Harold G. Fisher (Chair)
September 6, 2025

Dear DIERS Member,

The DIERS Operating Committee members are delighted to announce the publication of an updated strategic business plan. The purpose of developing this document is to facilitate the journey towards realization of the DIERS vision "*to make the world a safer place as the leader in the design of safe and effective over-pressure protection, emergency relief and effluent handling systems.*" It is meant to serve as a basis for further discussions between the DIERS membership and the DIERS Operating Committee.

The enclosed plan was carefully developed by the Operating Committee members and member volunteers. The DIERS vision and mission are provided first and then strategic pillars essential for DIERS success are enumerated. Those sections are followed by lists of stakeholders and a SWOT (strengths – weaknesses – opportunities – threats) analysis. This is followed by 2024 – 2025 accomplishments and 2025 -2026^{+} plans. Final sections include the interfaces with other technical organizations; benefits of DIERS membership for members, member's companies, and technical meeting sponsors; and finally, acknowledgements for contributions in developing this strategic plan.

A strength of the DIERS organization is its devoted membership. Numerous volunteers have enabled the success of key activities such as technical projects, education courses and technical meetings. Opportunities are also available for you to take part in strategic initiatives to improve the organizational effectiveness of the DIERS organization. Your feedback and participation in the strategy development and execution are welcomed.

Please provide comments to Greg Hendrickson by email at GregHendrickson1954@gmail.com or by phone at 832-527-9129 by October 10, 2025. Greg will compile the comments and share the feedback with the Operating Committee for final consideration. More importantly, please communicate your desires to plan, lead, or contribute to initiatives that enhance member experiences and/or improve the effectiveness of the DIERS organization. We look forward to hearing from you.

With regards,

Harold Fisher (Chair)

Greg Hendrickson (Secretary)

Design Institute for Emergency Relief Systems (DIERS)
2025 Strategic Business Plan

Date: 9/6/2025, Rev: 3

DIERS Operating Committee
Harold Fisher (Chair), Georges Melhem (Vice Chair), Greg Hendrickson (Secretary), Dan Smith (Education), Garrett Dupre (Program), Passa Piland (Projects), Lisa Ruth (Finance/Membership)

Abstract
DIERS was formed in 1976 as an industry consortium with corporate sponsors and a sponsor funded project. Since then, DIERS has evolved into an AIChE technical entity with individual membership and with volunteer project leaders and committee members. Considering the evolution of DIERS, the Operating Committee embraced the opportunity to update the 2024 strategic plan to focus activities leading towards achieving the DIERS vision. These strategic business projects are separate and distinct from DIERS technical projects. The vision, mission and strategic pillars for organizational sustainability are first defined. Finally, opportunities to improve organizational effectiveness are provided.

1. Introduction

The Design Institute for Emergency Relief Systems (DIERS) was formed in 1976 as an industry consortium to develop technologies for the design of emergency relief systems, particularly for overpressure events involving two-phase vapor-liquid flow and runaway chemical reactions. Results of the original DIERS project include methods to predict the occurrence of two-phase vapor-liquid venting, vent sizing methods for two-phase vapor-liquid flashing flow, and calorimetry methods to determine the required venting rate during runaway chemical reactions. The DIERS consortium became the DIERS Users Group in 1985, with corporate representation in biannual meetings. The DIERS Users Group then became DIERS, a Technical Entity within the AIChE, with the membership structure changing from corporate membership to individual membership in 2020.

As DIERS evolved from an industry consortium with corporate sponsorship and a sponsor funded project to a Technical Entity with individual membership and volunteer led projects, the nature and the scope of technical projects also evolved. Volunteer champions (leaders) and project committee members are selected to define and execute new technical projects based on their interests and skills. The scopes of selected technical projects are within the boundaries of DIERS mission, address current knowledge gaps, and are interesting enough to attract volunteer project team members. The DIERS technical scope is provided in Appendix 1 and an inventory of DIERS technologies in Appendix 2 and gaps in technical knowledge in Appendix 3.

