

Annual Safety Seminar 2024

Online – MS Teams

18 November 2024



WCC Online Safety Seminar Agenda

November 18, 2024

Time	Item	Presenter
13:00 (CET)	Welcome and Opening Remarks & WCC Antitrust Guidelines	Thomas Vanfleteren, Euro Chlor
13:05 (CET)	Goals and Vision of WCC for safety	Thomas Vanfleteren, Euro Chlor
13:10 (CET)	Loss of Primary Containment (LoPC) Improvement Program	Rod Herrick, Covestro
13:40 (CET)	Cognitive Readiness Project implementation	Antonio Freitas, Braskem
14:05 (CET)	Chlorine hydrates issues and prevention	JJ Hiemenz, K2 Pure Solutions
14:30 (CET)	Closure of the safety webinar	Thomas Vanfleteren, Euro Chlor

WCC antitrust guidelines



DO

DO ensure strict performance in areas of:

OVERSIGHT / SUPERVISION:

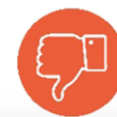
- Have a WCC staff representative at each WCC-sponsored meeting;
- Limit meeting discussions to agenda topics (unless additional topics have been approved by the WCC staff representative); and
- Provide each member company representative and WCC employee attending a WCC-sponsored meeting with a copy of this checklist and have a copy available for reference at all WCC-sponsored meetings.

RECORDKEEPING:

- Have an agenda and minutes which accurately reflect the matters which occur.

VIGILANCE:

- Protest or stop any discussion or meeting activities which appear to violate this checklist. Member company representatives should disassociate themselves from any such discussion or activities and leave any meeting in which they continue.



DON'T

DO NOT in fact or appearance, discuss or exchange information on:

PRICES, INCLUDING:

- Individual company prices, price changes, price differentials, markups, discounts, allowances, credit terms, etc.;
- Individual company data on costs, production, capacity, inventories, sales, etc.; and
- Industry pricing policies, price levels, price changes, differentials, etc.

PRODUCTION, INCLUDING:

- Plans of individual companies concerning the design, production, distribution or marketing of particular products, including proposed territories or customers; and
- Changes in industry production, capacity or inventories.

TRANSPORTATION RATES:

- Rates or rate policies for individual shipments, including basing point system, zone prices, freight equalization, etc.

MARKET PROCEDURES, INCLUDING:

- Company bids on contracts for particular products; company procedures for responding to bid invitations; and
- Matters relating to actuals or potential individual suppliers or customers that might have the effect of excluding them from any market or influencing the business conduct or firms toward them.

First aid with virtual meetings...



Please mute yourself when not speaking...

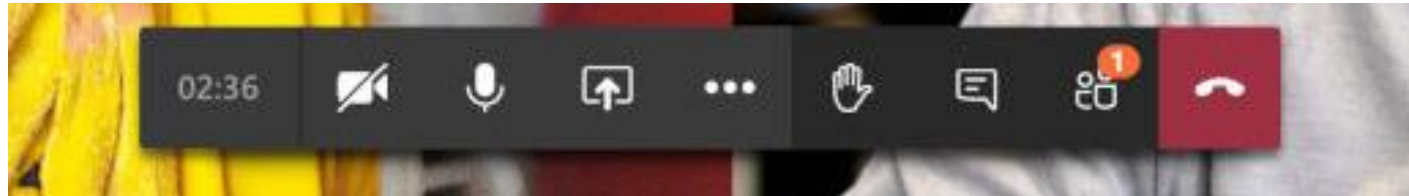
Camera can be on or off depending on your internet connection



If you have a question, please raise your hand, or put it in the chat box



Please don't forget to unmute yourself when you wish to intervene



Please note that the meeting will be recorded

Goals and Vision of the WCC



Dr. Thomas Vanfleteren
Technical & Safety Manager
Euro Chlor



What is the World Chlorine Council (WCC)?

WCC is a global network representing the chlorine and chlorinated products industries.

Originally formed in 1993, it brings together national and regional trade associations, along with their member companies to promote best practices and the benefits of Chlor-Alkali chemistry.



• Our Members

North America

- American Chemistry Council's Chlorine Chemistry Division
- Chlorine Institute
- Canadian Chlorine Chemistry Council
- Halogenated Solvents Industry Alliance

Approx. 15 million tonnes Cl_2

Eur-Asia

- Euro Chlor

Approx. 12 million tonnes Cl_2

Asia

- Alkali Manufacturers Association of India
- Japan Soda Industry Association
- Vinyl Environmental Council (Japan)
- Korea Chlor-Alkali Industry Association
- China Chlor-Alkali Industry Association

Approx. 50 million tonnes Cl_2

Latin America

- Clorosur

Approx. 3 million tonnes Cl_2

Rest of the world (not direct members)

Approx. 7 million tonnes Cl_2

- Global chlorine capacity is approx. 90 million tons per year of chlorine
- WCC represents about 85% of that capacity



WCC Vision

“Chlor-alkali chemistry is recognised as making an essential contribution to a sustainable world.”

WCC Mission

“Be a global forum to promote health, safety, and environmental best practices in order to provide society with the benefits of the chlor-alkali industry.”

Goal Area 1 | Safety

Promote the continuous improvement of safety, environment and health performance, progress and practices worldwide in the chlor-alkali production, transportation and use.

Objective: *Achieve zero incidents in the chlor-alkali industry*

Organise an annual safety seminar

- Safety Seminar in Buenos Aires, Argentina | November 2016
- Safety Seminar in Moscow, Russia | November 2017
- Safety Seminar in Perth, Australia | July 2018
- Safety Seminar in Monterrey, Mexico | September 2018
- Safety Seminar & African Water Forum in Johannesburg, South Africa | July 2019
- Safety in Transportation of all Chlor Alkali products seminar in Vadodara, India | September 2019
- Online Safety Seminar | 17 and 18 November 2020
- Online Safety Seminar | 9 and 10 November 2021
- Safety Seminar in Johor Bahru, Malaysia | 13 and 14 June 2023

Goal Area 1 | Safety

Promote the continuous improvement of safety, environment and health performance, progress and practices worldwide in the chlor-alkali production, transportation and use.

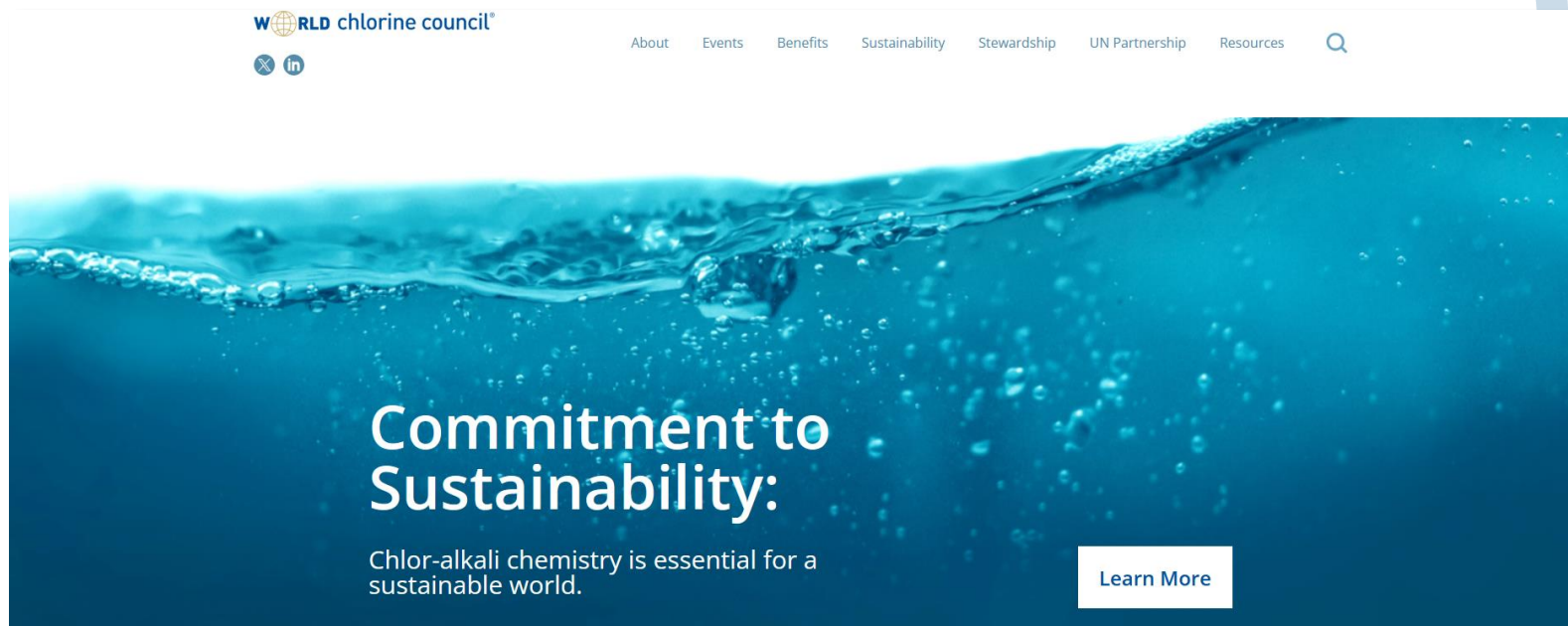
Objective: *Achieve zero incidents in the chlor-alkali industry (cont'd)*

Exchange and promote safety procedures, and information among regions

- Quarterly Global Safety Team (GST) teleconferences
- Exchange on incident reports and general best practices guidance
- Spring & October WCC Management Committee Meeting
- Quarterly safety newsletter

Want to know more about WCC?

