACM's involvement began with an assessment of the current situation and matured into Safety Requirement Specification development. The functional specification includes a description of: availability and reliability targets, I/O capacity & type requirements, acceptable layouts and wiring configurations, power supply constraints, communications and infrastructure requirements, environment and ambient settings, operator, maintenance and engineering needs, plot plans and junction box layouts, area classification, interface, expansion and documentation requirements.</p> <p>ACM prepared the bid package for vendors and was involved in the technical bid evaluation. Recommended a solution to Petro-Canada; tasked with project management responsibilities concerning the replacement, including commissioning, start up and swing over.</p>
2005	Agrium Ft. Saskatchewan Ammonia Plant	HAZOP	A HAZOP was conducted on this 25 year old ammonia plant as part of a full risk assessment. A SIL Determination study will follow to identify areas of high risk exist and the sufficiency of the existing safeguards.
2005	Albian Sands Closed Loop Cooling Water System	Revalidation HAZOP	This revalidation HAZOP reviewed the design changes made since the first Closed Loop Cooling Water (CLCW) system HAZOP.
2005	Agrium Carseland	HAZOP	Conducted a HAZOP on Agrium's 10 year old controlled release urea (CRU) nitrogen fertilizer facility.
2005	BP Canada Kemp River	HAZOP	Facilitated a HAZOP for a sweet condensate railcar-offloading terminal at the Kemp River Truck Terminal site; examined the potential hazards and operability problems where condensate is transferred to and stored for loading onto rail or truck.
2005	Suncor Voyageur Ft. McMurray	PFD Review, Inherent Safety Review & Pre-HA	ACM was engaged early in the Voyageur project to facilitate the PFD Reviews, Inherent Safety Review & Pre-Hazard Analysis reviews for this Ft. McMurray project.
2005	Suncor Energy Firebag 3+ Expansion	HAZID	Facilitated a HAZID on the Firebag 3 + facility expansion, for SAGD oil sands plant, located north of Fort McMurray, which was in the early stages of design. The objective was to identify hazards of concern for the conceptual design, risk rank them and make recommendations for those with high-risk values.
2005	ZADCO South Platform	HAZOP	Conducted a HAZOP on the produced water system for the South Satellite Platform for Upper Zakum, located in the Arabian Gulf, off the coast of UAE.



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2005	Petro-Kazakhstan Shymkent Refinery	HAZOP	A facilitator traveled to Kazakhstan to conduct a HAZOP for the Petro-Kazakhstan Shymkent Refinery - LPG truck unloading facility and replacement of butane bullets project.
2005	Johns Manville Innisfail Fibreglass Plant	HAZOP	Conducted a HAZOP to identify and address safety and operability issues, associated with the expansion of the “Climate Pro” production line, which comprises an entirely new glass and fiberizer production line, with a 156” diameter melter.
2005	L’Oreal Canada Montreal Plant 1MT Hair Dye Unit	HAZOP, Design Codes / Standards Review , Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment’s safety aspects function in accordance with the intention of the project from a safety perspective.
2005	Agrium Redwater Nitrogen Plant	HAZOP / SIL Training	ACM instructors provided operations staff with PHA Leadership training plus a 2-day overview of SIL Determination and SIL Verification.
2005	Duke Energy Pine River Plant	HAZOP	Facilitated a HAZOP on Duke Energy Gas Transmission’s Pine River Gas Plant Sulphur Recovery.
2005	Suncor Energy Firebag Expansion	HAZOP / SIL Determination	Facilitated a HAZOP on Suncor’s Firebag Expansion project, then facilitated a SIL Determination, which identified 51 SIF loops for further review using the LOPA method.
2005	ICOFC Gas Refinery (Iran)	HAZOP / SIL Determination	Used the Safety Layer Matrix method to identify scenarios where high risk existed in the Iran Central Oil Field Company’s Shanul, Varavi and Homa Gas Refinery.
2005	Agrium Joffre Nitrogen Plant	HAZOP / SIL Determination	Used a Safety Layer Matrix method to identify scenarios where high risk existed in the Nitrogen plant and then used the LOPA method to evaluate 259 SIF loops to determine the SIL levels for a new SIS.
2005	ConocoPhillips Central Alberta	P&ID / HAZOP Coordination	Provided ConocoPhillips Central Alberta region with professional services to ensure the area’s HAZOP studies were successful; including management / quality control of P&IDs, shutdown keys, etc. and resource scheduling.



