

# The High Cost of Paper Relief and Flare System Documentation

*Paper in a paperless world*

# *Preamble*

“It should not be necessary for each generation to rediscover the principles of process safety which the generation before discovered. We must learn from the experience of others rather than learn the hard way. We must pass on to the next generation a record of what we have learned.”

*- Jesse C. Ducommun  
Safety Pioneer*

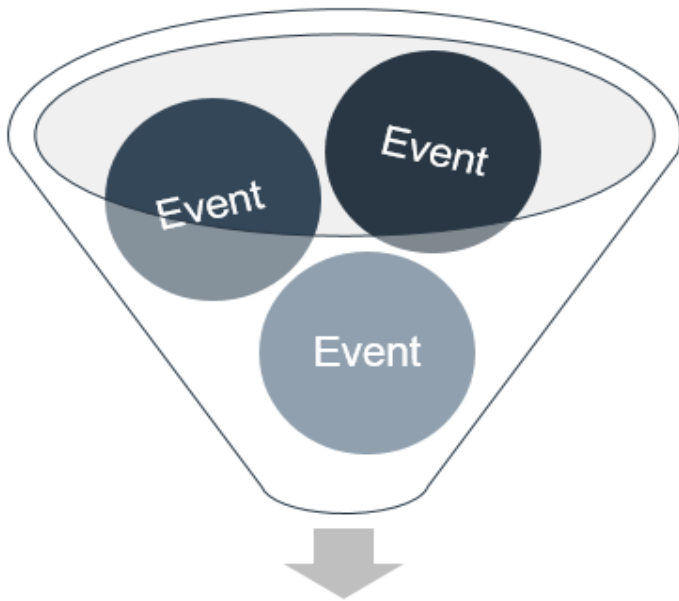
Quoted from the Report of the BP U.S. Refineries Independent Safety Review Panel

**We are as fast as our  
slowest parts**

# Relief Systems – The last line of defense

Are we safe to operate?