Visit our website - <https://worldchlorine.org>



Follow us on LinkedIn!



Loss of Primary Containment (LoPC) Improvement Program



Rod Herrick
Global HSE Head
Covestro



A photograph of a large industrial chemical plant at night, illuminated by various lights. The facility includes tall distillation columns, complex piping, and structural steel frameworks. A large orange curved graphic element is positioned on the right side of the image.

Process Safety Focus 2024

Loss of Primary Containment (LoPC) Improvement Program

Rod Herrick

Global Head of HSE-R

LoPC Background and Justification for Effort



What is an LoPC and why should we care?

Loss of Primary Containment (LoPC) is a **lagging indicator** to measure unplanned or uncontrolled releases of material or energy in chemical plants.

It is used to measure **process safety performance** and helps to **reveal opportunities for improvement**.

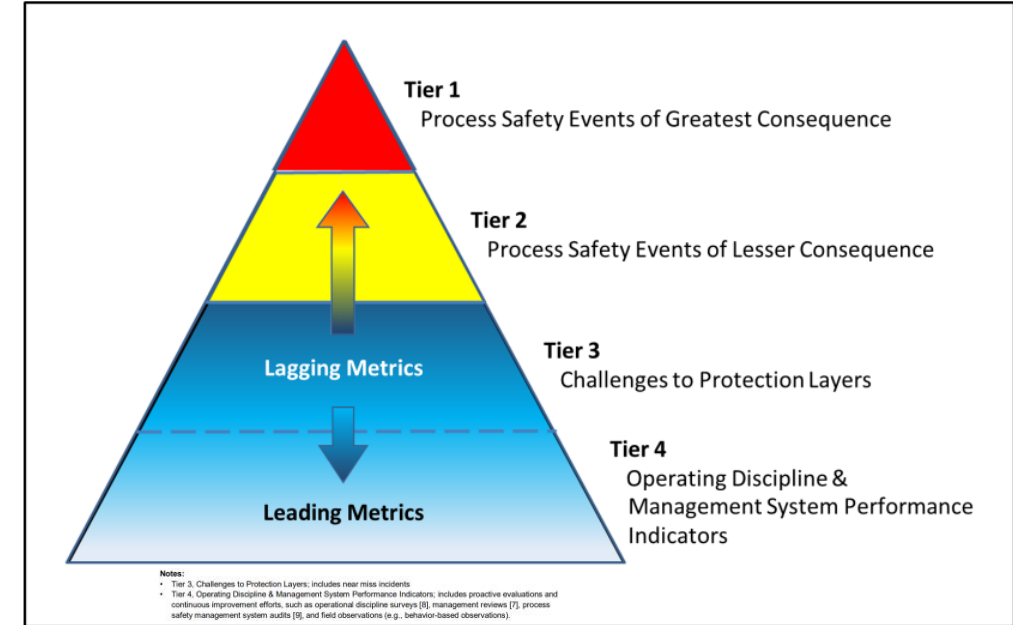
The reporting criteria are based on four impact areas:

- 1.Safety/human health consequences;
- 2.Direct cost due to damage from incident;
- 3.Community impact; and
- 4.Chemical release quantity

Many major disasters in the petro-chem industries started as an LoPC !



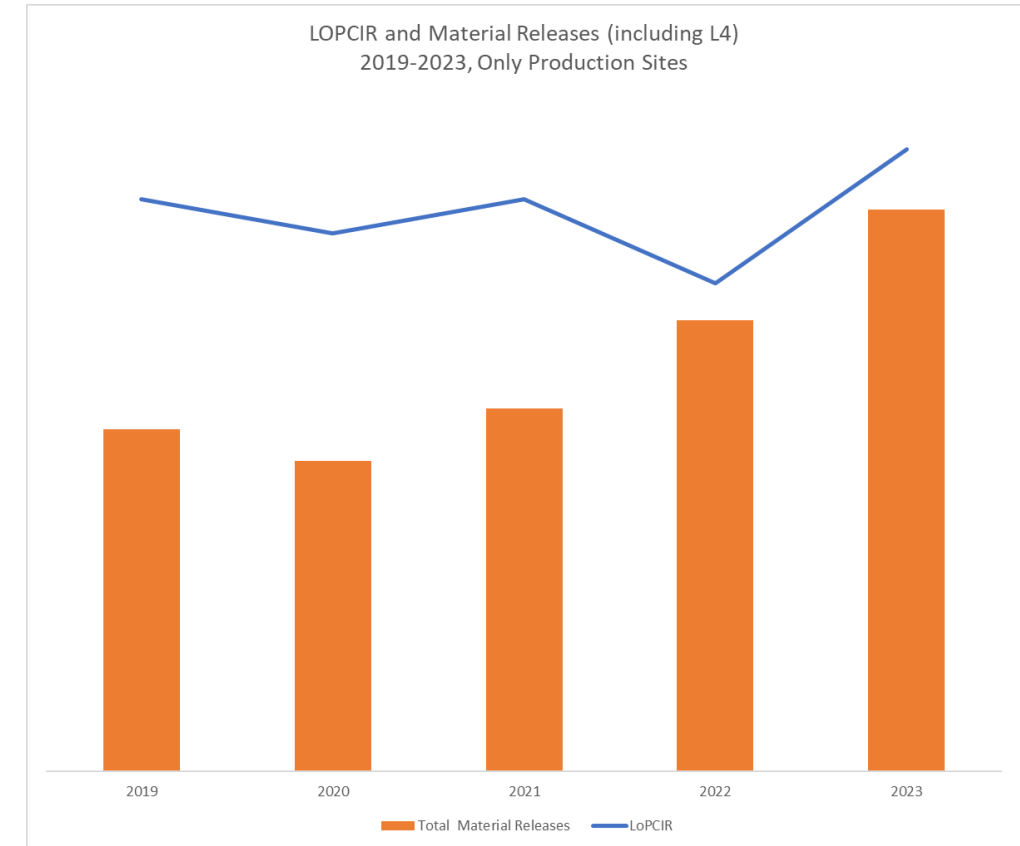
Process Safety Metrics: Guide for Selecting Leading and Lagging Metrics



- LoPCs and lesser spills generally indicate:
 - the organization has opportunities for improvement.
 - could be trending towards a severe process safety incident.

