1ST QUARTER 2007
VOLUME 6, ISSUE 1

ioView Newsletter

"This paper provides a general framework for evaluating and maximizing available flare systems capacity, and investigates criteria and approaches for determining a tolerable risk event for flare systems."

Inside this issue:

Edited by: G. A. Melhem, Ph.D.
Email: melhem@iomosaic.com
Tel: 603.893.7009
Fax: 603.893.7885

Maximize Use Of Your Existing Flare Structures

Due to the design vintage of many petroleum refineries and petrochemical plants, existing pressure relief and flare systems may be overloaded because of:

- Prior unit expansions/upgrades have increased the load on the flare for combined flaring scenarios beyond the original design intentions
- The desire to connect atmospheric relief valves to the flare for environmental and safety considerations and to eliminate blow down drums
- The addition of new process units that need access to flaring capacity

As a result, many petroleum companies are engaged in comprehensive flare systems evaluation and upgrading projects to ensure continuing safe operations. The goal of these projects are to MAXIMIZE the use of their exiting flare systems, and to MINIMIZE the need for modifying existing flare structures or building new ones. Achieving these goals presents several engineering challenges:

- Which existing atmospheric relief devices present vapor cloud explosion and thermal

Continued on page 2

Modeling LNG Pool Spreading and Vaporization

Consequence analysis of LNG hazards requires modeling of liquid spills on land and water surfaces. The liquid spill duration, release rate, and rate of vaporization are important factors for the estimation of safe separation distances for flammable vapor dispersion and thermal radiation from pool fires. Dispersion distances calculated to ½ LFL are required for the siting of LNG facilities.

For an LNG spill, NFPA 59A (2001) requires facilities to have impoundments sited such that the average concentration of methane in air does not exceed 50% of its lower flammability limit (LFL) beyond the property line. The federal code of regulations for siting LNG facilities in 49 CFR Part 193 allows the use of both DEGADIS and FEM3A2 for dispersion analysis. DEGADIS is a refined box model while FEM3A is a computational fluid dynamics (CFD) model. There is no defined model for calculating the source term.

LNG dispersion analysis is heavily influenced by: (a) an accurate estimation of the source term which included the leak rate and spill duration, and (b) the pool spreading and vaporization. LNG vapors are

Continued on page 2

Understand LNG Fire Hazards

LNG fire hazards have been well studied and there is general agreement on many aspects including:

- LNG vapors have a low ignition energy
- Delayed ignition of LNG vapors that are rich in methane will burn in the form of a vapor cloud fire
- Ignition of vapors from an LNG pool will burn back to the pool and result in a pool fire
- If an LNG vapor cloud is confined and rich in heavy hydrocarbons, it can explode if ignited
- A burning LNG pool fire will burn the methane in the pool first and leave a pool that is rich in heavy hydrocarbons

However, there is general disagreement among LNG experts on the extent of the thermal radiation hazard zones resulting from large LNG pool fires due to uncertainties in the flame size, the flame emissive power and the limiting thermal radiation impact criteria. This paper will focus on a brief discussion of the aspects that are in general agreement and will discuss in more detail the two issues where there is disagreement, including the arguments for different opinions.

Get Complete Whitepaper

Maximize Use Of Your Existing Flare Structures – *continued*

radiation risks and need to go to the flare?

- What is the impact of the additional flaring loads on the existing flare header system and individual relief devices during combined flaring events due to loss of power or cooling?
- Where and how many High Integrity Protection Systems (HIPS) should be employed to reduce the worst case flaring load?
- How should the HIPS components be configured to achieve the required safety integrity level (SIL)?
- In order to properly and cost effectively address these design questions, specialized expertise and tools for pressure relief systems design, risk analysis, and instrumentation are required:
- Dynamic simulation of relieving vessels and flare piping networks to identify capacity constraints
- Risk tolerability criteria related to vessel overpressure hazards

Get Complete Whitepaper

"In order to properly and cost effectively address these design questions, specialized expertise and tools for pressure relief systems design, risk analysis, and instrumentation are required."