upstream, midstream or downstream



Relief & Flare Design  
Documentation

**How much feed rate can we increase?**

**What if we push x% more feed?**

**Can our operations handle it?**

**What modifications do we need to make?**

**Can we handle more gas from the well as compared to oil for which our upstream facility was designed for?**

**Internal or External Audits**

**Atmospheric Tie-ins- Compliance,  
Environmental Maintenance,  
Turnaround cases**

**Ownership Changes**

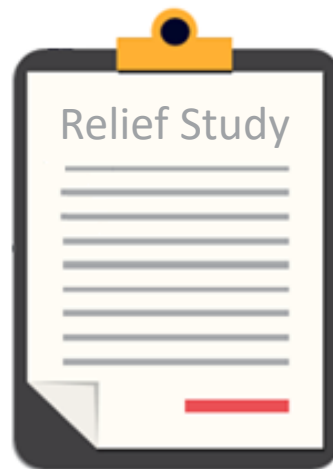
# What do you need for Relief Studies

**Design Unit Basis**

**Limiting Equipment Data**

**Stream Properties**

**Relief Device Information  
and Capacities**



**System Definition &  
Equipment Info.**

**Overpressure Contingencies  
& Relief Rates**

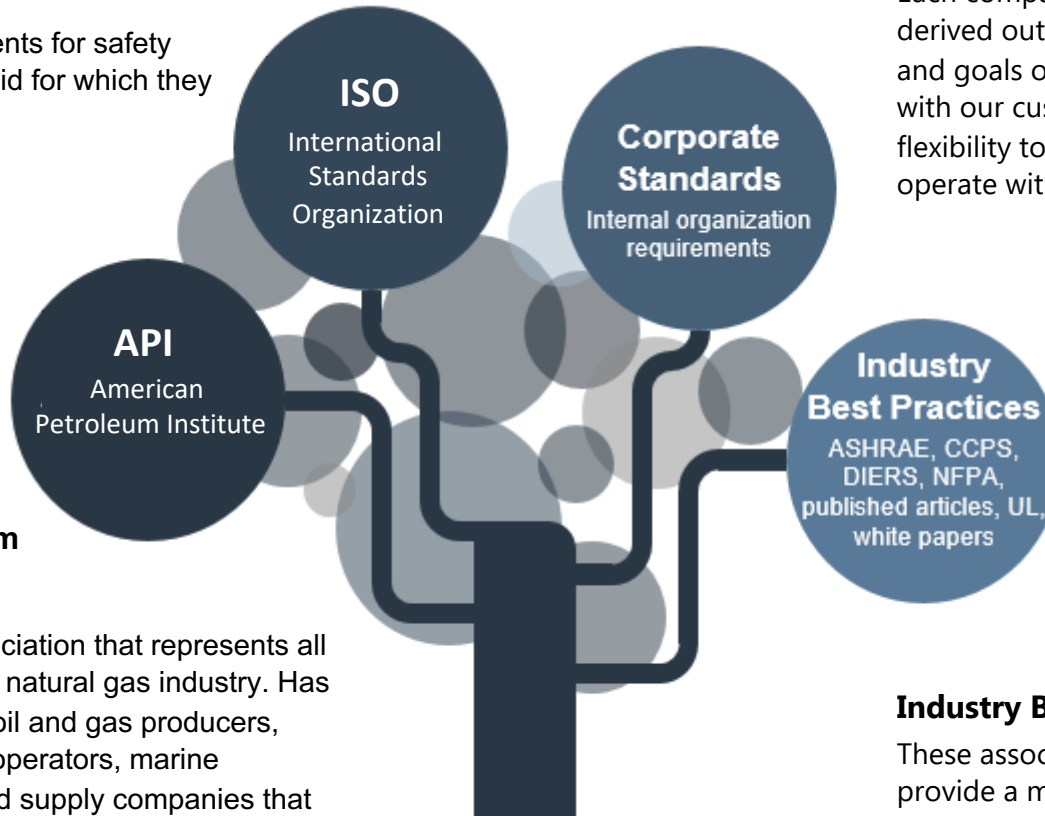
**Formulas & Calculations**

**Reports and Documentation**

# Process Safety Information (PSI)

## (ISO) International Standards Organization

Specifies general requirements for safety valves irrespective of the fluid for which they are designed.



## (API) American Petroleum Institute

The only national trade association that represents all aspects of America's oil and natural gas industry. Has 600 members consisting of oil and gas producers, refiners, suppliers, pipeline operators, marine transporters, and service and supply companies that support all segments of the industry.

## Corporate Standards

Each company has its own internal standards derived out of the history of their operation and goals of the organization. Salus works with our customers to provide them the flexibility to perform the work needed to operate with in these requirements..

## Industry Best Practices

These associations and/or sources provide a more detailed instructions and/or case studies supplementing the API and/or ASME standards.

# What is the end result?

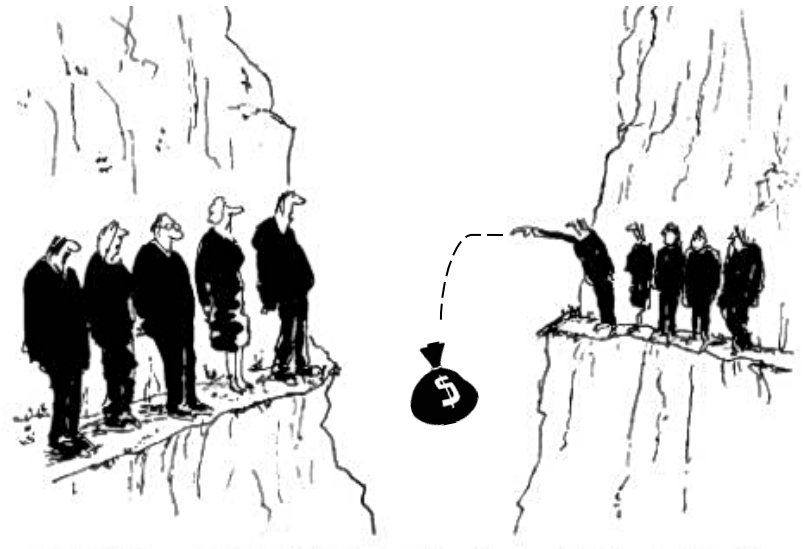


## Paper Reports or .PDFs

- Data can get scattered across different departments, systems, employee desks
- Different owners across the operating facility for different PSI
- Multiple PSI Systems
- Project based documentation

# Gaps In Communication

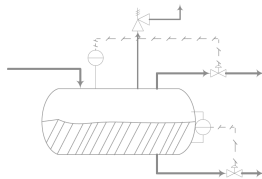
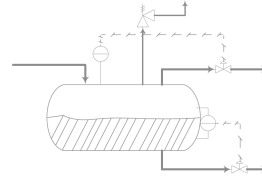
**Communication gaps and inconsistent analysis between various contractors resulting in expensive reworks for operators.**





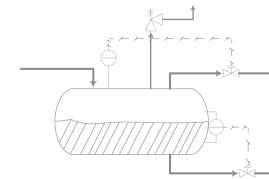
# Data Fragmentation

## *Equipment and Relief Device Data*



*Change "A"*

*Data can quickly become out of sync with each other and relies on strong communication between business segments.*



*Change "B"*

**There has been progress**

# Implementation of Technology



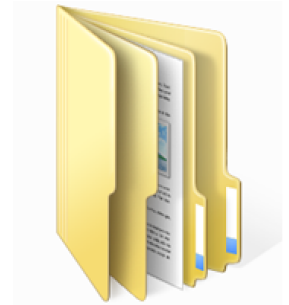
Faster Simulations



Faster Hand Calcs



Digital Paper



Digital File Cabinet

- Traditional work made faster
- Still Siloed
- Collaboration Limited
- Work is duplicated
- Deliverables still fragmented

**The faster we get the more  
expensive the delay**

# The Impact...

Up to

# 80%

Rework

Seen for relief valves on a new facility design (specially if the EPC is not familiar with codes & standards).

*Full or majority revalidation of relief systems*



- Decisions made with incomplete data
- Missed opportunities
  - Safely increase rates
  - Alternate modes of operation
  - Effective debottlenecking
- Installation of relief valves or equipment not needed
- Failure to understand the impact of a change.
- Corporate or Site standards not consistent.