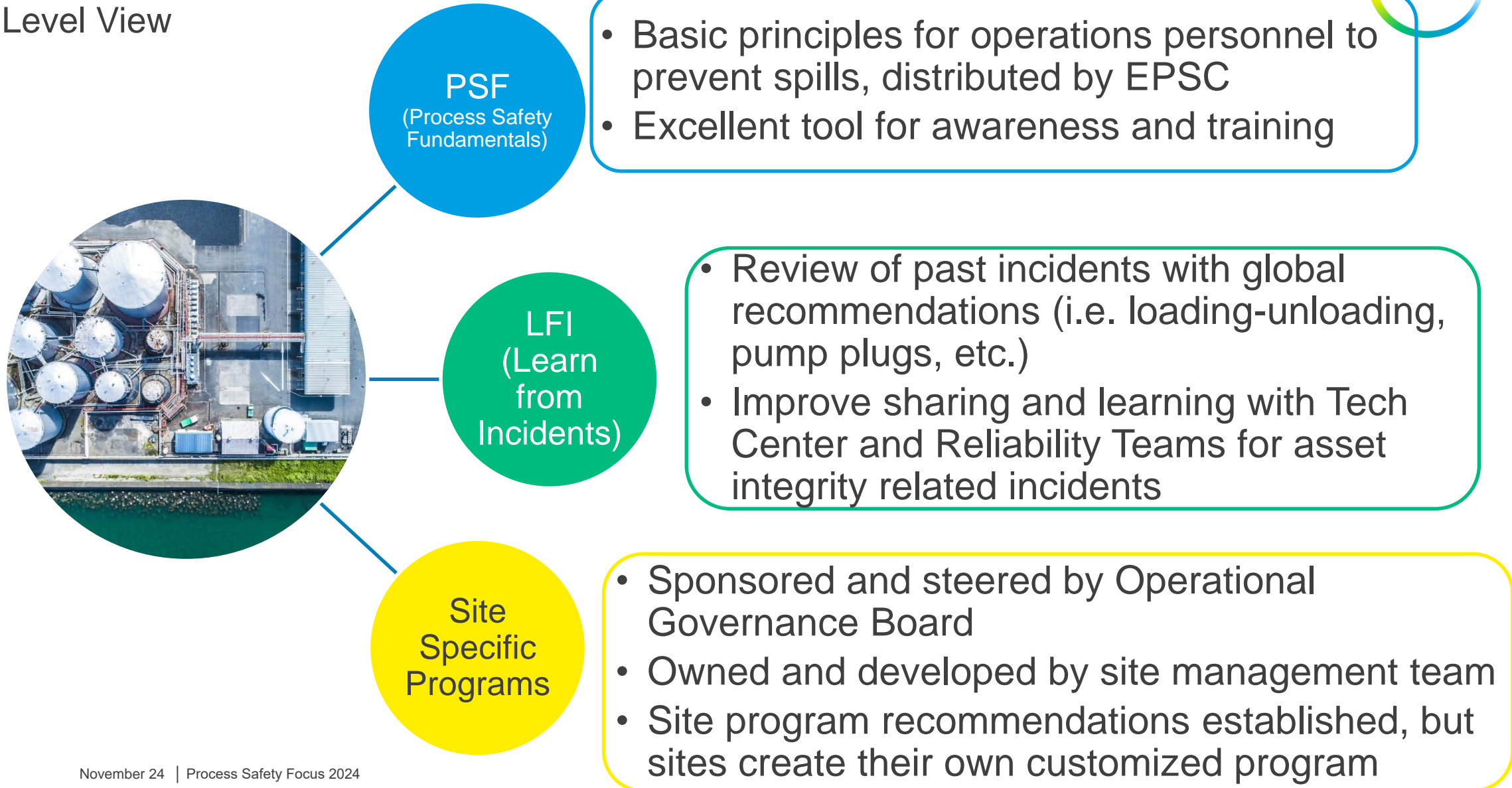
“Big Rock” Initiative for 2024

- Over past 5 years, we don't see improvement in the LoPC rate.
- Total material releases by year have gone up, mostly driven by Level 4 material releases (a leak or spill under the ICCA threshold for Loss of Primary Containment).
- Concerted efforts to improve reporting has driven up reporting of small spills; however, this has not translated into lower overall LoPC rates.
- Globally, Covestro will have an initiative geared towards lowering the LoPC incident rate.
- The causes of LoPCs are varied and complex and require a multitiered approach to improve.



LoPC Improvement Program

High Level View

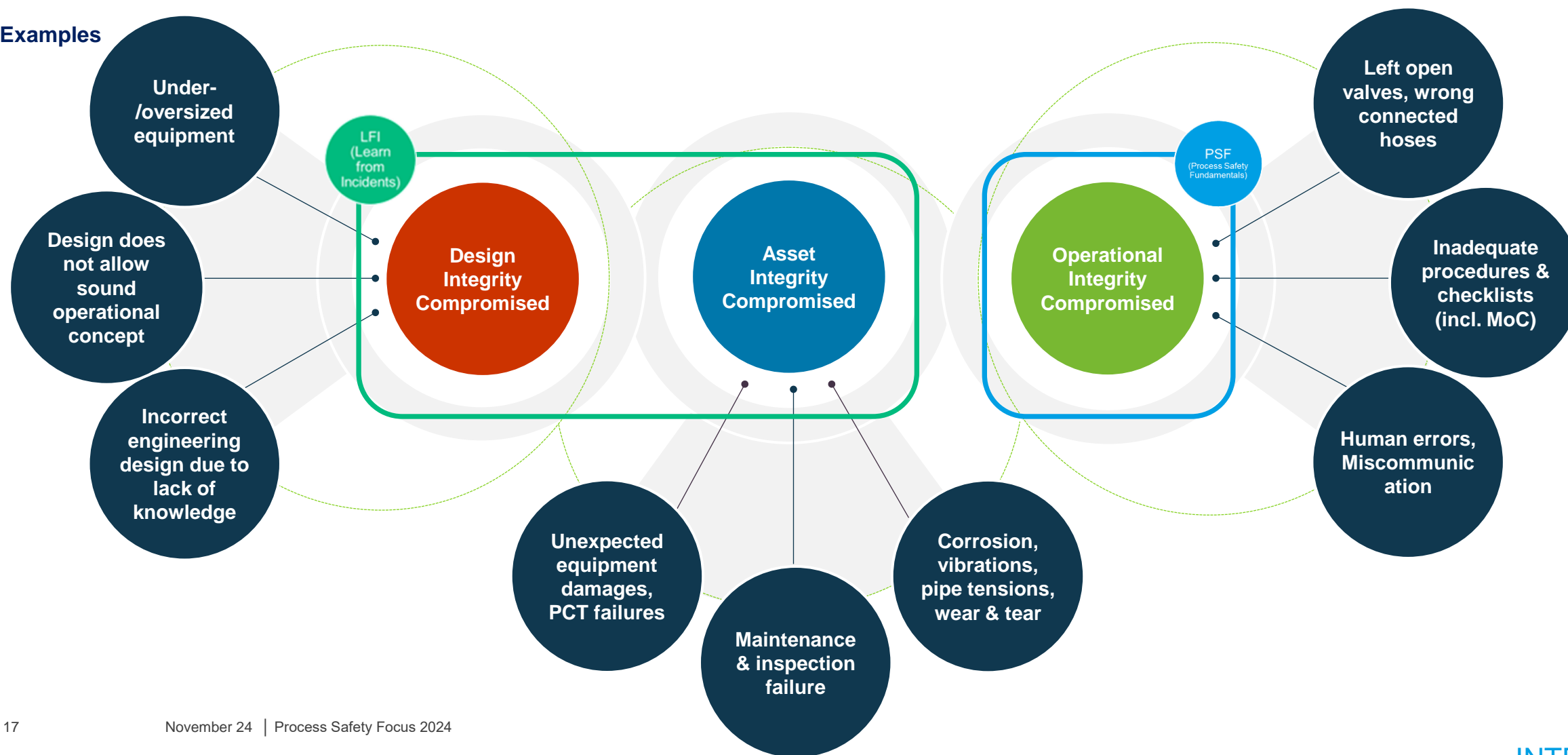


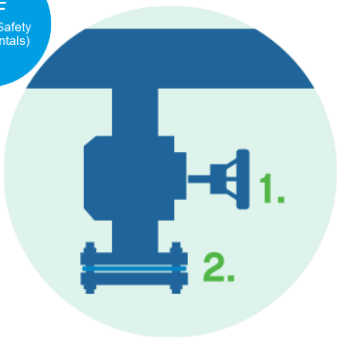
LoPC Incidents Analysis – Cause Categories



LoPC incidents occur when one or more of the following requirements are compromised

Examples





Apply double isolation



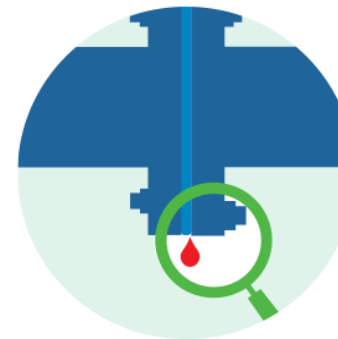
Empty and de-energize
before line breaking



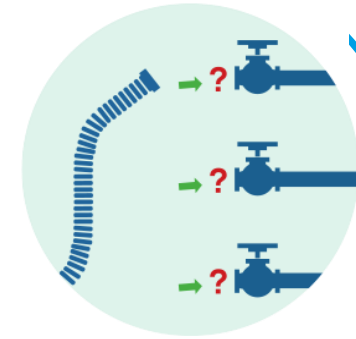
Verify the condition
of flexible hoses



Check explosive
atmosphere in fire boxes



Verify leak tightness
after maintenance work



Control (Un)loading



Monitor an open
drain



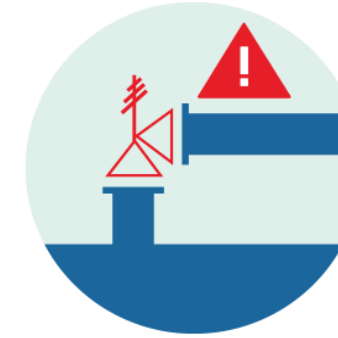
Operate within
safe limits



Manage overrides of
safety critical systems



Control unplugging of
equipment



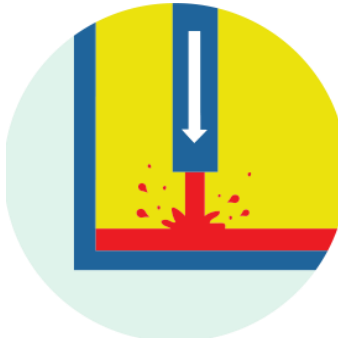
Report deficiencies on
safety critical equipment



Report process
safety incidents



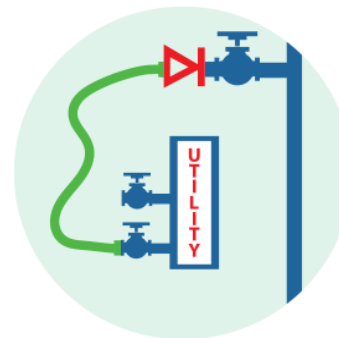
Avoid run-away
reaction



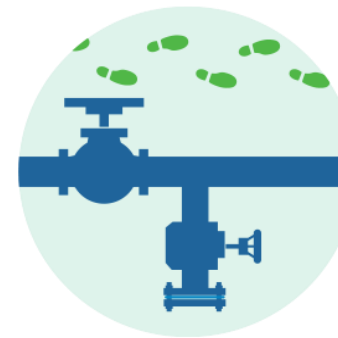
Avoid splash loading



Stay out of
the line of fire



Control utility
systems



Walk the line



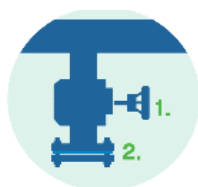
Avoid working behind
a single valve

Process Safety Fundamentals Walkthrough Guide



How to use this guide:

The following list contains **observable** conditions related to Process Safety Fundamentals during a plant walkthrough. Items marked with an asterisk (*) can be observed in the control room, while unmarked items are for field observations. These represent good practices, but their absence does not necessarily imply non-compliance, as requirements may vary across sites. If a good practice is missing, it presents an opportunity for open dialogue on that topic and potential improvement. This is not an exhaustive list, but rather a starting point for meaningful discussions on how Process Safety Fundamentals are implemented and lived day-to-day in the plants.