However, not all DIERS projects are technical projects. Some projects are strategic efforts to improve operational effectiveness, ensure financial sustainability, develop the next generation of pressure relief design subject matter experts (SMEs), and develop the next generation of DIERS leaders (succession planning). Strategic business projects are the responsibility of the Operating Committee members with the support of member volunteers. The purposes of this document are to define the DIERS business strategy and to present opportunities that support the strategy. Specific opportunities identified for membership involvement are found in Section 8, 2025 – 2026[+] Plans.

2. Vision

The DIERS vision is to make the world a safer place as the leader in the design of safe and effective over-pressure protection, emergency relief and effluent handling systems.

3. Mission[1]

The mission of DIERS is to advance worldwide the practice of designing safe and effective emergency relief systems, particularly for systems with multiphase flow and systems with runaway chemical reactions, so as to reduce the frequency and potential consequences of overpressure incidents.

The objectives of DIERS, related to relief system design are:

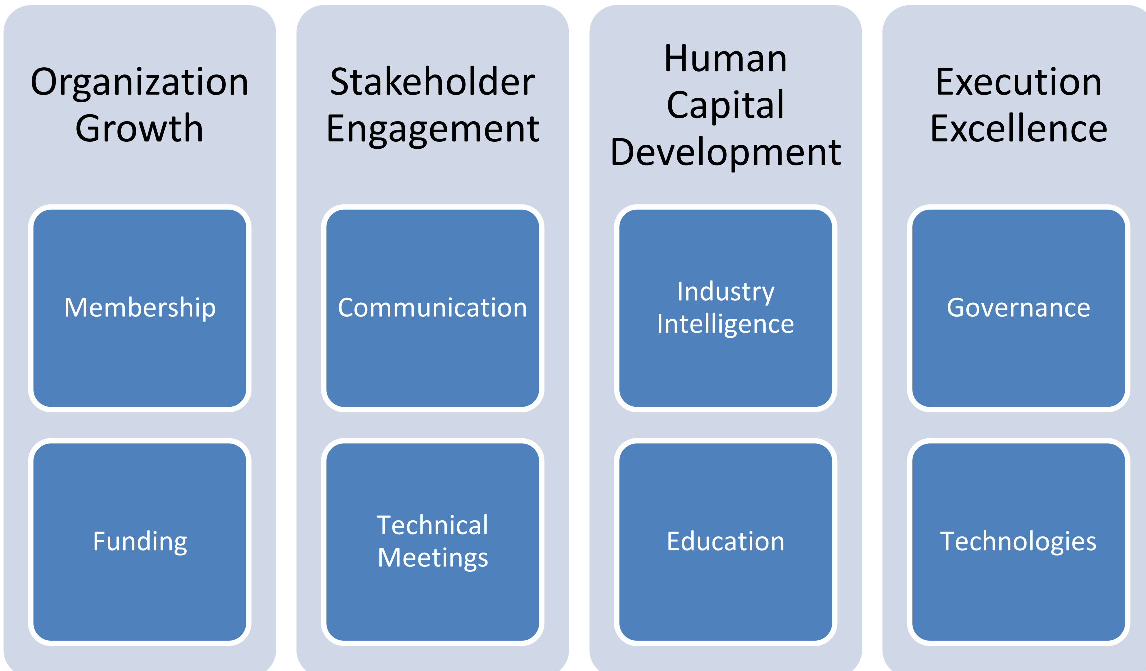
- Maintain and upgrade methodology within DIERS technical scope,
- Identify knowledge gaps in emergency relief system design and evaluation,
- Address knowledge gaps by promoting and developing improved emergency relief system design and evaluation techniques,
- Provide opportunities for junior members to develop into relief system Subject Matter Experts (SMEs),
- Provide a forum for discussion and a mechanism for exchange of information regarding specific improvements, modifications, clarifications or corrections,
- Develop technical meeting programs, arrange and host the technical meetings,
- Promote and provide continuing education related to emergency relief systems,
- Provide outreach to industry, trade groups, government, academia, and the public to increase awareness of emergency relief system design,
- Share best practices related to emergency relief system design with industry, trade groups, government, and academia,
- Provide a mechanism for ongoing cooperative research and development, and
- Interface with and advise code- and standard-writing organizations on improvements in emergency relief system technology.