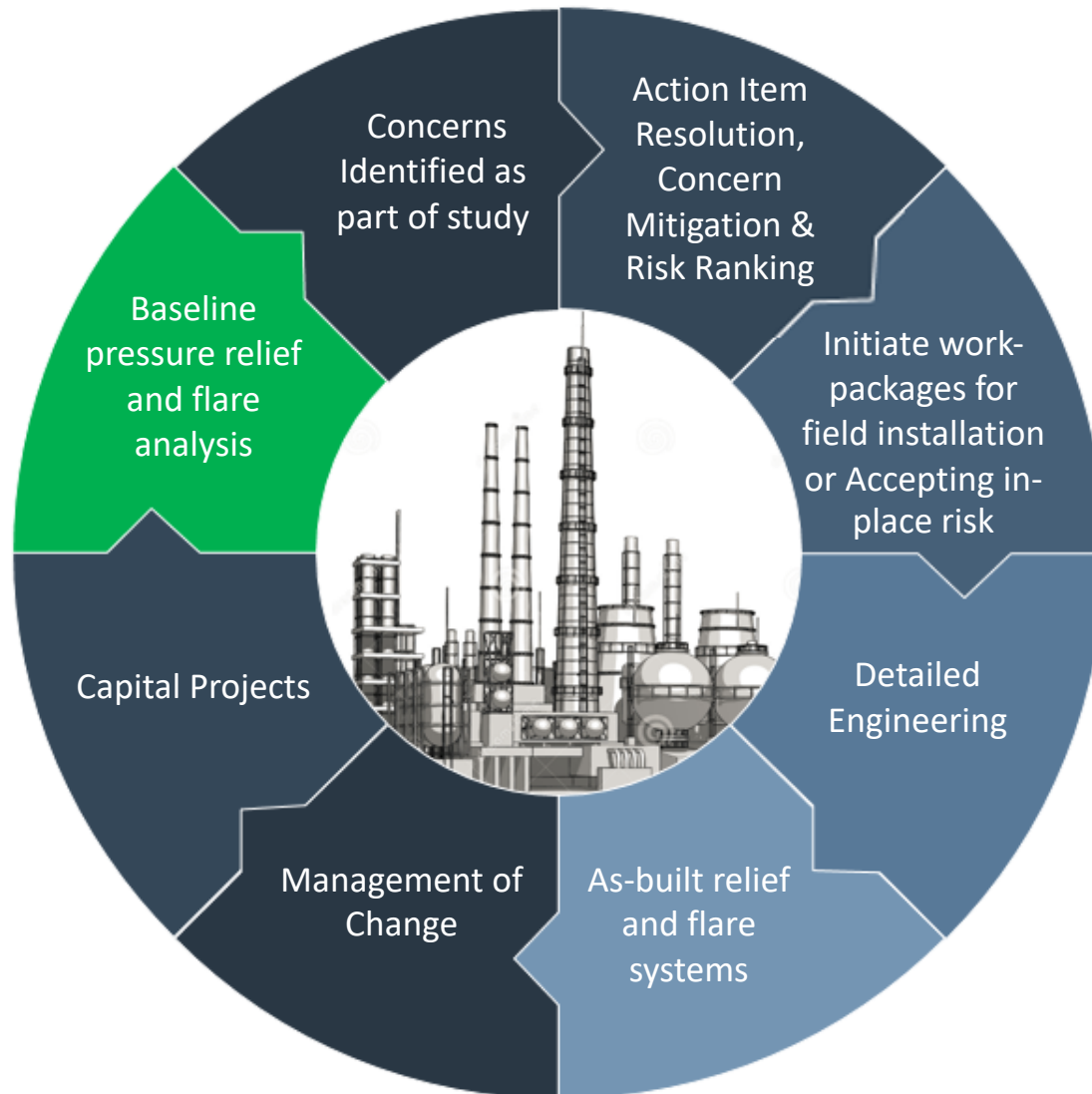
# Salus & Symmetry

# Build an Ecosystem



- ✓ Data consistency between Relief Systems and Flare models
- ✓ Consistency between design and as-built revisions for flare and relief systems.
- ✓ Provide flare data mining across multiple versions
- ✓ Provide reporting capabilities using the results and inputs of flare runs.
- ✓ Availability of working, approved, and as-built models in one place.