Apply Double Isolation & Avoid Working behind One Valve

Spill of hazardous materials can occur when a barrier fails, or is inadvertently opened, and no second barrier is in place.



Good practices to look for:

1. Drains, bleeds, and open process lines have a second barrier such as a second valve designed for isolation, plug, cap or blind.
2. Susceptible valves are locked or designed to prevent inadvertent opening.
3. Blinds have a proper gasket, correct bolts, and complete number of matching bolts.



Operate within Safe Limits

Hazardous reactions and releases or equipment damage can be caused when safe operating limits are exceeded.

Good practices to look for:

1. *A method of tracking the most critical safety parameters is established and clearly visible to the operators, for example Operator Monitoring Windows.
2. *Safety Critical Scenarios are accessible in the control room and known by the operators.
3. *Alarms and interlocks are established and visible to operators. Disabled alarms and interlocks are known to the operators and clearly visible in the control room.
4. Devices that are part of the safety concept are clearly labeled in the field, for example blue triangle tags.



Verify the Condition of Flexible Hoses

Hazardous fluids can be released due to hose failures.

Good practices to look for:

1. The hoses are labeled with materials of construction, design pressure and temperature, and inspection details.
2. The hoses are installed such that the following conditions are avoided: hose bends at the joint connection and tight bends that distort, bow, or kink the hose.
3. The hoses are properly stored: mild bend radius, hanging straight down, or lying flat.
4. The installed hoses are in visibly good condition: free of twists, cracks, corrosion, or bulges.

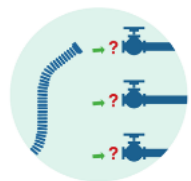


Walk the Line

Spills or inadvertent mixing might occur when the transfer line is not ready for operation due to open ended lines or drains, wrong valve opened, or tank line-up.

Good practices to look for:

1. Valves, including manual and drain, have labels that are easily observable by operators.
2. Pipes are clearly labeled and color coded with arrows indicating normal flow directions.
3. *Operators have access to up-to-date P&IDs (or isometrics) including redlined modifications.



Control (Un)Loading

Unexpected runaway reaction, formation of toxic chemicals, overfilling or loss of containment due to loading or temporary storage failures.

Good practices to look for:

1. Totes and drums are free from chemical residues, in good condition, properly labeled, and properly stored with adequate segregation based on chemical compatibility.
2. Logistics hose stations are free from chemical residues, labeled clearly, and have unique or color-coded connections for toxic and highly reactive chemicals.
3. A digital system for material verifications and compatibility checks is available in the field, for example: barcode scanning, digital line-up verification, inline or offline analytics.

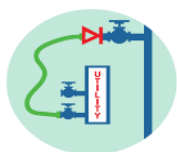


Empty and De-energize before Line-breaking

Uncontrolled release of energy or a hazardous material during the opening of piping or equipment.

Good practices to look for:

1. *A Lock Out Tag Out (LOTO) program is implemented with an organized LOTO station that is well-stocked with various lock out devices, labels, locks, and multi-craft hasps and boxes.
2. *A PPE board, which shows chemical and PPE combinations for line breaking and equipment opening, is located in the operations area.
3. Lock out points are clearly labeled (barcoded for e-LOTO) and accessible to the technicians.



Control Utility Systems Connected to a Process

When utility systems are temporarily connected with a flexible hose to a process, hazardous substances can flow back into the utility system.

Good practices to look for:

1. Safeguards are in place to prevent backflow of the process into the utility system, for example a non-return valve.
2. Utility hoses are rated and labeled for chemical compatibility, pressure, and temperature for the connected process conditions.
3. Utility hose and utility drop connections are unique to prevent the wrong utility connections.

Hoses connected to the process are labeled for their intended usage and duration

Forward-looking statements

This presentation may contain forward-looking statements based on current assumptions and forecasts made by Covestro AG.

Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future results, financial situation, development or performance of the company and the estimates given here. These factors include those discussed in Covestro's public reports, which are available on the Covestro website at www.covestro.com.

The company assumes no liability whatsoever to update these forward-looking statements or to adjust them to future events or developments.



THANK YOU FOR YOUR ATTENTION

Useful Practices

- EPSC working group “Human Factors” developed a collection of ‘useful practices’
- The useful practices are meant to help reduce human error through various technical and visual means
- **Proposal:**
 - develop team to gather and vet the ideas from across the company
 - Pair down existing list and add/replace with Covestro specific ideas
 - Utilize useful practices proactively and reactively (incident RCA or walkthrough observations)



FLANGE TIGHTENING TAG (FRONT)	FLANGE TIGHTENING TAG (BACK)
UNIT: _____	SYSTEM REQUIRES BOLT/ NUT REPLACEMENT? <input type="checkbox"/> YES <input type="checkbox"/> NO
EQUIP/ ID: _____	BOLTS and NUTS REPLACED? <input type="checkbox"/> YES <input type="checkbox"/> NO
DATE: _____	SYSTEM REQUIRES WASHERS? <input type="checkbox"/> YES <input type="checkbox"/> NO
LINE NO: _____	FLANGE FACE INSPECTED? <input type="checkbox"/> YES <input type="checkbox"/> NO
NOTE: _____	NEW GASKET INSTALLED? <input type="checkbox"/> YES <input type="checkbox"/> NO
SYSTEM REQUIRES USE OF TORQUE WRENCH? <input type="checkbox"/> YES <input type="checkbox"/> NO	BOLT, NUT, WASHER LUBRICATED? <input type="checkbox"/> YES <input type="checkbox"/> NO
TORQUE VALUE (ft.lbs) at: 30% 60% 100%	_____ PRINT NAME, DATE, SIGNATURE OF CRAFTSMAN
QA PART	QA PART
QC PART	QC PART

Cognitive Readiness Project implementation

Antonio Freitas
SSMA Braskem Alagoas



Cognitive Readiness Program

This presentation outlines the Cognitive Readiness Program for Program for the Alagoas Regional Braskem Vinyl Business. Business.

The Program is designed to enhance safety and operational efficiency efficiency by monitoring de fitness for service of industrial workforce. workforce.

A by Antonio de Pádua



Fitness for Service Assessment

The Cognitive Readiness program is designed to monitor the fitness for service of Braskem's workforce.

The program uses a mobile application to assess the cognitive skills of operators and technicians.

The assessment measures attention, perception, decision-making and memory of work, the results are used to determine the individual's cognitive readiness status.

The results are classified into three levels: green, yellow, and red.



Green Seal	Normal fitness for service Individual Capacity Within Standard
Yellow Seal	Slight Reduction in fitness for service Interview with the shift supervisor, and some critical activities cannot be performed
Red Seal	Significant Reduction in fitness for service Interview with the shift supervisor Restriction on performing activities in the field and at the control panel

COGNITIVE READINESS PROGRAM



The program has progressed through various phases.

The program began in 2020-2021.

In 2022-2023, the program was extended to whole regional AL

The program is continuous for regional AL

Program Highlights



Simple Assessment

The Cognitive Readiness Program uses simple, practical tests to assess user's mental alertness and cognitive function.



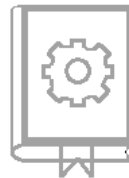
Quick Completion

The tests are designed to be quick, with an average completion time of just 2.2 minutes.



Personalized Feedback

After each assessment, users receive AI-generated feedback based in the current and previous performance.



Clear Instructions

Users receive detailed instructions before each test.