4. DIERS Strategic Pillars

DIERS strategic pillars are the key focus areas essential for the long-term sustainability of the organization. These pillars underpin the strategy and define areas where resources should be allocated. Both technical and strategic projects support the pillars. The DIERS strategic pillars are illustrated in Figure 1 and explained below.

[1] Revisions from the 2024 DIERS bylaws are indicated in red font.

Figure 1, DIERS Strategic Pillars



1.1 Membership – The strength of DIERS is reflected by its membership. Members' experiences and skills provide a crucial role in supporting the mission. Members also provide human capital by volunteering for technical and strategic projects. Maintaining the current membership, recruiting new members, fostering volunteers, and developing new leaders are essential for DIERS sustainability. *DIERS paid membership has averaged around 360 members for the past several years. The membership anecdotally varies annually along with chemical company profits.*

1.2 Funding – DIERS technologies are developed using a volunteer projects-based approach and disseminated through technical meetings and DIERS education courses, which requires operational funds. Additionally, DIERS is required to pay an allocated portion of the AIChE overhead. Funding is primarily obtained through membership dues, technical meeting fees, software sales, and book sales. Increasing income via increased stakeholder participation is the strategy for funding the organization. Corporate funding of special projects is not considered an element of the DIERS strategy[2]. *Membership dues provide income of about $11,000 per year. Other income sources vary each year.*

2.1 Communication – Clear communication of the business value provided by DIERS to stakeholders and accurate dissemination of DIERS technologies underlies the success of the organization. Clear communication of the business value of DIERS contributions and accomplishments maintains stakeholders' engagement and encourages new members to join. Communication is primarily through

[2] Sponsor funded projects have been discussed in the past, but have been removed from consideration.

the technical meetings, email, and websites. *Two technical meetings are provided each year and multiple emails are sent to advertise the meetings.*

2.2 Technical Meetings – Biannual technical meetings are the primary method of communication within the DIERS organization and subsequently for dissemination of DIERS technologies to stakeholders. The success of the technical meetings lies in the many contributions by a broad swath of the membership (and invited non-members) and members are encouraged to present at the meetings. Business and technical priorities of the DIERS organization are reflected in the meeting programs. *Approximately 65 members attend each technical meeting, for a participation rate of 19%. The spring virtual meeting registration is slightly larger than the fall in-person meeting registration.*

3.1 Industry Intelligence – Standards organizations, e.g., API, ISO, etc., recommend technologies that utilize and/or overlap with DIERS technologies. Monitoring of design methods recommended by other organizations and addressing them when they conflict with DIERS technologies as well as advocacy and advising of those organizations are fundamental roles of the DIERS organization. Technology monitoring and DIERS advocacy is primarily achieved by volunteer participation in industry and regulatory organizations. *Several members are engaged with providing regular updates from standards and code writing organizations to DIERS members.*

3.2 Education – Continuous education of DIERS members is primarily provided through biannual technical meetings and of non-member stakeholders through the DIERS Basic and Advanced Emergency Relief System Design courses. Education of targeted stakeholders and the general-public is through participation in external conferences, external publications, and advertising. *An average of 32 students per year attend the Basic Relief System Design course and an average of 18 students per year attend the Advanced Relief System Design course.*

4.1 Governance – The DIERS members act in a legal and ethical manner, guided by DIERS bylaws, AIChE Board guidance and applicable regulations. The Operating Committee provides oversite and controls of ethics and compliance activities. DIERS members and non-member technical meeting attendees are expected to follow the DIERS bylaws, the AIChE Code of Ethics and the AIChE Code of Conduct.