# An Evergreen Solution





# Affects of Change

Site  
Operations



*Mechanical  
Changes*

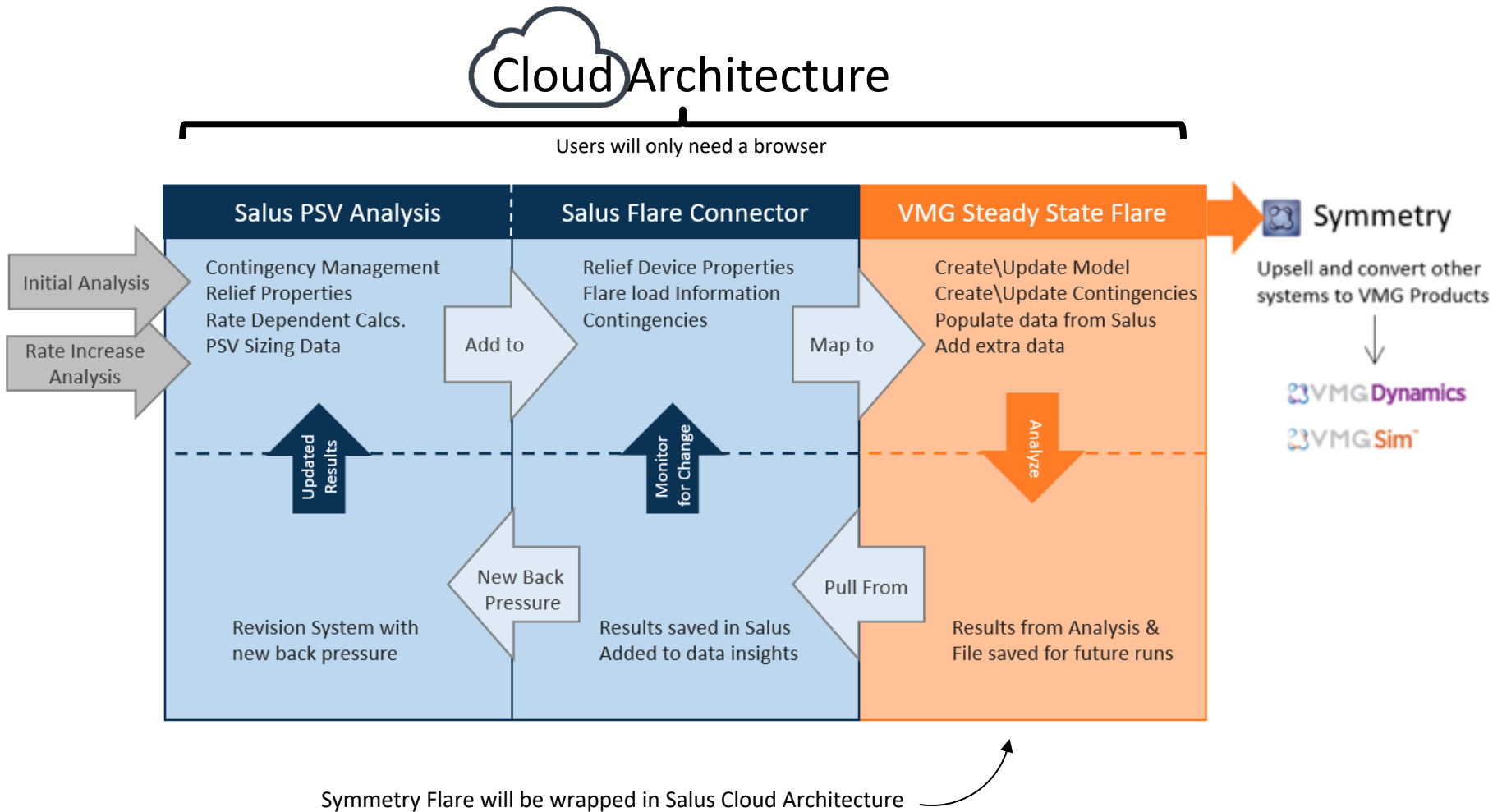


*Mitigation  
Changes*

Relief and Flare  
Analysis

# Flare Connection

A evergreen ecosystem for relief and flare analysis



# Data Insights

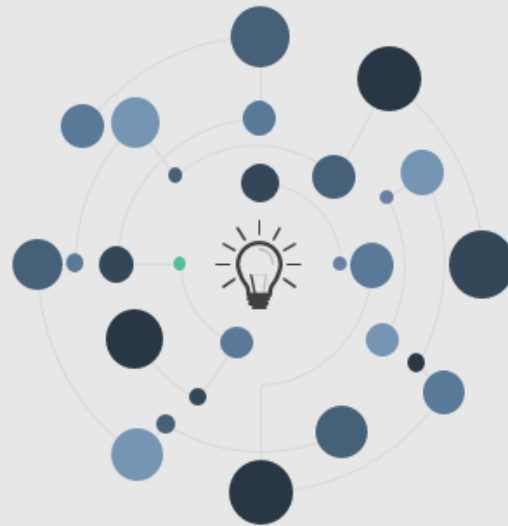
Search your data or analyze it for concerns

## Read only

### Findings Analysis

Search your data to identify issues with your relief systems.

- Undersized RD
- P-drop issues
- High Relief Temps
- Min Outlet Temp
- Rate Dependent



### Data Mining

Browse, filter, and search your data for your business needs.

- Relief Devices
- Equipment
- Control Valves
- Systems
- Streams
- Contingencies

## Relief Study Data

# Get Answers Fast

How many Consolidated PSVs do we have?

How many of our PSVs are going to the atmosphere?

Why are PSVs and Flare work so cool and fun to analyze?

What is the operating pressure versus set pressure for this PSV?



# Rate Dependent Calculations

Example Searches using Data Insights

The screenshot displays the Salus software interface. At the top, there are navigation tabs for 'Insights', 'Reports', and 'Approvals'. The main area is titled 'Insights - General Calculations'. A search bar contains 'Demo Refinery' and a filter is set to 'Rate Dependent'. A table below shows search results with columns for Plant, Unit, System, R D Tag, System State, R D Type, R D Subtype, Contingency, Contingency #, Contingency Title, and Calc. A stopwatch icon in the bottom left corner indicates a time of 15 seconds.