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2005	Suncor Energy Co-generation Plant	LOPA / SIL Determination	Prepared a SIL Determination Techniques report that considered the possible methods available and their strengths and weaknesses. ACM then conducted a SIL Determination using LOPA on the Ft. McMurray Co-Generation Plant.
2005	Syncrude Chlorine Handling	LOPA / SIL Determination	ACM performed a LOPA study to evaluate the risk of a chlorine release from the chlorine rooms and evaluate the layers of protection already in place to prevent exposure of personnel.
2004	Melut Oil Pipeline	HAZOP	Performed a HAZOP on a section of the Melut Basin Crude Oil Pipeline in the Sudan.
2004	IOOC Sirri Island Complex	RAM Study	A Reliability, Availability & Maintainability (RAM) study was performed on the expansion of the existing onshore Iran Offshore Oil Company's Sirri Island complex to determine the availability of the plant.
2004	L'Oreal Canada Franklin, NJ 10MT Hair Dye Unit	HAZOP, Design Codes / Standards Review , Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment's safety aspects function in accordance with the intention of the project from a safety perspective.
2004	L'Oreal Canada Solon, Ohio 20MT Hair Dye Unit	HAZOP, Design Codes / Standards Review , Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment's safety aspects function in accordance with the intention of the project from a safety perspective.
2004	Saudi Aramco Hawiyah Gas Compressors	HAZOP / LOPA / SIL Determination	Facilitated a LOPA to evaluate two alternative designs for the discharge piping and valves of the compressors. For each design, two scenarios were evaluated, namely: high pressure at the compressor discharge and high flow in the flare header.
2004	Petro-Canada MacKay River Pilot	HAZID	A HAZard IDentification (HAZID) study was performed on the MacKay River Pad 21 co-injection pilot project.
2004	IOOC Sirri Island	HAZOP / LOPA / SIL Determination	A HAZOP study was performed on the expansion of the existing onshore Iran Offshore Oil Company's Sirri Island complex. A subsequent LOPA session was conducted for all the



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			recommendations that required a SIL 2 or a SIL3 solution.
2004	BP Empress Terminal	SIL Determination	SIL Determination and Concept Validation performed to evaluate concerns regarding thermal shock issues on the cold boxes.
2004	Nova Chemicals Joffre Plant	SIL Validation	The Manufacturing Infrastructure (MI) team at Nova Chemicals (Nova) in Joffre, Alberta commissioned ACM to work with Nova engineers to complete a SIL Validation study for selected assets related to the Cooling Tower operations presently in use at the facility.
2004	CNRL Horizon DRU & Coker	HAZOP	Canadian Natural Resources Limited (CNRL) requested that a Process Hazard Analysis (PHA) be performed on the Diluent Recovery Unit (DRU) & Common Area and the Delayed Coker Unit (DCU).
2004	CNRL Horizon Sulphur Recovery	HAZOP	Performed a HAZOP review at the (EDS) Engineering Design Specification phase on Units 51 & 51B, 52, 53, 54, 55, 56, and 59 of the Horizon project in Ft. McMurray, Alberta.
2004	Husky Oil Lloydminster Upgrader	HAZOP	Performed a Guide-Word Hazard & Operability (HAZOP) study on Husky Lloydminster Upgrader Plant 42 Gas-Oil Hydrotreater. The HAZOP was executed with the intention of performing a SIL Determination later.
2004	L'Oreal Canada Clark, NJ 6MT Gel Unit	HAZOP, Design Codes / Standards Review, Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment's safety aspects function in accordance with the intention of the project from a safety perspective.
2004	Petro-Canada Ferrier Gas Plant	SIL Determination	Using LOPA, provide SIL Determination on the existing facilities at the Ferrier gas plant. Objective of the study was to minimise the risk in releasing more gas to the flare line than the capacity the flare lines are designed for (60 mmscfd) at the Ferrier Gas Plant at Rocky Mountain House, Alberta.
2004	Larson and Toubro Takreer Sulphur Recovery Unit	SIL Training and Consulting	Provide SIL Consulting and Training to Takreer SRU project engineers in terms of guidance, direction and instruction on how to perform SIL Determination & Validation on the project. Provide SIL Reporting guidance, direction and instruction to ensure that the Draft and Final SIL reports meet the deliverable expectations of Takreer.
2004	BP	FMEA Study	The BP Buck Creek Fractionation Plant is undertaking a major electrical system upgrade.