Modeling LNG Pool Spreading and Vaporization – *continued*

heavier than air. They usually form low, pancake shaped clouds which spread due to their own density even in the absence of wind. Since the heavy gas dispersion behavior of LNG is different from buoyant clouds, numerous models have been proposed to mathematically represent heavy gas dispersion. The proliferation of dispersion models has resulted in several good dispersion models. DEGADIS and FEM3A are two such heavy gas dispersion computer programs recommended for calculating flammable vapor dispersion distances.

The applicability of a mathematical model generally depends on the degree to which important physical phenomenon are represented. In that regards, FEM3A is least limited by various approximations but at the same time requires significantly more computational time. FEM3A is free of surface geometry constraints and can evaluate the impact of obstacles.

However, in general, the quality of predictions of dispersion models is very similar, as demonstrated in Table 1 and Table 2. The selection of dispersion models does not appear to significantly affect the quality of results.

A sophisticated dispersion model will produce an inaccurate answer if the source term (vaporization rates and duration) used are in error. We need to establish realistic, accurate, and prudent estimates of the vaporization rates. Fortunately, and despite several factors that are difficult to quantify such as wave action for spills on water, we can use existing methods to establish safe estimates of pool spreading and dynamic vaporization rates.

This paper discusses the theoretical basis for SuperChems' dynamic pool spreading model and details the performance of SuperChems against several field data sets for a wide variety of fluids including LNG.

Get Complete Whitepaper

Join us in Welcoming Our New Team Members

ioMosaic Corporation is rapidly expanding and we are pleased to introduce our newest team members.

Yangyong Qin joined ioMosaic's Salem office in March of 2006 as a Software Engineer.

Alan Keiter formerly of Rohm & Haas, joined ioMosaic in June of 2006 as an ERS Engineer.

Michelle Murphy formerly of Arthur D. Little Inc., joined ioMosaic's Salem office in September of 2006 as a Reactivity Specialist.

Vanessa Millette joined ioMosaic's Salem office in November of 2006 as the Office Manager / Executive Assistant.

Matt Borene joined ioMosaic's Minneapolis office in January of 2007 as an ERS Engineer.

Elly Prophet joined ioMosaic's Houston office in January of 2007 as the Administrative Assistant.

Please join us in welcoming our new members to ioMosaic.

ioMosaic Training Courses

SuperChems™ User Group Meeting

ioMosaic Corporation held the first Annual SuperChems™ User Group Meeting in Houston on January 16 & 17, 2007. Attendees included representatives from AmbSeg Engenharia (Brazil), Bayer Corporation, Chevron Phillips, Croda, Degussa, Eastman Chemical, FM Global, Honeywell, KBR, and Solutia.

The two-day event gave users training in advanced SuperChems modeling techniques. Topics covered included Emergency Relief System Design, Modeling Vent Headers, Low Pressure Vent Design, Dynamic Modeling, Consequence Modeling & Quantitative Risk Analysis, and Reactive Systems modeling.

Users were also given an update of forthcoming SuperChems developments, as well as having the opportunity to provide their own suggestions for future enhancements. Audience participation was encouraged, with plenty of lively Q&A throughout both days.

The second annual SuperChems User Group meeting is scheduled for January, 2008. Further details will be published on ioMosaic Corporation's website.

ioMosaic's 1st Annual SuperChems User Group Meeting

January 16-17, 2007
Houston Texas

Managing LNG Risks Training

ioMosaic has developed a comprehensive LNG training program, *Managing LNG Risks - Separating the Facts from the Myths*. This course is offered on February 26-27, 2007 in Houston, Texas.

This two-day course provides an overview of unique LNG hazards such as pool formation, rollover, dispersion, fire and explosion, etc., associated modeling techniques, and risk management methodologies. References will be drawn to previous LNG incidents, test programs and applicable regulations throughout the discussion. This course is ideally suited to anyone working for or associated with the LNG industry, particularly those involved in LNG project development, operations, and safety and risk management.

The program will be conducted by some of the world's foremost LNG specialists.

Registration for training is now open.