Plant	Unit	System	R D Tag	System State	R D Type	R D Subtype	Contingency	Contingency #	Contingency Title	Calc
Demo Refinery	ADV Wastewater Treat Unit	513 spheroid protection, 0	PSV28008 Void	Working	Vacuum Vent		Inbreathing	1		E
Demo Refinery	North Tank Farm	513 spheroid protection, 0	PSV28008	Working	Vacuum Vent		Inbreathing	1		E
Demo Refinery	ADV Wastewater Treat Unit	513 spheroid protection, 0	PSV28009 Void	Working	Vacuum Vent		Inbreathing	1		E
Demo Refinery	North Tank Farm	513 spheroid protection, 0	PSV28009	Working	Vacuum Vent		Inbreathing	1		E
Demo Refinery	K. Bowser PSV runs	Co processing PSVs, 0	PSV32016	Working	Pressure Relief Valve	Conventional	Overfilling	1		E
Demo Refinery	543 Crude	PSV-01022, 0	PSV-01022	Working	Pressure Relief Valve	Conventional	Hydraulic expansion	1		E
Demo Refinery	543 Crude	PSV-01023 (1) PSV-31000, 0	PSV-01023 (1)	Working	Pressure Relief Valve	Conventional	Hydraulic expansion	1		E
Demo Refinery	543 Crude	PSV-01023 (1) PSV-31000, 0	PSV-31000	Working	Pressure Relief Valve	Conventional	Hydraulic expansion	1		E
Demo Refinery	543 Crude	PSV-01023, 0	PSV-01023	Working	Pressure Relief Valve	Conventional	Hydraulic expansion	1		E
Demo Refinery	543 Crude	PSV-02013, 0	PSV-02013	Working	Pressure Relief Valve	Pilot	Hydraulic expansion	1		E
Demo Refinery	Sun-Olin	PSV-09001, 0	PSV-9001	Working	Pressure Relief Valve	Bellows	Closed outlet	1		E
Demo Refinery	Sun-Olin	PSV-09002, 0	PSV-9002	Working	Pressure Relief Valve	Bellows	Failure of auto. controls	5	PCV-09106 & Bypass	R
Demo Refinery	Sun-Olin	PSV-09002, 0	PSV-9002	Working	Pressure Relief Valve	Bellows	Closed outlet	1		E
Demo Refinery	FCC	PSV-1/2/3/4/30/31/32/33/ 35...	PSV-00036	Working	Pressure Relief Valve	Bellows	Power failure	2	Bus 1	E
Demo Refinery	FCC	PSV-1/2/3/4/30/31/32/33/ 35...	PSV-00002	Working	Pressure Relief Valve	Bellows	Sidestream reflux failure	1	Intermediate Reflux	E

1. Add more columns to your search results
2. Export any search to Excel to take advantage of Microsoft's toolset or email results
3. Perform Advanced searches to quickly refine results.
4. We provide results in 15 seconds or less

# Undersized Relief Devices

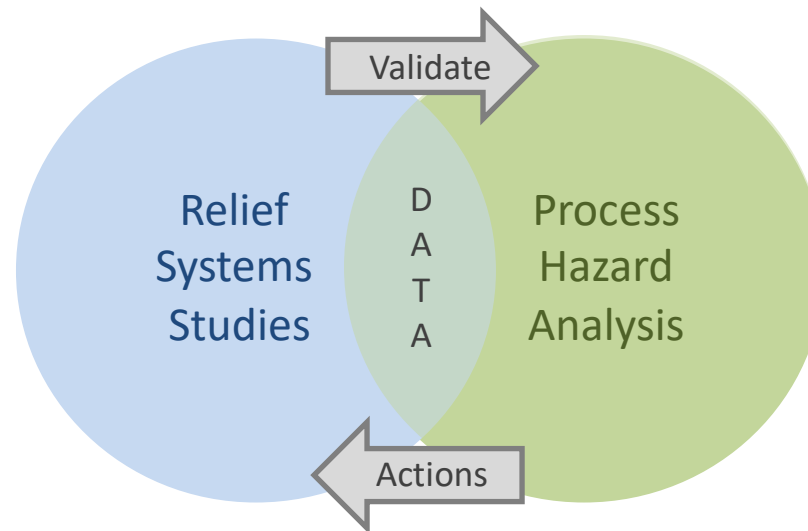
## Example Searches using Data Insights

The screenshot shows the Salus software interface. The top navigation bar includes 'salus', 'Salus Demo', and menu items for 'Insights', 'Reports', and 'Approvals'. The main content area is titled 'Insights - Undersized Relief Devices'. A search bar contains 'Demo Refinery'. A dropdown menu is open, showing 'ENTITIES' (Systems, Relief Devices, Equipment, Control Valves, Isometrics, Contingencies, Calculations, Streams) and 'STANDARD QUERIES' (Undersized Relief Devices, Oversized Relief Devices, Inlet Pressure Drop Analysis, Outlet Pressure Drop Analysis, High Relief Temperature Analysis, Outlet Temperature Analysis). The 'Undersized Relief Devices' query is highlighted with a red circle and the number '1'. The main table displays a list of relief devices with columns for Tag, Revision, System State, Relief Device, System, Contingency Name, Contingency Title, Controlling, and Required Relief.