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	Buck Creek		To ensure that all risks were identified and BP’s standards were met it was decided to perform a FMEA (Failure Modes and Effects Analysis).
2004	TransGas Regina Compressor	Risk Determination	This study reviewed the need for Automated ESD valves on cavern storage wellheads.
2004	Gulf Farabi Petrochemicals Complex	SIL Determination	Provide SIL Determination, using LOPA on the proposed Gulf Farabi petrochemicals project in Saudi Arabia.
2004	BP Ft. Saskatchewan Flare System	SIL Analysis	The purpose of the HAZOP/ LOPA study was to assess the adequacy of the Safety Protection Layers (SPLs) that are in place to mitigate against hazardous events relating to operations of the Edmonton Storage Tanks, identify those SPLs that do not meet the required risk reduction for a particular hazard, and make reasonable recommendations where a hazard generates a residual risk that needs further risk reduction.
2004	EnCana Salt Plains Gas Storage	HIPPS	Goal was to design and validate a Pressure Protection System to protect low pressure piping at EnCana’s Salt Plains storage facility. Failure of a Pressure Control loop upstream of the low-pressure piping could lead to high pressure downstream of the Pressure Control Valve (PCV). The low-pressure pipe downstream of the PCV is rated at for 820 psig. The pressure delivered during injection phase could reach 1650 psig to a maximum. To mitigate this risk ACM designed a pressure protection system using two Independent Protection Layers to mitigate the risk to a tolerable frequency (TF) of 10^{-3} as defined by EnCana.
2004	BP Buck Creek Fractionation Plant	Integrated HAZOP / SIL Analysis	The BP Buck Creek Fractionation Plant is undertaking a major electrical system upgrade. A control systems upgrade is being considered because the plant people are not sure that the existing plant wide PLC system is reliable enough or has sufficient integrity to handle the safety functions, particularly if the BP standard is to be followed. To ensure that all risks were identified and BP’s standards were met it was decided to perform a HAZOP and a LOPA study. The HAZOP identified all the potential hazards, and the LOPA identified solutions to mitigate the hazards. The LOPA also identified the contribution of each individual solution.
2004	L’Oreal Canada Montreal 12MT Hair Dye Unit	HAZOP, Design Codes / Standards Review , Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment’s safety aspects function in accordance with the intention



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			of the project from a safety perspective.
2004	Petro-Canada Edmonton Refinery Propane Spheres	HAZOP / LOPA	Petro-Canada’s Edmonton Refinery is planning to increase the Safety Integrity Levels of the Propane Tanks. The HAZOP and LOPA studies highlight the risks involved and help in reducing the risks when designing and installing a new control system for the Propane tanks.
2004	Petro-Canada Edmonton Refinery Butane Spheres	SIL Analysis	LOPA analyses for the events High Level and High Pressure in the Butane Spheres were carried out using the instrumentation from the updated P&ID and compared to a target tolerable frequency.
2003	BP Thunderhorse	HAZOP/SIL Determination & Validation	ACM was contracted by Technip to perform a detailed HAZOP study of the Subsea asset to demonstrate due diligence on the proposed design and operation of four BP Thunderhorse systems - Subsea Production System, Chemical Injection System, Control System and Water Injection System. Thunderhorse is located in 6,000 feet of water in the Boarshead Basin, 125 miles southeast of New Orleans. A subsequent SIL Determination and Validation study on the four BP Thunderhorse systems used the IEC 61508 standards to assess the safeguards in place and determine where these safeguards do not mitigate the risk to acceptable levels. Where more mitigation was required, proposed solutions, complying with IEC 61508, were provided.
2003	National Iranian Oil Company Ahwaz / Marun	Detailed HAZOP and Risk Analysis	ACM facilitated a detailed HAZOP on the Ahwaz/Marun Gas Compression/Treatment Projects (AMAK) on behalf of Iran International Engineering Company (IRITEC) and Macdonald Engineering Group. ACM, in conjunction with RWDI West Inc. of Calgary, prepared a hazard and risk assessment of a 96 km acid gas pipeline connecting a gas sweetening plant to a petrochemical facility.
2003	EnCana Deep Panuke	Coarse HAZOP	ACM facilitated a coarse HAZOP on the proposed Deep Panuke development plan comprised of a Production Platform, Utilities and Quarters Platform and a Wellhead Platform, with two interconnecting bridges. The Deep Panuke gas prospect is located of the coast of Nova Scotia. ACM also provided a Senior Independent Safety Engineer to represent the client during the HAZOP study.
2003	Nexen Long Lake SAGD	Coarse HAZOP	ACM facilitated a coarse HAZOP on the Long Lake SAGD project, a heavy oil thermal recovery pilot plant employing a Steam Assisted Gravity Drainage (SAGD) recovery process with horizontal steam injection and production wells.