4.2 Technologies – DIERS members develop improved technologies using a project approach and promote them during the DIERS technical meetings. Project ideas may be submitted by members and/or generated during brainstorming sessions during the technical meetings. Proposed projects are prioritized considering stakeholder input and aligned with resources contributed by volunteers. *Multiple technical projects are in progress each year as reported by the Project Chair.*

5. Stakeholders

The roles of DIERS stakeholders in support of the pillars are essential and multifaceted. Each group influences or directly supports DIERS financial sustainability while continuing to deliver high-impact technical advances. Stakeholders are the DIERS sponsor (CCPS, AIChE) and current users of DIERS technologies including:

- Operating companies
- Original equipment manufacturers (OEMs)
- Engineering consulting companies

- Individuals
- Regulatory agencies
- Industry associations
- Educational institutions

The sponsor primarily provides DIERS governance support and operational support. Governance support includes organizational oversight, policy and legal compliance, and financial management. Operational support includes administrative and logistical support (technical meetings), membership management (membership database and dues collection), technical infrastructure (website and communication platform), legal and contractual support.

The stakeholders support all the strategic pillars in one manner or another. The sustainability of the DIERS organization is highly dependent upon the participation, engagement, and technical excellence of the stakeholders. Stakeholder engagement and stakeholder satisfaction are strategic priorities of the DIERS Operating Committee.

6. Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis

The SWOT analysis is used to identify forces that enhance and diminish DIERS ability to accomplish its mission. This analysis provides areas of focus for the Operating Committee to allocate resources and to improve work processes.

Strengths: Broad experience of DIERS senior members, deep passion for the subject by DIERS members, DIERS brings together a collaborative network of subject matter experts, the latest process safety information is shared during regular biannual technical meetings, AIChE/CCPS affiliation provides resources for DIERS sustainability, few other organizations with the same focused area of expertise exist[3], basic and advanced emergency relief design courses are offered annually, modeling software (SuperChems™ for DIERS and SuperChems™ for DIERS Lite) is offered, calculation methods for two-phase vapor-liquid flow are expertly adopted, experimental and calculations methods for reaction calorimetry are proficiently developed and demonstrated, DIERS methods align with regulatory and international standards frameworks, membership is comprised of representatives from major companies (chemical, petrochemical, and pharmaceutical), annual virtual technical meetings make attendance possible for more members with travel restrictions, joint meetings with the European DIERS User Group (EDUG) demonstrate a commitment to global sharing of process safety knowledge

Weaknesses: Missing global name recognition (Africa, Asia-Pacific, Middle East), DIERS narrow focus may not fully address broader process safety issues, inability to recruit candidates for Operating Committee position elections limits member interests, inability to recruit project champions/leads limits the number of active projects, lack of cogent business cases for DIERS technical projects limits support for new projects, lack of communication to business leaders limits DIERS ability to obtain their contributions of resources, insufficient general funds are available to effectively close technical gaps, the website fails to communicate DIERS value (e.g., recent contributions and accomplishments), the proper balance between focus on complex solutions to unusual problems versus developing new SMEs to correctly apply existing technologies in real-world design situations is unresolved, a succession plan to develop future DIERS leadership is missing, there is little recognition of differing global standards (US

[3] Another organization is the European DIERS User Group (EDUG)

ASME, EU PED, Russian GOST, etc.), no formal method exists for approval of DIERS technologies (e.g., membership review and approval of submitted data and/or methods as DIERS technologies)