For more details on any of our courses please visit our website www.ioMosaic.com or contact us at ioMosaic 603-893-7009 or support@iomosaic.com

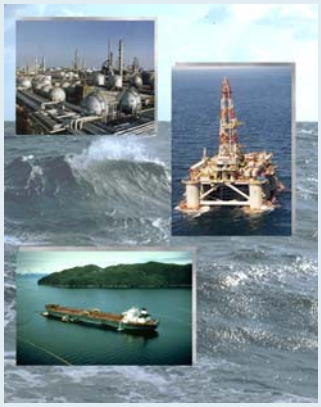
Effective ERS Design Training

ioMosaic has developed an Effective ERS Design course with the objective of offering operating companies, engineering firms and regulatory agencies with a structured and comprehensive training program for a wide range of ERS design, risk management and compliance issues. This program offers three core modules plus a wide choice of electives directed towards more complex ERS design challenges and methodologies.

Effective ERS Design is offered on various dates throughout March of 2007 in our Houston office.

Please visit our website for specific details on the course dates and topics.

Training Calendar Here



Quantitative Risk & Consequence Analysis

This four day course is a comprehensive discussion on the concepts and principles of Consequence Analysis & Modeling as well as Quantitative Risk Analysis. This course addresses both how and why hazardous incidents occur.

Case histories and hands-on computer modeling will be employed throughout the course to enable participants to apply the knowledge on real plant problems.

Topics will Include:

- Regulatory requirements
- Fundamentals (thermodynamics, chemical kinetics, heat transfer, combustion, transport, meteorology)
- Quantitative risk analysis
- Source term characterization
- Dispersion analysis
- Fire Modeling
- Large-scale test validations
- Explosions
- Case Studies

Please visit our website for upcoming dates for this seminar.

SuperChems™ Users Group Meeting, Managing LNG Risks, Effective ERS Design and Comprehensive Consequence Analysis

Software Updates

Competitive Upgrade

If you are a current PHAST™ and/or SAFETI™ user, contact us for a competitive upgrade to SuperChems™ offer.

SuperChems™ is an advanced software tool for relief systems design, chemical reactivity assessment and management, consequence analysis, and Quantitative Risk Analysis (QRA).

- Developed in 1989 by Arthur D. Little
- Used by leading companies, industry associations, and government agencies worldwide; there are now more than 250 users.
- Selected by AIChE/DIERS in July 2002 to replace the SAFIRE code
- Recognized by the state of New Jersey DEP, and the State of California
- Offers simple relief design techniques for non-experts
- Offers dynamics, reactivity, and effluent handling designs for power users

SuperChems™ Expert (Available from ioMosaic) features:

- Relief System Evaluation & Design (including Flares & Effluent Handling)
- Chemical Reactivity Assessment & Management
- Consequence Analysis (Fires, Explosions, Dispersion)
- Quantitative Risk Analysis

SuperChems™ for DIERS (available directly from AIChE) features:

- Relief System Evaluation & Design

SuperChems™ is the industry "gold standard" for design/rating of emergency relief systems (ERS) and effluent handling equipment. Risk Management, including QRA, capabilities are now included in SuperChems™ Expert. SuperChems™ is the only software product that enables all steps in a QRA to be done on the same platform. The QRA results can be displayed as risk contours that are overlayed on GPS maps of one facility. Other advantages of SuperChems™ include:

- Windows Based Software
- Peer Reviewed and against AIChE DIERS Benchmarks and largescale field data
- Integral Physical Property Data Base
- Extensive Integral Data Base of Manufacturer Data on Rupture Disks and Relief Valves
- Truly handles mixtures and multi-component systems in all models
- Integral Kinetics Package for Reactive Chemicals
- Down Stream Effluent Handling, including Flares and Vent Headers, can be Designed/Rated
- The best Source Term for flow models in the Industry
- Integral Source Term for Dispersion Modeling
- Consequence Analysis (Ground Level Concentrations, Unconfined Vapor Cloud Explosion, Fireballs): this Capability includes Analysis of LNG Spills/Releases
- Quantitative Risk Analysis (QRA) Capability, including Risk Profiles & Contours
- Report Generator

ioXpress™

Benefits include:

- Easily configured to manage exiting PSM processes, such as management of change, incident investigation and auditing
- Track and manage PHA Findings, including Continuous PHA Revalidation™
- Import PHA recommendations directly from HAZOPtimizer™ will integrate with other PHA software
- Significant productivity gains-savings should pay for the software in 6 months or less

ioXpress™ Benefits include:

- Easily configured to manage exiting PSM processes, such as management of change and incident investigation and auditing
- Track and manage PHA Findings, including Continuous PHA Revalidation™
- Import PHA recommendations directly from HAZOPtimizer™ will integrate with other PHA software
- Significant productivity gains-savings should pay for the software in 6 months or less

ioXpress™ is a web-based workflow process and knowledge management solution that operates on a Microsoft SQL Server platform. ioXpress is designed to help companies leverage "unstructured" corporate data for business advantage and learning. ioXpress can administer workflow, manage data and documents, enable knowledge sharing, and enhance communication. All document collections are categorized, centralized, and managed through a secure web-based data platform. ioXpress™ can be configured to the needs of a specific Corporation.

There are currently two versions of ioXpress™: Basic and Workflow. The Basic version is a knowledge management system that manages unstructured data including electronic documents and dynamic forms including Engineering Drawings (AutoCAD and Visio), Databases, Email, HTML, ASCII Text, Portable Document Format (PDF), and all Microsoft Office documents.

www.ioxpress.com/mocdemo

ioXpress™ **Basic** comes with an Action Tracking module which allows action items to be entered directly or imported and then managed and tracked to completion. The ioXpress™ **Workflow** version adds a workflow and business rules engine that enables management of entire business processes such as management of change (MOC), auditing, task management, and incident investigation. In turn, ioXpress™ can generate any necessary reports.

The ioXpress™ **MOC** module is a comprehensive visual workflow that guides the user through a step-by-step process for standard MOC functions such as MOC initiation, approvals, process hazard analysis (PHA), pres-start-up safety review (PSSR), start-up authorization, etc. ioXpress™ can produce significant improvements in MOC efficiency and effectiveness. One of the major efficiencies is the ability to revalidate your PHA after each MOC or Continuous PHA Revalidation™. This workflow engine can easily and cost-effectively be configured to conform to a site's specific procedures.

Software Updates *Continued*

HAZOPtimizer™

ioMosaic Corporation is proud to announce the newest release of HAZOPtimizer™ version 4.0. We are offering this software FREE of charge. To download your free copy of our HAZOPtimizer software, please register here.

HAZOPtimizer™ is a Microsoft Excel based program used to document Process Hazard Analyses.

HAZOPtimizer™ offers the following advantages:

- Can be used for any Process Hazard Analyses (PHA) technique, including HAZOP, FMEA, What If, and Checklist
- Automatically generates recommendations sorted by Risk Level Recommendations can be downloaded directly to ioXpress™ for tracking action items
- Contains default phrases to simplify recording
- Automatic item numbering and renumbering when new rows are added
- Unit conversion utility to easily switch from English to SI units
- Configurable up to 5 x 5 risk matrix
- HAZOP Deviation Matrix

New Features:

- Table of contents (TOC) tab to summarize the study Sections when user clicks on the Summary button
- Option to allow user to define the starting Section number
- An attendance sheet tab for tracking the participants' attendance
- Option to enable the print setup to activate sheet or entire workbook
- Option to make the Comments/Questions column optional for printing
- Export recommendations to ioXpress™ for web-based action tracking
- Automatically calculates the risk level based on the likelihood and severity range

Download HAZOPtimizer 4.0

FREE!

here

In The News

Eastman Chemical Company – ioXpress

Implemented at several client sites, the ioXpress Knowledge Management system provides easy access to process safety information. According to OSHA 29 CFR 1910.119(d), "…the employer shall complete a compilation of written process safety information before conducting any process hazard analysis required by the standard… This process safety information shall include information pertaining to the hazards of the highly hazardous chemicals used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process." Organized and maintained over the web with ioXpress, relief system design documentation, process technology information, and process equipment information, are kept up-to-date and made available for appropriate company personnel.