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2003	EnCana Suffield Storage	Detailed HAZOP	ACM facilitated a detailed HAZOP on the proposed J-T plant to be installed at the Suffield storage site. The J-T plant consisted of a gas/gas exchanger with glycol injection, a J-T valve, a low temperature separator, condensate stabilization and glycol regeneration.
2003	Terra Nova FPSO	SIL Validation	ACM validated that the Magnetrol level switch replacements for the High Level switches in the High Pressure Flare Knock-out Drum and Low Pressure Flare Knock-out Drum SIL loops maintained a SIL 2 rating, as per the original SIL Assessment, for the Terra Nova Floating Production Storage and Offloading (FPSO) facility.
2003	Conoco Canada	FSC Programming	Changes were made to the Honeywell Fail Safe Controller (FSC) program that ACM installed and commissioned at the Conoco Empress Straddle Plant in May 2001.
2003	Nigerian National Petroleum Corporation Atlas Jetty	Detailed HAZOP	Facilitated a HAZOP on the proposed New Atlas Cove Jetty (NACJ) at Takwa Bay, Lagos, Nigeria for receiving and unloading of petroleum products from tanker vessels to the existing Atlas Cove Depot Terminal storage tanks.
2003	Suncor Energy Tie-ins	What-If Study	Facilitated a What-If study on the side draw kerosene Tie-in between Plants 52 and 55 of Suncor's Fort McMurray facility.
2003	Suncor Energy Tanks Farms	Detailed HAZOP	Facilitated a HAZOP for Suncor's Kerosene, VGO, Recovered Diluent and Diluted Bitumen product lines tie-ins in the North Tank Farm, South Tank Farm and main pipe ways interconnecting lines at their Fort McMurray facility.
2003	EnCana Corporation McCovey Drilling Rig	HAZID	Facilitated a Hazard Identification (HAZID) study of the McCovey Drilling Rig, located off the coast of Alaska. The main purpose of this HAZID was to systematically review the drilling systems to identify any hazards with its operation and maintenance.
2003	Airborne Pollution Control Kentucky Plant	Detailed HAZOP	Facilitated a HAZOP of a Sodium Bicarbonate Regeneration Demo Plant being built in Kentucky.
2003	Suncor Energy Plant 57	SIL Validation	Validated that through the successful application of manipulating the testing intervals, changing hardware configurations, and validating assumptions, Suncor did not need new hardware to meet their SIL standard in 10 loops of SIL 2 or greater for Plant 57 at their Fort



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			McMurray facility.
2003	Nova Chemicals Chlorine System	SIL Determination	Facilitated and fully documented the process used to comply with the Nova standard for establishing the Safety Instrumented System (SIS) and Safety Integrity Level (SIL) requirements for the modifications being made to the Chlorine and Diesel Firewater systems at their Joffre, Alberta location.
2003	ExxonMobil Properties Canada Tier I	Contractor Audits	Provided an independent review of the Safety Management Systems of a number of Sable Tier 1 contractors. ExxonMobil was preparing a set of Safety, Health and Environmental guidelines for contractors and the information gathered through the review provided valuable information for this initiative.
2003	Petro-Canada Edmonton Refinery	HAZOP & SIL Determination	Conducted a HAZOP study to demonstrate due diligence on the design and operation of the Edmonton Butane Sphere operation originally constructed in 1972 and modified several times since. A SIL Determination was performed to assess the safeguards in place and determine where these safeguards do not mitigate the risk to acceptable levels. Also included was the development of proposed solutions and the testing and maintenance of those solutions to maintain the safety integrity of the proposed solutions. Finally, ACM prepared a management brief concerning the Instrument Overpressure Protection initiative to increase the awareness and understanding of the proposed instrumented solution to Petro-Canada management and staff.
2003	Nova Chemicals Product Storage	SIL Validation	Contracted by Nova to provide SIL Validation services for the Product Storage (C3, C4, C5, and Aromatic Concentrate Storage) and Rail Loading operations presently in use at the Joffre, Alberta facility. ACM used the previously completed SIL Determination on the same assets and provided SIL Validation services in accordance with Nova Loss Prevention Standards (LPS) and in compliance with the intentions of the IEC 61508 standards. ACM provided loop architecture defining instrumentation and configuration services where safeguarding with a Safety Instrumented System (SIS) was required.
2003	Petro-Canada Terra Nova	HAZOP & SIL Determination (Subsea)	Contracted to facilitate Coarse HAZOP and SIL Determination studies to identify, assess and validate the basic issues concerning the new subsea trips and flowlines for the proposed new Far East development, located 5.2 km east of the Terra Nova FPSO facility. Of particular interest were issues pertaining to the Far East development's higher operating pressures to the FPSO and potential incidents and threats caused by implementation of Far East development.
2003	Abu Dhabi Gas	HAZOP / SIL Determination &	Commissioned by Parsons E & C in the FEED engineering phase to facilitate a HAZOP on