Opportunities: Developing a larger/new user base of Subject Matter Experts (SMEs), global expansion (Africa, Asia-Pacific, Middle East), publishing practical guidance and informational products, publishing stakeholder focused communications, training junior engineers to develop into SMEs, developing and publishing a business case communication (why DIERS), implementing a Reactive Hazards Evaluation and Calorimetry class, validating SuperChems™ for DIERS and SuperChems™ for DIERS Lite with results found in Adair and Fisher paper[4], providing DIERS fundamentals tutorials (refreshers) during the biannual technical meetings, providing continuity of technology awareness (through SME and DIERS leadership development), incorporating machine learning and AI tools into DIERS technologies and knowledge base, increasing DIERS presence in the overpressure protection of transportation vessels (e.g., US DOT), developing a database of actual incidents with benchmarking of DIERS tools (knowledge base), publishing a monograph containing worked example problems ranging from simple single phase relief scenarios to complex runaway chemical reaction scenarios, integrating DIERS technologies into academic curricula

Threats: Becoming irrelevant by failing to innovate, loss of talent and institutional knowledge due to aging of experts, insufficient general funds to continue operating, inability to define and execute a cohesive direction, stagnant or reducing membership size, diminishing corporate participation (either by staff cuts or industry consolidation), aversion to alternative viewpoints or explanations [Not Invented Here Syndrome (NIHS)], no formal method for accepting/rejecting new methodologies or technologies, advanced DIERS methods are beyond the reach of many general practitioners without adequate training, absence of major technical challenges decreases interest in DIERS, failure to keep technology relevant in the face of regulatory shifts, competition from competitive simulation tools and software

7. 2024 – 2025 Accomplishments

Pillars	Accomplishments
Membership	Membership list updated to current-status New member introductions at technical meetings implemented Honorarium award work process implemented
Funding	Monetizing DIERS content proposal approved (tiered membership plan) SuperChems™ for DIERS price increased and license agreement updated Improved work process for identifying and contracting sponsors for the technical meetings
Communication	Strategic plan introduced and reviewed by membership Annual marketing campaign for technical meetings and training growth implemented
Technical Meetings	Technical meeting planning workflow defined Implemented used of Confex for management of abstracts and presentations Spring and fall technical meetings provided
Industry Intelligence	Interfaced with standards writing organizations (ASME and API)

[4] Adair, S.P. and Fisher, H.G., "Benchmarking of two-phase flow the safety relief valves and pipes," J. Loss Prev. Proc. Ind., 12(1999), 269-297

Education	Provided instructors for scheduled basic and advanced relief design courses Updated basic and advanced course materials Developed reactive hazard evaluation course curriculum for approval by AIChE Updated AIChE website to reflect basic and advanced course content
Governance	Annual planning calendar developed and utilized Bylaws updated and submitted to AIChE for approval DIERS roadmap introduced
Technologies	Technical project submission and approval workflow implemented Reaction round-robin standard development investigated

8. 2025 – 2026⁺ Plans

Pillars	Plans
Membership	Develop an international expansion plan
Funding	Monetize DIERS content implementation (tiered membership)
Communication	Strategic plan update and review by membership
Technical Meetings	Provide spring and fall technical meetings
Industry Intelligence	Interface with standards writing organizations (ASME and API)
Education	Provide instructors for scheduled basic and advanced relief design courses Develop reactive hazard evaluation course curriculum for implementation by AIChE Develop runaway reaction incidents database (case studies)
Governance	Bylaws approval and posting by AIChE DIERS roadmap update Publish Operating Committee member’s job descriptions Leadership succession plan
Technologies	Work process for funded project approval and execution Round-robin test results database AI implementation to knowledge base

9. DIERS Representatives Interfacing with Other Organizations

A key role within DIERS is to liaison with code- and standard-writing organizations and with other organizations focused on safety in the process industries. DIERS representatives provide periodic updates to the membership during the biannual technical meetings. DIERS representatives at other organizations are listed below.