Relief Device Tag	Revision	System State	Relief Device	System	Contingency Name	Contingency Title	Controlling	Required Relief	
PSV-00001	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-00002	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-00031	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-00033	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-00035	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-00036	0	Working	Pressure R	PSV-1/2/3/4/30/31/32/33/ 35/36, 0	PSV-1/2/3/4/30/31/32/33/ 35/36, 0; Sidestream reflux failure, 2	Slurry Oil	Yes	80046.75 lb/	
PSV-01022	0	Working	Pressure R	PSV-01022, 0	PSV-01022, 0; Exterior fire, 1		Yes	11936.72 lb/	
PSV-01023	0	Working	Pressure R	PSV-01023, 0	PSV-01023, 0; Exterior fire, 1		Yes	11760.46 lb/	
PSV-01023 (1)	0	Working	Pressure Relief Valve	Conventional	PSV-01023 (1) PSV-31000, 0	PSV-01023 (1) PSV-31000, 0; Exterior fire, 1	Yes	16444.71 lb/	
PSV-100131	0	Working	Pressure Relief Valve	Bellows	PSV-100131, 0	PSV-100131, 0; Power failure, 2	Total Power	Yes	520370.84 lb
PSV-100131	A	Working	Pressure Relief Valve	Bellows	PSV-100131, A	PSV-100131, A; Power failure, 2	Total Power	Yes	485623.48 lb
PSV-100135	0	Working	Pressure Relief Valve	Conventional	PSV-100135, 0	PSV-100135, 0; Closed outlet, 1	Yes	87445.11 lb/	
PSV-100137	A	Working	Pressure Relief Valve	Bellows	PSV-100131, A	PSV-100131, A; Power failure, 2	Total Power	Yes	86592.74 lb/
	0	Working	Pressure Relief Valve	Conventional	PSV-100166, 0	PSV-100166, 0; Closed outlet, 1	No	4320 lb/hr	
	0	Working	Pressure Relief Valve	Conventional	PSV-100166, 0	PSV-100166, 0; Failure of auto. controls, 2	PV-07264A+BP	No	5830.19 lb/h

1. Quickly analyze for a number of concerns using our industry standard queries.

# Process Hazard Analysis



- ✓ Improved quality of Analysis
- ✓ Quick answers to questions
- ✓ Action Tracking Avoidance

# Prepare before the PHA

## Example Searches using Data Insights

The screenshot shows the Salus software interface. The navigation bar includes 'salus', 'Salus Demo', 'Insights', 'Reports', and 'Approvals'. The main content area is titled 'Insights - Contingencies'. A search bar contains 'Demo Refinery' and '543 Crude'. An advanced search filter is set to 'Contingency Type' contains 'closed'. The table below shows the results of this search.