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	Industries (GASCO) Habshan Ruwais	Concept Validation	the injecting and receiving facilities for a liquid sulphur pipeline operated by Abu Dhabi Gas Industries Ltd (GASCO). ACM subsequently performed a SIL Determination and Concept Validation.
2003	L'Oreal Canada Montreal 1MT Hair Dye Unit	HAZOP, Design Codes / Standards Review , Pre-Startup Safety Review	ACM executed a three phase process - HAZOP demonstrated design and operation due diligence. Design Codes / Standards Review assessed compliance of the design with the relevant significant codes and EH&S standards. Pre-Startup Safety Review ensured that installed skid package equipment's safety aspects function in accordance with the intention of the project from a safety perspective.
2002	Petro-Canada Terra Nova	SIL Consulting	Engaged by Petro-Canada to provide leadership in upgrading Terra Nova's SIL management systems and practices. ACM worked collaboratively with project staff to address outstanding risk management issues and suggested strategies to achieve IEC 6151 compliance.
2002	EnCana Corporate Standards	SIL Guidelines & Practices	Developed SIL Guidelines (a higher-level document that non-technical specialists can understand) and SIL Practices (written in sufficient detail such that a professional SIL practitioner will clearly understand EnCana's Practices) for EnCana's International and Offshore Division.
2002	Husky Oil White Rose	SIL Determination & Validation (FPSO Turret)	Contracted by SBM Imodco to facilitate and fully documented the SIL Determination and Validation study for the Turret section of the White Rose FPSO. Particular emphasis was placed on the Emergency Shutdown System (ESD) and Fire & Gas System (FGS). This was a continuation of the SIL Determination and Validation work previously completed for the Topsides and Hull sections.
2002	Siemens Canada White Rose	SIL Determination & Validation	Facilitated and fully documented the SIL Determination and Validation study for the Hull section of the White Rose FPSO off the coast of Newfoundland. Particular emphasis was placed on the Emergency Shutdown System (ESD) and Fire & Gas System (FGS). This was a continuation of the SIL Determination and Validation work previously completed for the Topsides section.
2002	Nova Chemicals Joffre	SIL Determination	Facilitated and fully documented the process used to comply with the Nova standard for establishing the Safety Instrumented System (SIS) and Safety Integrity Level (SIL) requirements for the modifications being made to the Chlorine and Diesel Firewater systems at their Joffre, Alberta location.
2002	Suncor Energy Plant 57	SIL Validation	Validated that through the successful application of manipulating the testing intervals, changing hardware configurations, and validating assumptions, Suncor did not need new



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			hardware to meet their SIL standard in 10 loops of SIL 2 or greater at Plant 57 of their Fort McMurray facility.
2002	EnCana (PanCanadian Energy)	Detailed HAZOP	Conducted a detailed HAZOP on all of the facilities at the Rosemary battery and well pads as well as the shutdown key.
2002	Total Austral S.A. Aries Wellhead	Validate HIPS Design	Validated the design and integrity of High Integrity Protection System (HIPS) for the Total Austral S.A. Aries wellhead platforms using API standards. Incorporated a SIL validation process based on IEC standards. Identified potential ways to optimize the SIL rating by adjusting and reviewing failure data, testing frequencies and other major related factors.
2002	Shell Canada	HAZOP / QRA / Bow-Tie Analysis	Facilitated a HAZOP on the Shell Caroline gas plant's Utilities, specifically pertaining to the Cooling Water System. Incorporated Fault Tree Analysis into THESIS® (The Health, Environment & Safety Information System) software to identify, assess and evaluate the risks inherent in the plant's cooling water system. Report prepared following the Bow-Tie risk analysis methodology.
2002	Conoco Canada Empress Straddle	FSC Upgrade	Upgraded new requirements and corrected hardware and software errors for the Safety Instrumented System (FSC) at the Empress Straddle Plant.
2002	ExxonMobil Properties Canada Tier II	HAZOP	Revisited parts of the Alma gas production platform for the Sable Tier II Project, the hydrocyclone and chemical injection package.
2002	Petro-Canada Terra Nova	SIL Validation	Validated that the Magnetrol level switch replacements for the High Level switches in the High Pressure Flare Knock-out Drum and Low Pressure Flare Knock-out Drum SIL loops maintained a SIL 2 rating, as per the original SIL Determination, for the Terra Nova Floating Production Storage and Offloading (FPSO) facility.
2002	Conoco Canada Empress Straddle	As-Built Verification	Provided As-Built verification of the shutdown keys for the Safety Instrumented System upgrade at the Empress Straddle Plant.