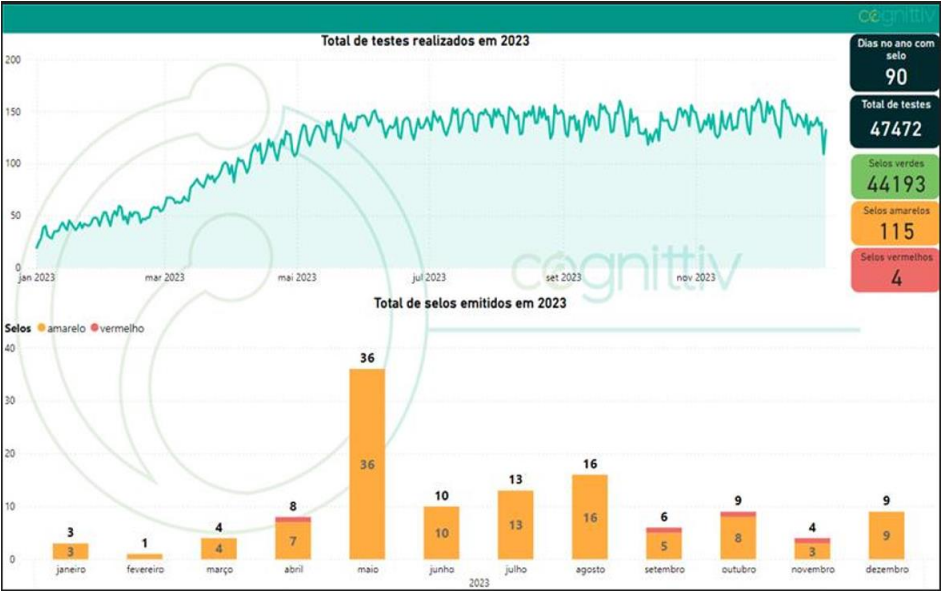


General Data



Number of participants	319 (95.5% adherence)
Functions of participants	Process operators, substation operators and laboratory technicians
Device access	Mobile phones or tablets
Average test time	2.2 minutes
Calibration time (baseline)	3 weeks
Test frequency	At the beginning of each shift
Red and yellow seals	A workflow is triggered, notifying shift and lab supervisors

Results – 2023 and 2024



Fitness for Service monitoring throughout 2023

47.3K
Tests

Number of tests conducted up to July.

115
Yellow

Seals identified by the App.

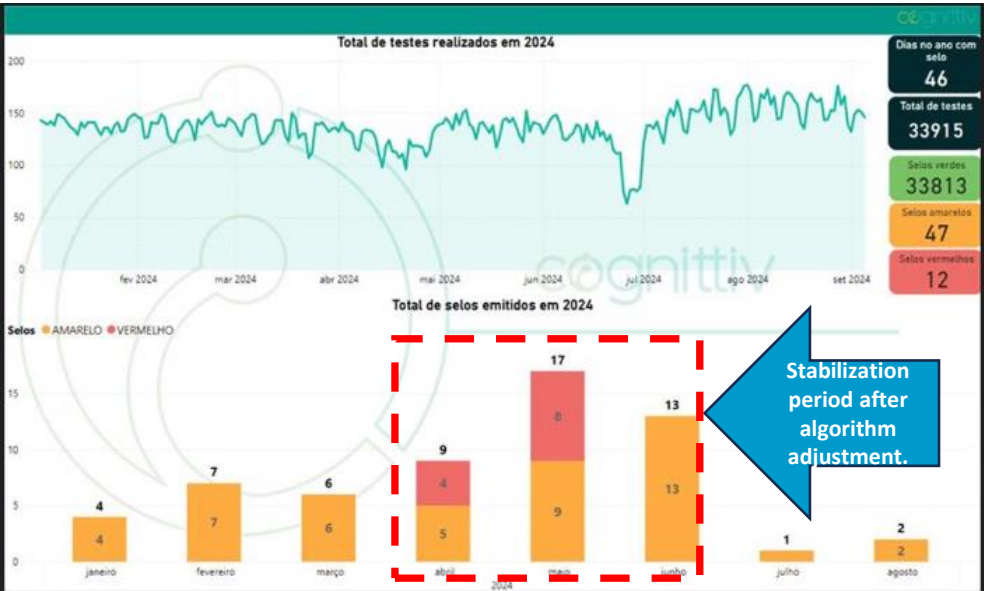
4
Red

Seals identified by the App.

0.35% -

87 days (24%)

Unpreparedness rate



Fitness for Service monitoring throughout 2024

42.3K
Tests

Seals identified by the App.

56
Yellow

Seals identified by the App.

0.16% -

52 days (17%)

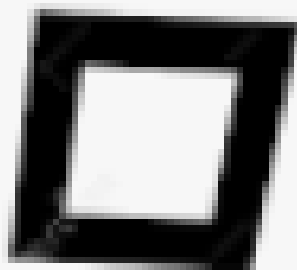
Unpreparedness rate

RESULTS

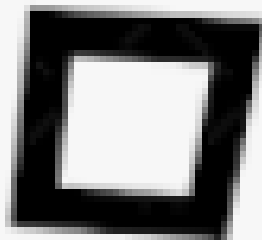
excellent



good



satisfactory



EXAMPLES OF UNPREPAREDNESS IDENTIFIED SCENARIOS

- The user received a red seal and perceived a reduction in his readiness. For example, an operator was grieving the loss of a close relative.
- The user got a red seal and did not perceive the reduction in his readiness. For example, an operator spent the night at the hospital with his son and believed He was fit to work.



Lessons Learned



Given that these are unconventional assessments involving sensitive data, it is crucial to involve the legal department to determine the legal boundaries the program can cover, thereby reducing the risk of legal vulnerabilities.



It is important to thoroughly explore during the planning phase what is expected from the program's implementation and to assess whether the supplier has ready-made solutions for the identified needs. Otherwise, a significant investment of time will be required to develop the solutions.



The program was initially defined as voluntary participation. However, after validating the App as reliable, we are planning to transition to mandatory participation, which reduces the effort needed to maintain engagement.



It is recommended to have kiosks and an electronic time filter for conducting the tests, so that users can perform the evaluation in a controlled and Appropriate environment, ensuring the representativeness of individuals' conditions at the start of their workday.



The protocol for cases of unpreparedness should be developed with the participation of personnel from the involved areas, ensuring better management of potential absences during work shifts and mitigating the risk that the absence outweighs the benefits obtained from the program.



Since this is a new topic with limited application in industrial environments, it is important to have a robust training process and continuous communication with participants and leadership, ensuring that the benefits are understood and reducing the risk of mistrust and loss of engagement.



Conclusion

Program Benefits

The Cognitive Readiness Program is a valuable tool for improving safety across the company.

- The app helps assess work readiness.
- The program has positively impacted operator behavior.
- Safety results in Alagoas have reached historic highs.

Program Success

Operator feedback indicates a high level of satisfaction with the the program.

- 96% of participants believe the the program contributes to their performance improvement.



Antonio de Pádua A. de Freitas

ESH MANAGER

T. +55 11 3177 5322 Cel +55 82 9 9973-6003



Thanks!

Braskem acknowledge the valuable contributions and participation of all team members involved with this Program.

Chlorine Water Hydrates



JJ Hiemenz
Technology Director for
K2 Pure Solutions



Chlorine Water Hydrates

- Chlorine/Water hydrate basics
- Conditions in which they form
- Locations in the process they might form
- Possible process safety issues when they do form