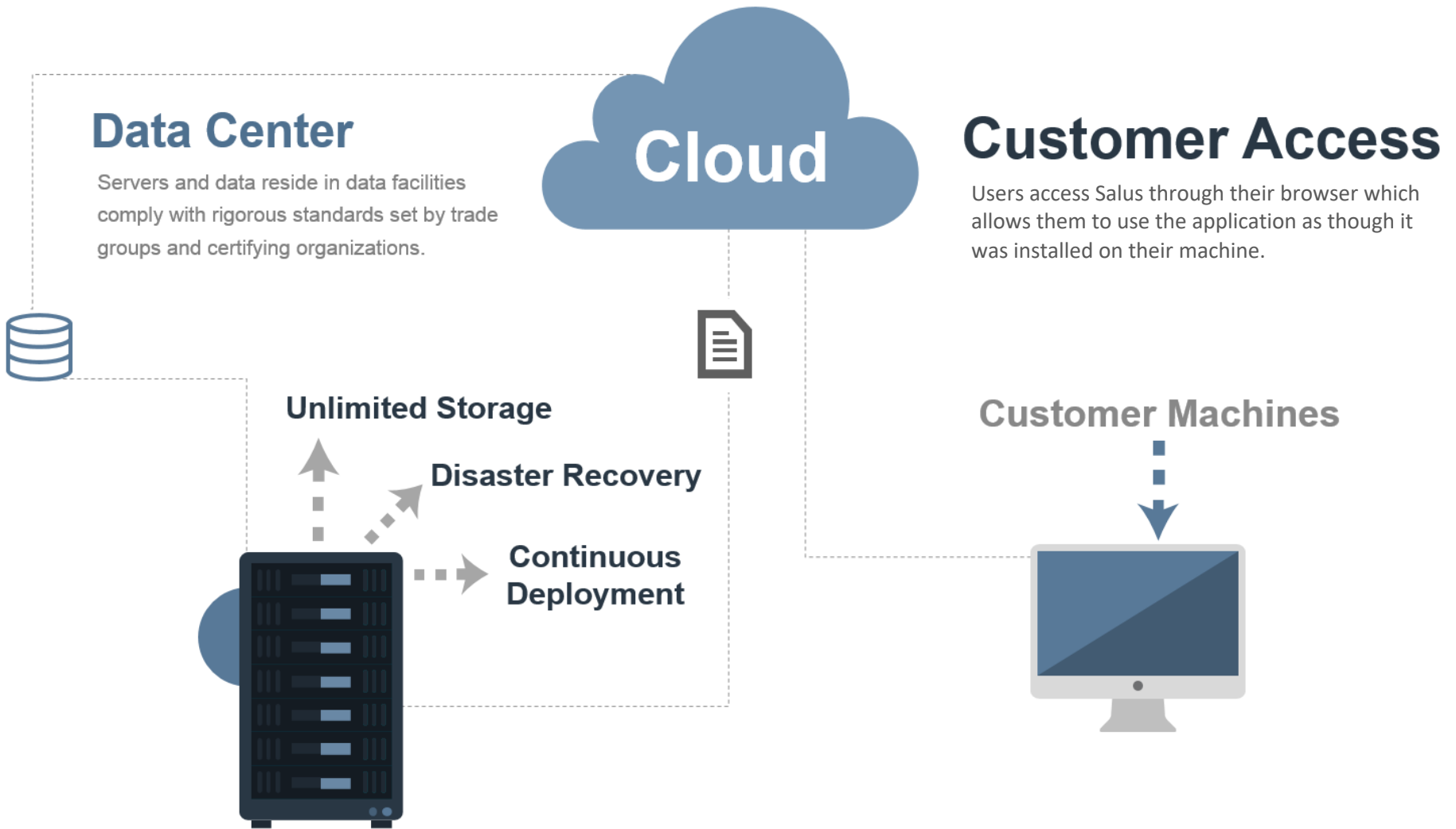
Plant Name	Unit Name	System Name	System State	Contingency Type	Contingency Title	Contingency #	Applicable	Remote	Calc Required	Req
Demo Refinery	543 Crude	PSV-3021/3031/3041/3051/3...	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-3021/3031/3041/3051/3...	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-338, 0	Working	Closed outlets		1	Yes	No	Yes	3
Demo Refinery	543 Crude	PSV-328, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-329, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-30912-1/319, 0	Working	Closed outlets		1	Yes	No	Yes	2
Demo Refinery	543 Crude	PSV-01023, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-312, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-314, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-40904, 0	Working	Closed outlets		1	Yes	No	No	
Demo Refinery	543 Crude	PSV-853, 0	Working	Closed outlets		1	Yes	Unknown	No	
Demo Refinery	543 Crude	PSV-337, 0	Working	Closed outlets		1	Yes	Unknown	No	
Demo Refinery	543 Crude	PSV-01022, 0	Working	Closed outlets		1	Yes	Unknown	No	
Demo Refinery	543 Crude	PSV-30908, 0	Working	Closed outlets		1	Yes	Unknown	No	
Demo Refinery	543 Crude	PSV-30908-1, 0	Working	Closed outlets		1	Yes	Unknown	Yes	3

1. PHA facilitator can prepare before the PHA by searching contingencies analyzed.
2. Select the Unit being analyzed.
3. Perform an advanced search for all closed outlets.
4. Review, print, and analyze before the PHA kicks off

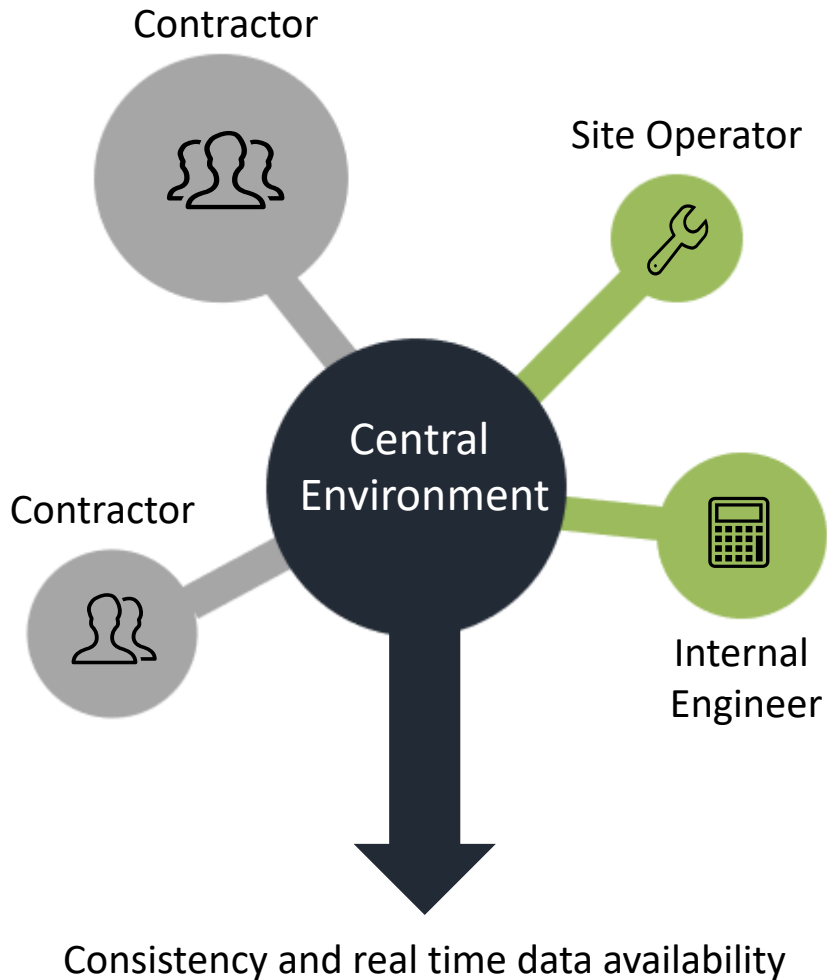


# A Centralized Workspace

# Hosted Environment



# Centralized Data Management



- ✔ Operator has full control over the centralized data set
- ✔ Consistency and standards are enforced across all parties
- ✔ Data is available for everyone to view for their specified use cases.
- ✔ Operator owns and can update the models.