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2002	ExxonMobil Properties Canada Sable Tier II	HAZOP / SIL Determination	Performed a detailed HAZOP on the Sable Tier II Project consisting of the Alma gas production platform, a subsea production pipeline to Thebaud platform, a MEG pipeline from Thebaud to Alma and modifications to existing facilities on Thebaud for pipeline tie-in. Reviewed the Alma Tie-in to Thebaud P&IDs for all safety related trips and conducted a SIL Assessment of the Alma development project. Identified the safety and automation system requirements and discrepancies deficit to the overall SIS.
2002	Suncor Energy Firebag	HAZOP / SIL Determination	Conducted detailed HAZOP and a Safety, Financial and Environmental Integrity Level (SIL/FIL/EIL) Determination on Suncor Firebag’s Millennium Vacuum Unit.
2001	Conoco Canada Dewdney Terminal	HAZOP / SIL Determination	Facilitated a detailed HAZOP of the Conoco Regina Dewdney terminal, pipeline and storage caverns, followed by a SIL Determination.
2001	PetroBras P43 & P48	FMECA and SIL Determination	Completed a FMECA study on the integrated Control and Safety Systems for P43 and P48 FPSOs, followed by a SIL Determination based on IEC 61508 standard.
2001	Nova Chemicals Joffre	Integrated HAZOP / SIL	Facilitated an integrated HAZOP / SIL session for the Polyethylene 1 Plant (PE1) at Joffre to provide the participants with an understanding of how this process is used to make cost effective decisions on capital upgrades necessary to meet Nova safety and reliability standards.
2001	Shell Canada	Commissioning Assistance	Provided experienced engineers to assist with the commissioning of Shell's Albion Sands Scottford Refinery.
2001	Petro-Canada	Detailed HAZOP	Facilitated a HAZOP of Brazeau River gas plant blow case and compressor skid packages, including shutdown key.
2001	EnCana (PanCanadian Energy)	HSE Manual Review	Performed a high-level gap analysis and benchmarking against ORMS, API 9100 and applicable OGP standards of the PanCanadian East Coast Operations Health, Safety and Environment Management System (ECO-HSEMS) manual in conjunction with the preparation of the Safety Plan for the Deep Panuke Natural Gas Development project.
2001	Petro-Canada Oil Sands Mackay River	Procedures Development	Wrote and coordinated the delivery of 27 different systems' operating and commissioning procedures to the Mackay River SAGD facility.
2001	Anglo Albanian Petroleum Patos Marinza	HAZID	Facilitated a Hazard Identification session at the end of the Front-End Engineering Design (FEED) phase to identify any hazard and operability concerns associated with the operation, layout and utility requirements of the proposed Patos Marinza Development Project process



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			plant and well pads in Albania.
2001	EnCana (PanCanadian Energy) Deep Panuke	Safety Plan Summary	Provided guidance and direction on the Deep Panuke Gas Development project, specifying how hazards and their effects specific to the project's lifecycle phase will be managed. Based on the project lifecycle phase, from conceptual development to abandonment, this hazard management process will apply the appropriate emphasis on hazard identification, hazard assessment, hazard control and mitigation.
2001	EnCana (PanCanadian Energy) Deep Panuke	HAZID and Bow-Tie Analysis	Produced a Safety Plan for the Deep Panuke Project. ACM first performed a conceptual HAZID study on the onshore and offshore production and utility systems for Deep Panuke and created a series of Bow-Ties (Thesis®) used for the Hazards and Effects Matrix for the Risk Management procedures.
2001	Conoco Canada Straddle Plant	SIL Validation	Conducted a SIL Validation to determine the change in integrity of proposed wiring and valve modifications at the Empress Straddle plant. This involved validating the before and after upgrade design of the inlet area SIL loop using IEC 61508 and ISA S84 standards and calculating spurious trip rates before and after upgrade.
2001	Husky Energy White Rose FPSO	Coarse HAZOP (Concept Phase)	Facilitated a Coarse HAZOP study of the Topsides on the White Rose FPSO to identify design and operability issues during conceptual design.
2001	Petro-Canada Terra Nova FPSO	SIL Design	Optimized the inspection requirements and frequency of inspection of the SIL 2 and SIL 3 safety system loops in the Terra Nova FPSO. Second step of the Terra Nova FPSO project – the first reviewed the SIL loop configurations and results of the EPC engineering SIL study to optimize test intervals, system configuration and/or architecture without impairing the integrity ratings.
2001	Petro-Canada Terra Nova FPSO	SIL Validation	Reviewed and mathematically verified the SIL 2 and SIL 3 loops initially designed and specified by Terra Nova engineering team for the FPSO facility.
2000	EnCana (PanCanadian Energy)	HSE Plan	Provided guidance to the PanCanadian Deep Panuke Development project management team in managing Health, Safety & Environment and Asset Integrity. Identified and defined HSE activities required during the conceptual phase and provided an outline for subsequent HSE activities for the whole project lifecycle.
2000	Nova Chemicals	SIL Determination	Conducted a SIL study for the Nova Chemicals' E1/E2 Steam Pressure Control System