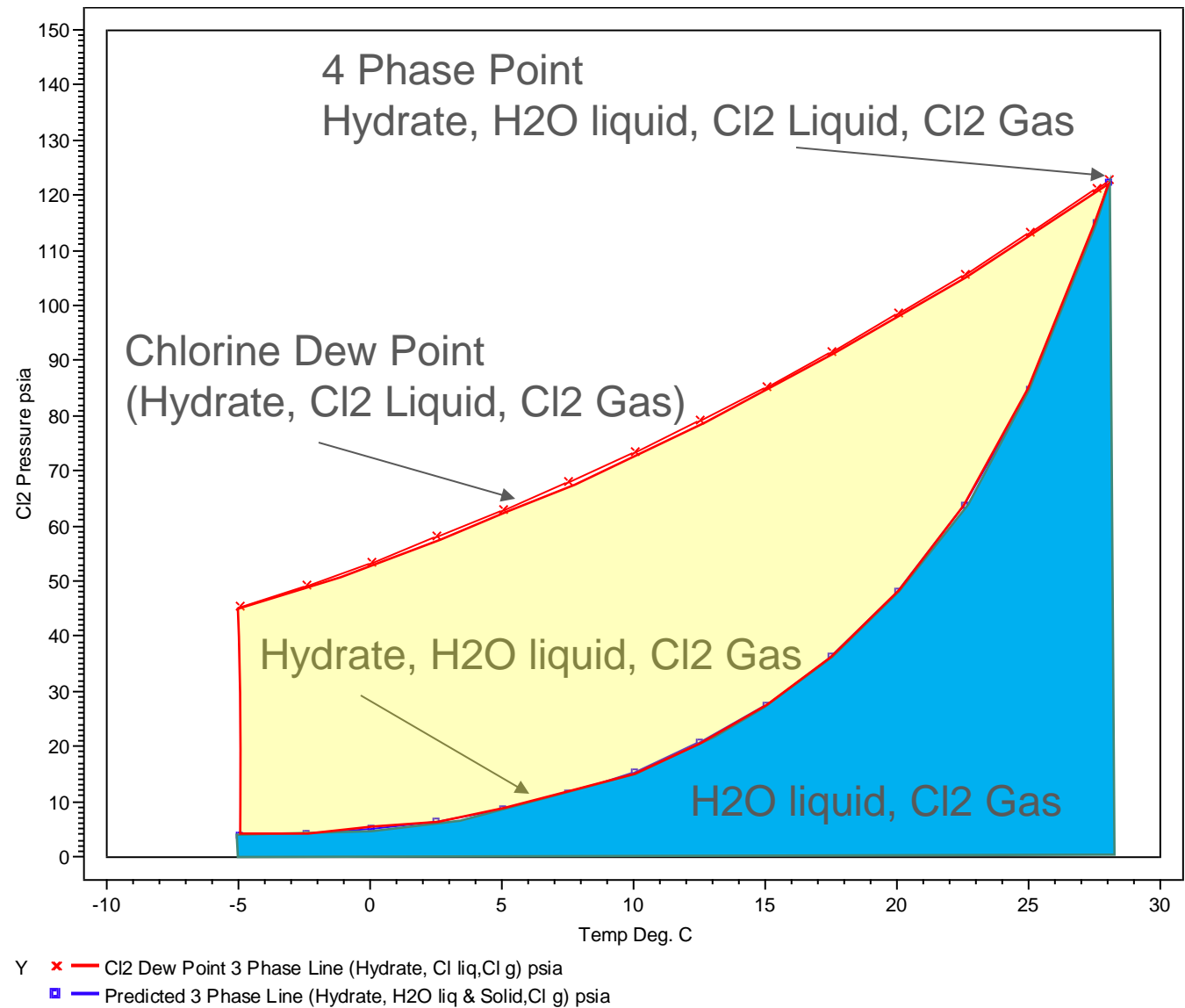
Chlorine/Water Hydrate Basics

- Can form an ice mixture of chlorine & water when liquid water is present and the right temperatures & pressures exist
- Takes up more volume than liquid water or ice would by themselves
- The temperature this happens at is a function of the chlorine pressure
 - Generally the higher the pressure the higher the hydration temperature
 - Right up until 28 Deg. C, after which it does not form
- CI Pamphlet 155 guidance:
 - Chlorine hydrate, a greenish ice-like substance ($\text{Cl}_2 \cdot 8\text{H}_2\text{O}$), may form as crystals below 49.3°F (9.6°C) at atmospheric pressure.
 - Chlorine hydrate can also form at higher temperatures if the chlorine is at an increased pressure.
 - These crystals can interfere with the proper operation of chlorination systems.

Conditions In Which Chlorine Water Hydrates Form

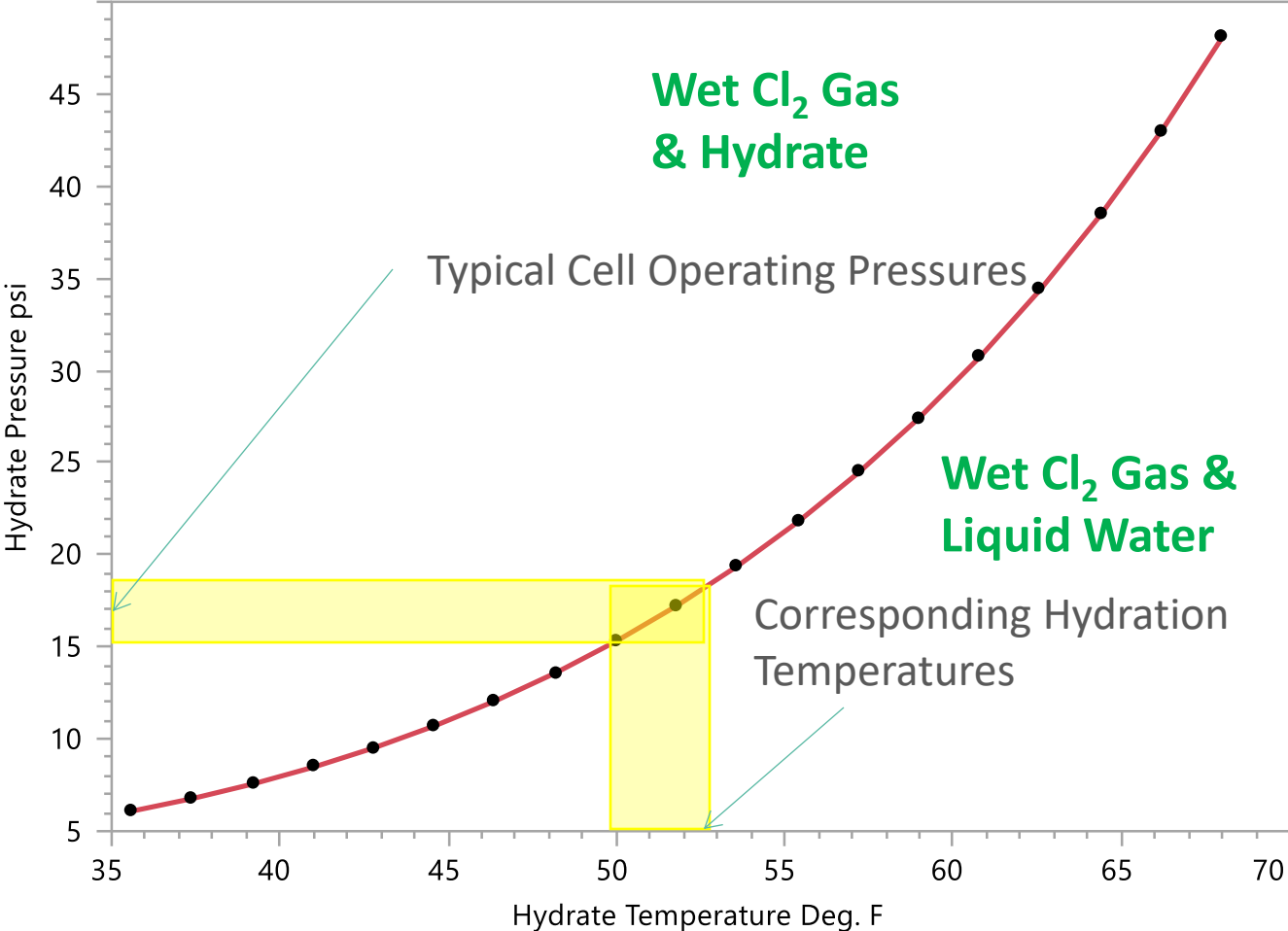
- Chlorine gas & liquid water present
- Not a single point
- Proper conditions vary with temperature & pressure