# Safety can be effective & affordable

Savings

# 60%

*\*See NIST\_GCR\_04-867 - Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry*

3-5% of the actual cost of the baseline revalidation vs revalidation every 5 years

*Site savings varies from Upstream, Midstream, and downstream but is significant.*



- Your data is always up to date and is available to all parties.
- Business and operations can make reliable decisions to manage change and increases at a facility.
- Impact of change identified quickly
- Standards are followed between contractors and operators
- Corporate wide data and analytics across sites can be measured
- Findings and risk rankings are better managed

# What about data warehousing and digital twin initiatives?

# Data Integrity

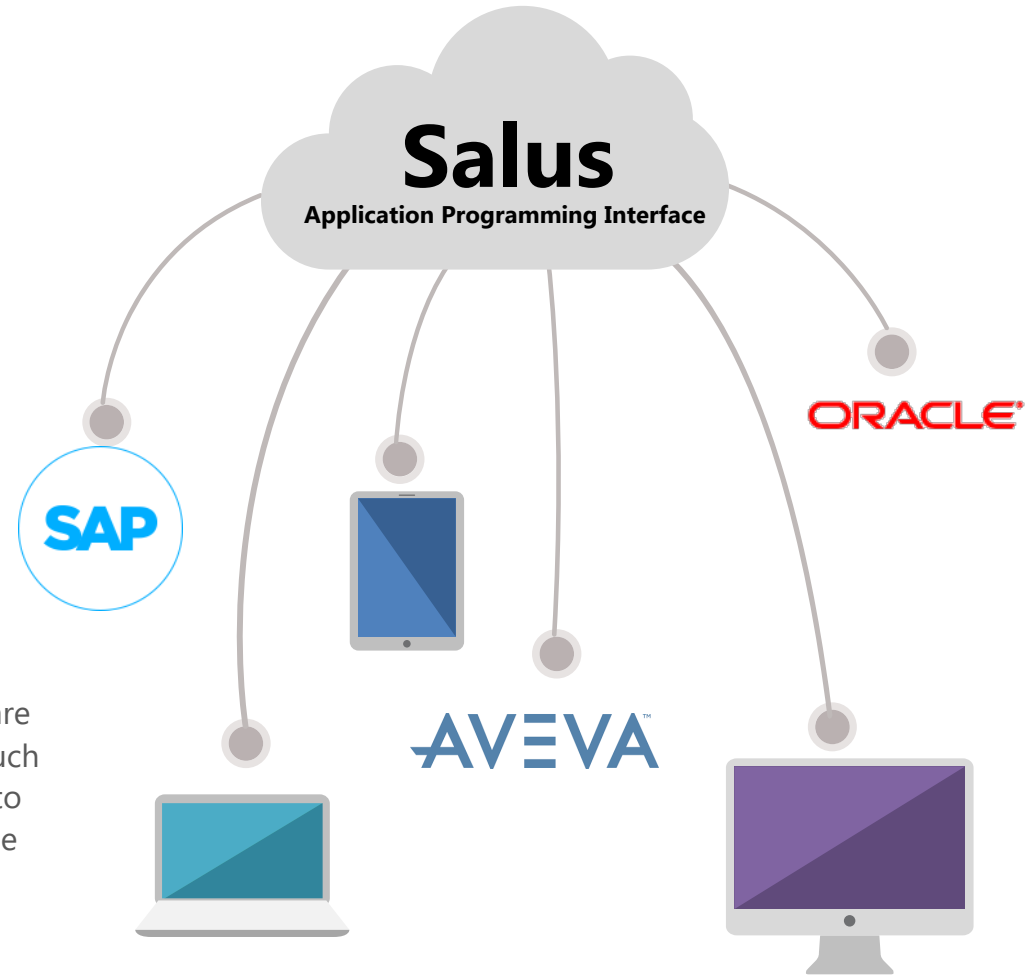
Protect against data fragmentation and duplication

## A solution for data fragmentation

Corporate data is often stored in many locations which lends for double data entry and data fragmentation. An update to one does not always propagate through all the other business systems. This can lead to documentation and analysis that are missing information and can quickly become out dated.

## Integration support for 3<sup>rd</sup> party software

Salus provides an working application programming interface [API] which allows for connectivity to any software that supports this kind of connection. Business systems such as SAP, Oracle, AVEVA, and other can all work with Salus to help make sure your data is updated as per your corporate workflows.



# A Complete Ecosystem

- Promote cross business communication of change
- Affective view of data from any dashboard
- Automated transfer and notification of change
- Elimination of fragmented data
- Corporate wide view of information
- Consistent report generation



# Its Question Time!

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