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	Joffre		based on the IEC 61508 safety requirements. Evaluated the proposed changes as they affected the three main areas: sensor data (pressure transmitter), logic solver (DCS) and the final element (pressure control valve).
2000	Petro-Canada Brazeau Gas Plant	HAZOP	Facilitated a HAZOP of the Brazeau gas plant over-compressor and wellhead.
2000	Conoco Canada Empress Straddle Plant	Safety Instrumented System Programming	Configured the programming for the upgraded safety instrumented system with the existing DCS at the Empress Straddle Plant. Provided functional and detailed design of the system, acceptance test documentation, implementation of code program, pre-commissioning and testing, testing with customer, final installation / commissioning and start-up.
1999	Petro-Canada Remote Riser Site	PHASIL Study & HIPPS Design	Conducted a HAZOP study and SIL Determination for Petro-Canada remote riser site 12-8 on a three-phase separator to determine the need for a SIL rated safety system. ACM subsequently developed the conceptual design and cost estimate for a High Integrity Pressure Protection System (HIPPS) for the facility.
1999	Alliance Pipeline Gas Control	Operating Procedures and Training	Developed operating procedures and a training program for Alliance Gas Control, taking into account normal and abnormal operations. Operating Procedures will be divided into four major sections - normal conditions, abnormal conditions, extreme, emergency response and crisis conditions and Management, and Physical Plant.
1999	Petro-Canada Wildcat Hills	HIPPS Design	Incorporated the results of a previously completed Process Hazard Analysis Safety Integrity Level (PHASIL) study into the design of a High Integrity Pressure Protection System (HIPPS) required for the Petro-Canada Wildcat Hills/Shell Burnt Timber tie-in metering separator in order to reduce the flow requirements of a Pressure Safety Valve (PSV). Researched the standards and codes applicable to HIPPS, then designed and estimated the cost of a system that would meet Petro-Canada’s SIL standards.
1999	Toronto Transit Commission	FMECA HAZOP / SIL Design and Validation	Facilitated a Fault Tree Analysis (FTA) and Failure Modes, Effects and Criticality Analysis (FMECA) HAZOP study, and created a reliability block diagram for the PLC system in order to verify that the target MTBF numbers were met. Required because the Toronto Transit Commission was converting their existing emergency trip system from a relay-based system to a high integrity PLC based system.
1999	Nova Chemicals SCLAIR Project	FMECA HAZOP and SIL Determination	Conducted a Failure Modes, Effects and Criticality Analysis (FMECA) as well as a process deviation based HAZOP study, followed by a SIL Determination on the Emerald plant, which was part of Nova’s Advanced SCLAIR Technology plant upgrade in Joffre.
1999	Nova Chemicals	Integrated PHA / SIL	Conducted an integrated Preliminary Hazard Analysis / SIL Determination for the