Liaisons with Code- and Standard-Writing Organizations

- ASME Boiler and Pressure Vessel Code (BPVC) – Danielle Mainiero-Cessna
- API Subcommittee on Pressure-Relieving Systems (SCPRS) – Georges Melhem
- ISO 4126 – Georges Melhem
- NFPA – ??
- ASTM Committee E27 on Hazard Potential of Chemicals – Garrett Dupre

Liaisons with Process Safety Organizations

- European DIERS Users Group (EDUG) – Georges Melhem
- European DIERS Users Group (EDUG) Joint Meeting – Ben Doup
- Center of Safety Excellence (CSE) – Georges Melhem
- Mary Kay O'Conner Process Safety Center (MKOPSC) – ??
- Purdue Process Safety Assurance Center (P2SAC) – Ben Doup
- Center for Chemical Process Safety (CCPS) – Georges Melhem

10. Benefits of DIERS Membership

DIERS provides access to methods and techniques beyond those provided by code- and standard-writing organizations, for example, methods to assess the impacts of non-ideal fluid properties and chemical reactions on emergency relief requirements, to select two-phase flow calculation methods when reactions are occurring (e.g., when the ω-method is not applicable), and to determine when vapor disengagement occurs during venting. Member benefits beyond access to advanced relief design methods include:

- Acquire skills to develop into a reactive relief system Subject Matter Expert (SME)
- Gain expertise by being part of vital exchanges with noted colleagues worldwide
- Participate in General Project Committees and contribute to the development of new relief system technologies (that may influence future standard and/or code revisions)
- Participate in round-robin calorimetry testing of reactive chemicals
- Participate in technical meetings to network with other technologists, acquire the latest technology developments, and learn about software updates in a timely manner
- Vote in DIERS elections to select DIERS leadership
- Participate in the development and updates of books, training materials, tools, and other products

- Access the DIERS website containing meeting minutes, meeting presentations and final reports of technical projects

11. Benefits of DIERS for Member's Companies

Benefits go beyond those experienced by members. The member's companies also benefit from supporting DIERS:

- Preventing catastrophic failures protects valuable assets, reduces unplanned downtime, avoids equipment repair costs, and avoids production losses.
- Companies that follow DIERS-recommended methodologies demonstrate a stronger safety culture and risk mitigation, potentially resulting in reduced insurance rates or improved terms.
- Adherence to DIERS best practices helps companies comply with process safety regulations (e.g., OSHA, EPA RMP, etc.) reducing the risk of fines, legal fees, and litigation due to process accidents or non-compliance with the regulations.
- DIERS provides access to validated models, experimental data, and tools (like the Vent Sizing Package (VSP)) allowing for more precise and cost-effective relief system sizing.
- Member companies have access to collaborative technical projects, case studies, and round-robin test data to validate in-house test equipment and methods.
- Employees of member companies benefit from technical meetings, training courses, and publications, enhancing internal capabilities and reducing dependency on external consultants.
- Participation gives companies a voice in shaping industry standards and best practices, ensuring future regulations and norms align with practical industry needs, avoiding burdensome or expensive requirements.

12. Benefits of DIERS Technical Meeting Sponsorship

The DIERS meetings normally have about 60 attendees representing a variety of operating companies (mostly major and mid-size refining, petrochemical, and chemical companies), relief device manufacturers, and consultants. Attendees represent a broad range of experience from beginning engineers to senior engineers and technical leads whose focus includes emergency relief system design and chemical reactivity hazard analysis. Many of the senior attendees are the decision makers in their organizations.

Sponsorship offers an ideal opportunity to reach an audience of like-minded individuals. Sponsors are given the opportunity to communicate their companies' message and educate attendees on their expertise and products with a sponsor presentation. Additionally, sponsors are invited to submit a technical presentation to further highlight their application of the latest emergency relief system technologies.

During the technical meetings there are ample opportunities for informal and technical discussions to build relationships with new contacts and reconnect with people you already know. Whether you are looking for an opportunity to enhance your brand recognition or to meet and talk with prospects, there is an opportunity for you.