Chlorine Gas Saturated With Water



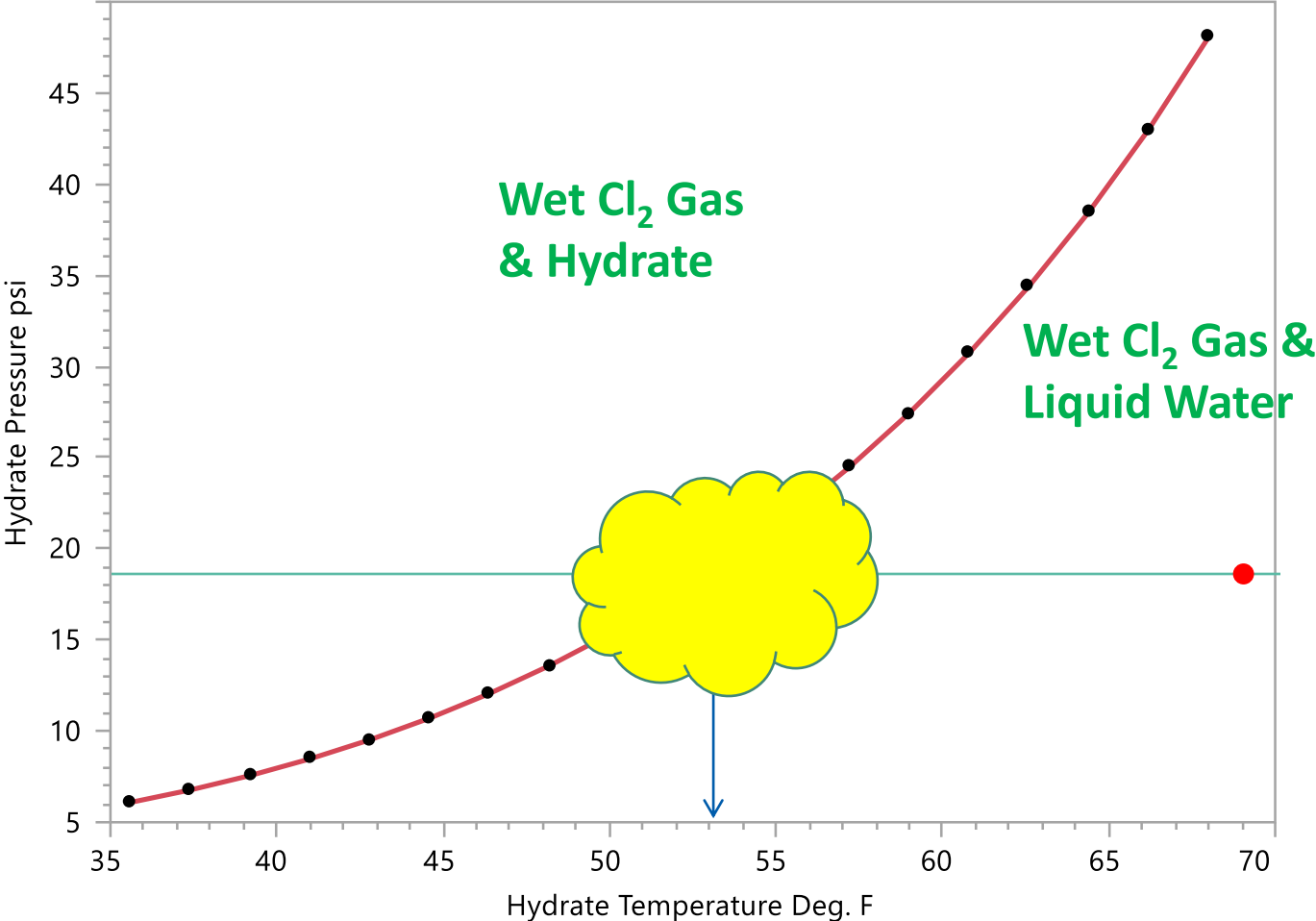
Wet Chlorine Hydration Conditions

Overlay Plot



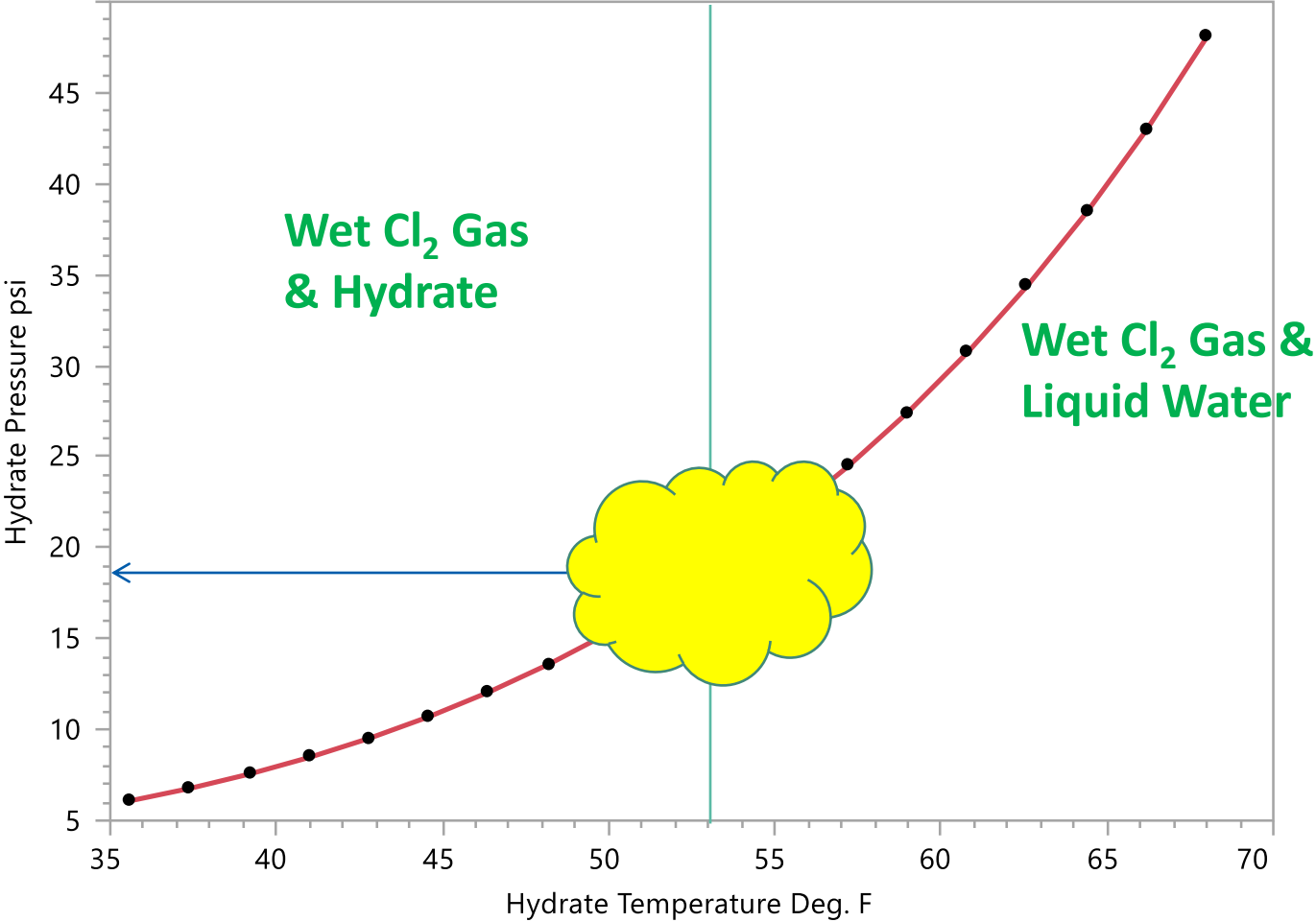
Wet Chlorine Hydration Conditions As Temperature Drops

Overlay Plot



Wet Chlorine Hydration Conditions As Pressure Rises

Overlay Plot



Where In Process Might They Form?

- EVS/Vent Conditions
 - EVS lines
 - Liquid water & chlorine present
 - Colder temperatures around 50 Deg. F or less
- Cell Gas Pressures
 - Cell Gas pressure relief or control valves
 - Main gas cooling
 - Lines leading to other unit operations such as Hypo Units or HCl Synthesis
 - Chlorine suction chillers (if moisture is present)
- Elevated Pressures
 - After blowers or wet gas compressors
 - As gas cools hydrates can form at normal ambient temperatures

Possible Process Safety Scenarios

- Plugging lines/equipment resulting in backpressure or overpressure of cells
- Plugging or interference with instrument signals resulting in overpressure or flow imbalance
 - Flowmeter taps plug & read incorrectly – could be significant issue where flows need to be accurate & responsive (Example: HCl Burner)
 - Pressure taps plug & read incorrectly – could be significant issue for pressure control

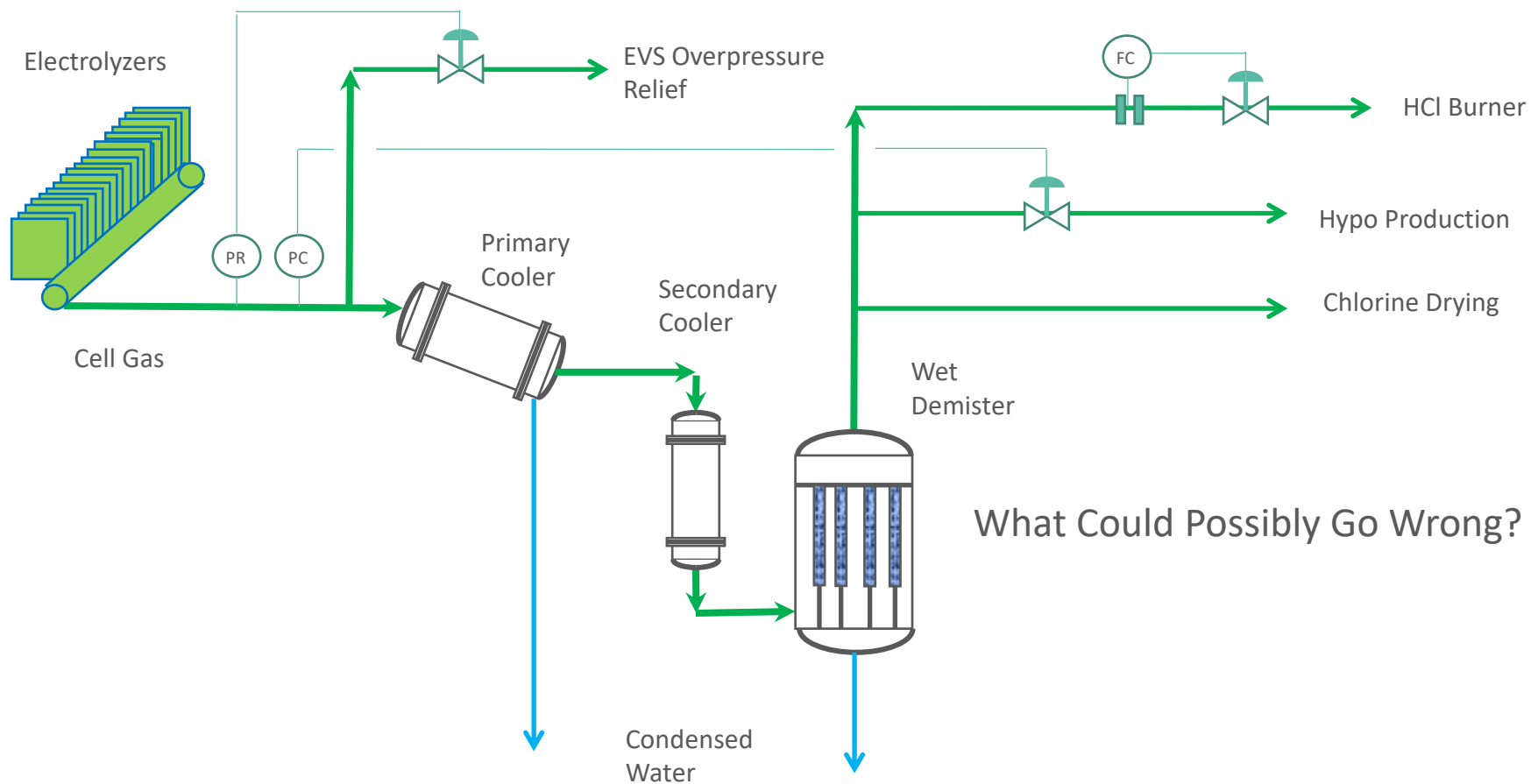
Bad Night In The Chlorine Plant...