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	PE2 Plant	Determination	Polyethylene Plant PE2, which was changing it's catalyst preparation system, to determine where the risk was unacceptable and therefore what changes were required in the system design.
1999	Agrium	SIL Determination	Conducted a study to determine the reliability of the methanator emergency trip system and made recommendations to ensure the Redwater fertilizer plant met a SIL 1 rating. Generated Fault Trees for loss of automatic trip, loss of manual trip and loss of power, identified failure modes and estimated probabilities of failure over the specified test interval, evaluated the reliability of each subsystem as well as the total system, and made recommendations for improving the system to meet SIL 1.
1998	Novacor/BP Amoco	HAZOP and SIL Determination	Conducted a HAZOP study, then SIL Determination (PHA) Study for the BP Amoco Spot Loading Facilities.
1998	Petro-Canada Empress Straddle Plant	ESD Design, Procurement, Testing & Maintenance	ACM designed the Emergency Shut Down (ESD) systems for the Empress Straddle plant. The entire safety life cycle of the ESD system was considered. Responsibilities included conducting a PHA study as well as ESD System Design, Documentation, Maintenance and Testing and Management of Change. ACM was then appointed as agent to Petro Canada to perform the Engineering, Procurement, and Management of the Safety Instrumented System (SIS).
1998	Petro-Canada Pipeline Terminal Company	HAZOP	Facilitated a HAZOP on Petro-Canada's pipeline between Empress and Winnipeg. The study included tank storage facilities, caverns, rail and truck loading.
1998	Suncor Energy Diesel Pump	SIL Determination	Conducted a demonstration SIL Determination exercise for the Diesel Pump Supply System on the Millennium Project.
1998	Nova Chemicals	SIL Determination	Facilitated a SIL Determination to define the SIL levels of a grass root Safety Instrument System (SIS) for the E3 and PE2 Cooling Towers, Rail Loading and Storage and High Pressure Steam Distribution Header. Worked through the process on a “loop by loop” basis (as opposed to a line by line, node by node which would be performed in a typical HAZOP).
1998	Petro-Canada Empress Straddle Plant	Major SIS Design and Upgrade	Re-evaluated the current safety system philosophy at the Empress Straddle Plant, redesigned the plant ESD, Fire and Gas, and Safety Systems to meet Petro-Canada corporate and ISA S84 standards and installed a highly reliable safety PLC system.
1998	Suncor Energy Millennium Project	SIL Determination	Analyzed the process hazards and risks associated with check valve failure of one of Suncor's process loops for the Millennium project and made recommendations impacting



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			the design of the safety instrument system as well as various mechanical and process procedures.
1998	NOVA Chemicals Compressor	SIL Determination	Established a compressor station baseline to be used as the standard from which future design changes will be made. The study included a cursory examination of all field instrumentation including fire, gas and heat detectors, valves and systems associated with the SIS or Emergency Shutdown system (ESD). The study included an examination of the design of the compressor station and focused on addressing the safety aspect of the ESD system based on the ISA S84 standard.
1998	Petro-Canada Ferrier Gas Plant	Investigation & Optimization	Investigated the reasons that the Petro-Canada Ferrier Gas Plant surge controller actuates thus opening and closing the surge control valve in rapid succession. Three options were provided to improve the system.
1998	Petro-Canada Wildcat Hills	HAZOP / SIL Determination	Facilitated a HAZOP / SIL Determination for the Wildcat Hills gas plant to determine the risk implications of increasing the system capacity of the facility.
1998	Petro-Canada Empress Straddle Plant	ESD Safety Study	Evaluated the shutdown systems in place at the Empress Straddle Plant to examine the location of the various ESD stations that have experienced spurious and costly trips to the plant.
1998	Alliance Pipeline	HAZOP / SIL Determination	Facilitated a HAZOP / SIL Determination on the Alliance Mainline compressor stations.
1998	NOVA Gas Transmission	SIL Determination	Developed a recommendation for monitoring and control of the Pemex natural gas/liquids pipelines in the Luna Region of Mexico to provide safe and efficient operation. Evaluated existing block valves and actuators, instrumentation systems, and communication system.
1997	NOVA Gas Transmission	SIL Determination	Provided front-end engineering in regards to the automation and modernization of block valves and associated equipment for safe and efficient operation of the mainline pipelines in the Atasta Region of Mexico in order to develop a plan to rehabilitate and upgrade pipelines to minimize risks.
1997	Petro-Canada Empress Straddle Plant	ESD System Review	Conducted a Safety System Review of the ESD Stations and systems at the Empress Straddle Plant to identify the causes of numerous unplanned shutdowns related to the 13 manual emergency stations scattered throughout the plant.
1997	NOVA Gas Transmission	SIL Determination	Provided a safety methodology for NOVA to use in design of safety instruments system for NOVA Compressor Stations. Provided Determination on existing SIS Station designs and made recommendations



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1997	Nova Chemicals	SIL Determination	Using Latornell compressor station as a prototypical design, conducted a SIL Determination to establish a baseline standard from which future design changes will be made to with particular attention paid to the safety aspect of the ESD system.
1996	SABLE Onshore	HAZOP and SIL Determination	Conducted a HAZOP and SIL Determination for onshore gas processing facilities in Nova Scotia.
1996	Chevron Canada	SIS Evaluation and Upgrade	Conducted a study of Kaybob K3 gas plant to determine the reliability and integrity of the existing safety system. Complete project management of the resulting upgrade, including engineering, procurement, configuration and installation of a new Safety System.
1996	Norske Shell	Engineering Audit	Conducted an Engineering Audit on the Troll Gas Process in Norway. The Troll project is the largest gas processing plant in Europe, producing 89 million e3m3 of gas per day. Five process trains each with 40 Mwatts of compression HP to supply gas to eastern Europe. Audit work included valve sizing, process control engineering, modelling and control review strategies.