13. Acknowledgements

Inputs and comments were provided by the DIERS Operating Committee (Harold Fisher, Georges Melhem, Greg Hendrickson, Dan Smith, Garrett Dupre, Passa Piland, Lisa Ruth) and by numerous volunteers (David Goetz, Casey Houston, Tom Kemp, Davide Moncalvo, Richard Pudlo, Stephen Schoniger, Julie White)

Inputs were compiled and edited by Greg Hendrickson

Appendices

Appendix 1 – Detailed Definition of DIERS Technical Scope

This section provides a definition of what is included within and excluded from DIERS scope. The DIERS mission emphasizes the development and dissemination of technologies for the design of emergency relief systems comprising multiphase flow and those including runaway chemical reactions. This statement is interpreted to mean technologies used to establish required relief rates (source terms), size and establish the mechanical integrity of components comprising the emergency relief systems, and estimate consequences of relief events are within the boundaries of DIERS scope. Relief systems designed using DIERS methodologies will be in accordance with industry standards, such as API, ASME, ISO and NFPA standards. A more detailed definition of DIERS mission and description of its boundaries is:

- The term "multiphase flow" is meant to include simultaneous flow of up to four phases (solid-liquid-liquid-vapor)
- The term "multiphase flow" is also meant to include both choked flow (critical flow), e.g., within pressure relief devices, and subsonic flow (subcritical flow), e.g., within emergency relief system devices and piping. Methods to determine two-phase flow regime, liquid hold-up, and pressure loss (both recoverable and non-recoverable) are included within DIERS purview. This definition of multiphase flow includes flow outside of containment, e.g., atmospheric dispersion of vapor clouds, by the necessity of venting to a safe location.
- The term "runaway reactions" is meant to include deflagrations inside containment (including gas-phase deflagrations and dust explosions). Including internal deflagrations within DIERS mission means sizing of deflagration vents is within DIERS purview. This definition excludes explosions outside of containment, e.g., vapor cloud explosions, and resulting overpressure effects.
- The term "emergency relief systems" is meant to include:
    - Every element that can be located within the flow path of the relieved fluid, such as pressure relief valves and similar devices (e.g., rupture disks and buckling pins), piping and piping components (e.g., valves and fittings), vapor-liquid separators, vent stacks, and flares. By this definition, devices such as conservation vents, flame arrestors, and back flow preventers are within DIERS purview[5].
    - Methods and devices to protect the mechanical integrity of process equipment, e.g., vessel venting requirements based on estimated time to failure due to fire exposure
    - Methods and devices to safely dispose of the vented or flared materials. By this definition, considerations of venting to a safe location, and thus dispersion modeling and flame radiation modeling, are within DIERS purview.
- The term "emergency relief system design" is meant to include:
    - Specification of elements contained within an emergency relief system (and their flow order or connectivity or layout) such that the system performance is "safe and effective" according to requirements provided by Recognized And Generally Accepted Good

[5] Sometimes piping and equipment are part of both the process and the relief system. In these cases, the DIERS methods may be applied to process equipment during abnormal operation.

Engineering Practices (RAGAGEP), regulations, and industry standards. This definition includes specifying relieving pressure, flow capacity, and mechanical design aspects, e.g., consideration of low temperature embrittlement, pressure relief valve chattering, and flow induced piping vibration. It also includes calculating reaction forces and transient fluid forces on relief system components. The interface between elements within DIERS purview and outside its purview is the equipment and pipe wall. Design of associated civil, structural, electrical, and instrumentation, etc. is not within DIERS purview.

- Functional specification of alternative methods to prevent equipment overpressure (e.g., overpressure prevention by design) such as by dumping, flooding, or killing runaway chemical reactions. The definition of the "functional specification" of instrumented systems is to specify the design intent and performance requirements, such as flow capacity and response time. By this definition, the functional specification of, for example, safety instrumented systems (SIS) and high integrity protection systems (HIPS) are within DIERS purview, but the detailed design of the instrumented systems to meet the specified safety integrity levels is not. Also, conducting the Layers of Protection Analysis (LOPA) and/or Quantitative Risk Analysis (QRA) to define Safety Integrity Level (SIL) are outside of DIERS purview.
- Functional specification of systems to prevent loss of containment due to overtemperature events, e.g., vessel wall weakening during fire exposure such as, for example, vessel depressurization and water spray systems. This means that modeling of fires and their effects on process equipment is included within DIERS purview.