The flexible database of ioXpress, is utilized by both ioMosaic and Eastman Chemical Company personnel. Available as raw data in the database modules are basic mechanical design information for the equipment items and relief devices in the evaluated process systems. Relief system calculations, relief system design documentation, and process technology information are stored online in the libraries and linked to the database records. Additionally, quick access to existing documentation stored on internal networks and other data management systems can be provided via data links to efficiently manage the process safety knowledge. In addition to complying with OSHA regulations, by managing process safety knowledge in a single accessible location, future process hazard analyses can be executed more effectively.

"Eastman Chemical Company successfully implements ioMosaic's ioXpress web-based solution."

Review of the Sound Energy Solutions LNG Project

ioMosaic Corporation recently completed an independent safety, risk and compliance review of the Sound Energy Solutions LNG project in Long Beach for the California Energy Commission (CEC). The CEC has been designated by the Governor of California as the state agency to consult with FERC regarding the application. Our report will be submitted to the Federal Energy Regulatory Commission as part of the CEC's Safety Advisory Report. Our review included both confidential energy infrastructure information (CEII) and Sensitive Security Information (SSI) that was submitted as part of the application and the draft EIR/EIS prepared by FERC.

"ioMosaic provides an independent review of the proposed Sound Energy Solutions Long Beach LNG Import Terminal"

More News Link

ioMosaic
discovering solutions

ioMosaic Corporation Quarterly News

ioMosaic Salem Office
93 Stiles Road
Salem, New Hampshire 03079

Phone: 603-893-7009
Fax: 603-893-7885
E-mail: support@iomosaic.com

ioMosaic Houston Office
2650 Fountain View Drive, Suite 410
Houston, Texas 77057

Phone: 713-490-5220
Fax: 713-490-5222
E-mail: support@iomosaic.com

ioMosaic Minneapolis Office
333 Washington Avenue North, Suite 334
Minneapolis, Minnesota

Phone: 612-373-7037
Fax: 832-553-7283
E-mail: support@iomosaic.com

Discovering Solutions to Safety and Risk Management

www.ioMosaic.com

Whitepapers Library Link

Founded by former Arthur D. Little Inc. executives and senior staff, ioMosaic Corporation is the leading provider of safety and risk management consulting services. ioMosaic has offices in Salem, New Hampshire and Houston, Texas.

Since the early 1970's, ioMosaic senior staff and consultants have conducted many landmark studies including an audit of the Trans-Alaska pipeline brought about by congressional whistle blowers, investigation of the Bhopal disaster, and the safety of CNG powered vehicles in tunnels. Our senior staff and consultants have authored more than ten industry guidelines and effective practices for managing process safety and chemical reactivity and are recognized industry experts in LNG facility and transportation safety.

ioMosaic Corporation is also the leading provider of pressure relief systems design services and solutions. Its pressure relief system applications are used by over 250 users at the world's largest operating companies. It holds key leadership positions in the process industries' most influential and active pressure relief system design, and chemical reactivity forums, and plays a pivotal role in defining relief system design, selection, and management best practices.

Safety & Risk Management Consulting Services

- Auditing
- Calorimetry, Reactivity, and Large-Scale Testing
- Crisis Management Support and Training
- Due Diligence Support
- Effluent Handling Design
- Facility Siting
- Fire and Explosion Dynamics
- Incident Investigation, Litigation Support, and Expert Witness
- Liquefied Natural Gas (LNG) Safety
- Pipeline Safety
- Pressure Relief Design
- Process Engineering Design and Support
- Process Hazards Analysis
- Process Safety Management
- Risk Management Program Development
- Quantitative Risk Assessments (QRAs)
- Structural Dynamics
- Training

Software Products:

ioXpress™ (Enterprise Knowledge, Management of Change (MOC), and Information Management).

SuperChems™ (Advanced Pressure Relief Design, Reactivity Management, Consequence Analysis, and Quantitative Risk Analysis).

HAZOPtimizer™ is a software product for recording and managing process hazard analysis.

SuperChems™ Software

SuperChems™ is a sophisticated tool for consequence analysis and among other things can be used to analyze LNG spills, Rollover, dispersion, and fire hazards. For more information go to: www.iomosaic.com/iomosaic/products/products.html or contact us by email: lng@iomosaic.com