Appendix 2 – Inventory of DIERS Technologies

Key DIERS technologies[6] are the foundation upon which future improvements rest and include:

- Criteria for determining if single-phase or multiphase flow will occur during emergency venting scenarios, e.g., vapor-liquid disengagement for both churn-turbulent and foaming chemical systems (α versus ψ curves)
- The DIERS coupling equation for relating two-phase vessel flow to two-phase vent flow
- A low-phi bench-scale adiabatic calorimeter to determine the source-term energy release rates for vapor systems and gas-generation rates for gassy systems under runaway reaction conditions (Vent Sizing Package, VSP2™)
- Methodology to apply VSP2™ data to the α versus ψ curves to predict flow capacities and pressure drops through relief devices or containment strategies to manage runaway chemical reactions
- Calculation methods to scale design data obtained from laboratory calorimetry to commercial processes, i.e., Fauske relief sizing equations
- The Henry-Fauske non-equilibrium two-phase flow model to predict critical (choked) two-phase mass flux
- Calculation method to size emergency relief devices, i.e., an analytical solution of the isentropic nozzle equation using the Omega Method Correlation of State
- Software to size emergency relief systems, including:
    - SuperChems™ for DIERS
    - SuperChems™ for DIERS Lite
- Education courses that emphasize a precise rigorous code compliant approach to emergency relief system design and provide the skills to design vapor-liquid two-phase flow systems
    - Basic Emergency Relief System Design
    - Advanced Emergency Relief System Design
    - SuperChems™ for DIERS

[6] Copyrights and publication rights of the results of any projects sponsored through DIERS and any inventions and/or patents arising out projects sponsored by DIERS are assigned to the AIChE.

Appendix 3 - Gaps in Technical Knowledge

The intent of identifying gaps in knowledge is to determine what innovations are needed to advance the science (and the art) of multi-phase pressure relief, especially when runaway reactions contribute to the required relief rates. The list of knowledge gaps is useful to facilitate prioritization of future DIERS technical projects.

- Differences between US and European global relief standards
- Fluid mechanics of multiphase systems other than two-phase liquid-vapor systems, e.g., vapor-solid systems
- Limitations in liquid swell models used for sizing emergency relief systems, e.g., drift flux models that consider void fraction variation in vessels (particularly vessels with internals)
- Limitations in methods for characterizing reactivity for the purpose of relief sizing, e.g.
    - Decomposition reactions
    - Reactions that occur at high temperature (>400°C)
    - Rate measurements for solid systems (where adiabatic calorimetry has shortcomings)
    - Rate measurement for high reaction rate systems (where calorimetry temperature and/or pressure tracking are too slow)
    - Rate measurements for gas systems (where heat transfer rates to thermocouples are a limitation)
    - *In-situ* measurement of species concentrations in adiabatic calorimetry
- Limitations in the application of DIERS methodology to processes containing solids (surface reactions), e.g.
    - Trickle bed reactors
    - Gas phase fluidized bed reactors
- Limitations on modeling fire heat flux, e.g.
    - Fire temperature and emissivity
    - Engulfed in fire versus visible to fire
    - Heat flux with confined fires, e.g., with radiation reflected from walls
- Vessel rupture criteria during overtemperature events, e.g., hoop stress versus von Mises stress
- PRV Stability for complex systems, e.g., parallel PRVs or PRVs mounted on piping
- Relief criteria for high temperature boiling materials, e.g., decomposition rate dependent
- Deflagration science applied to vent sizing methodology/software
- Guidelines for selecting atmospheric dispersion modeling methodology/software
- Flow induced vibration screening methodology/software
- Body bowl choking/restricted lift