It was a pretty rough night. We had to shutdown the HCl burner, back pressured the wet gas system & tripped the electrolyzers on overpressure.... On the bright side we did learn quite bit about chlorine/water hydrates

Other than that it sounds like you had a successful night.



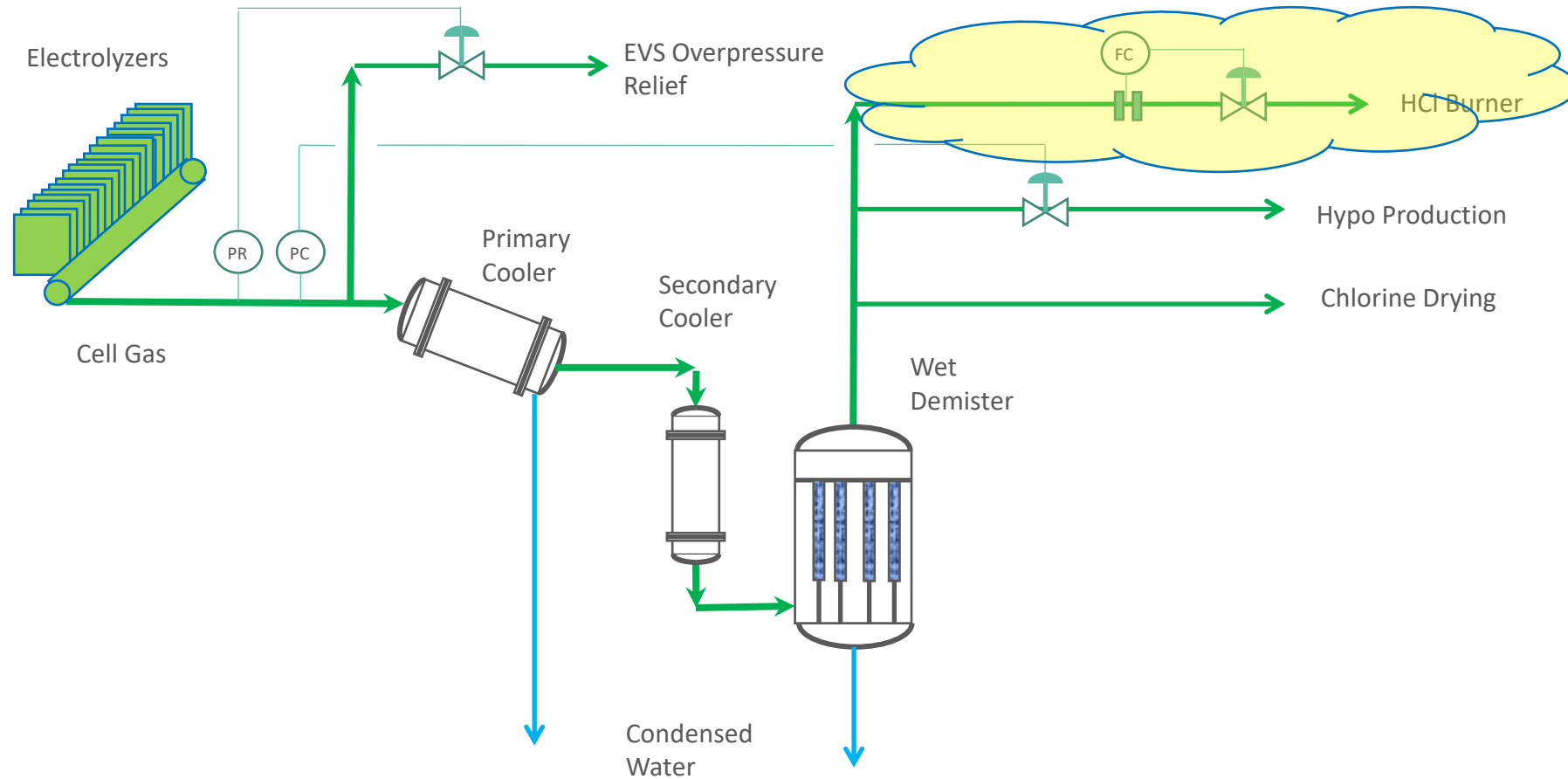
Super Cool Cl₂ Plant Layout



Bad Night Ahead

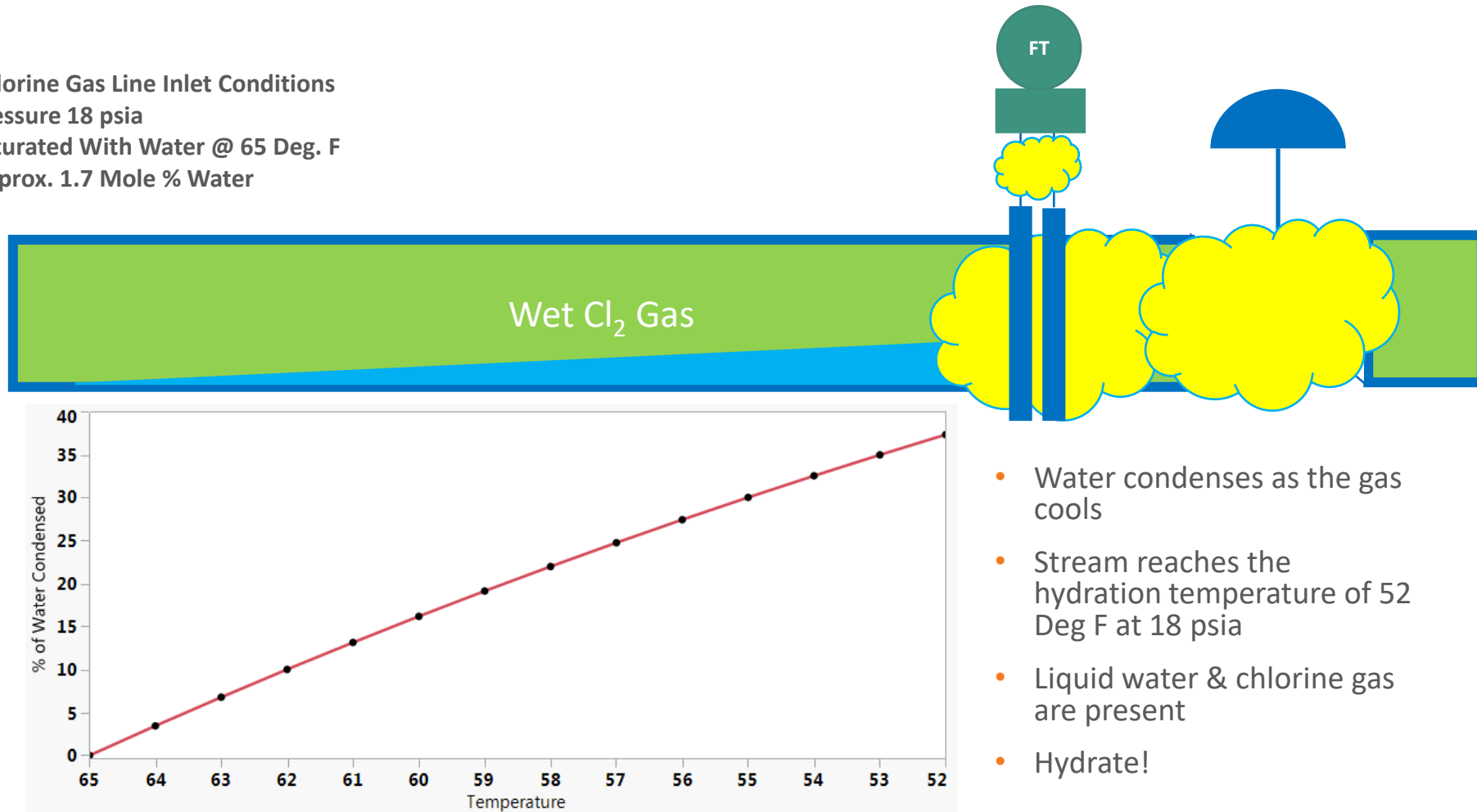
- Expecting cooler conditions, temperatures dropping into the low 40's
- Having difficulty controlling the cooling tower water temperatures above 60 deg. F
- And then the problems start....
 - Started having trouble controlling the chlorine flow to the HCl burner
 - Flow indication swinging & control valve swinging
 - Had to shutdown the burner

Problems With The Cl₂ Flow To The Burner



Wet Cl₂ to HCl Burner Problems— What Exactly Happened

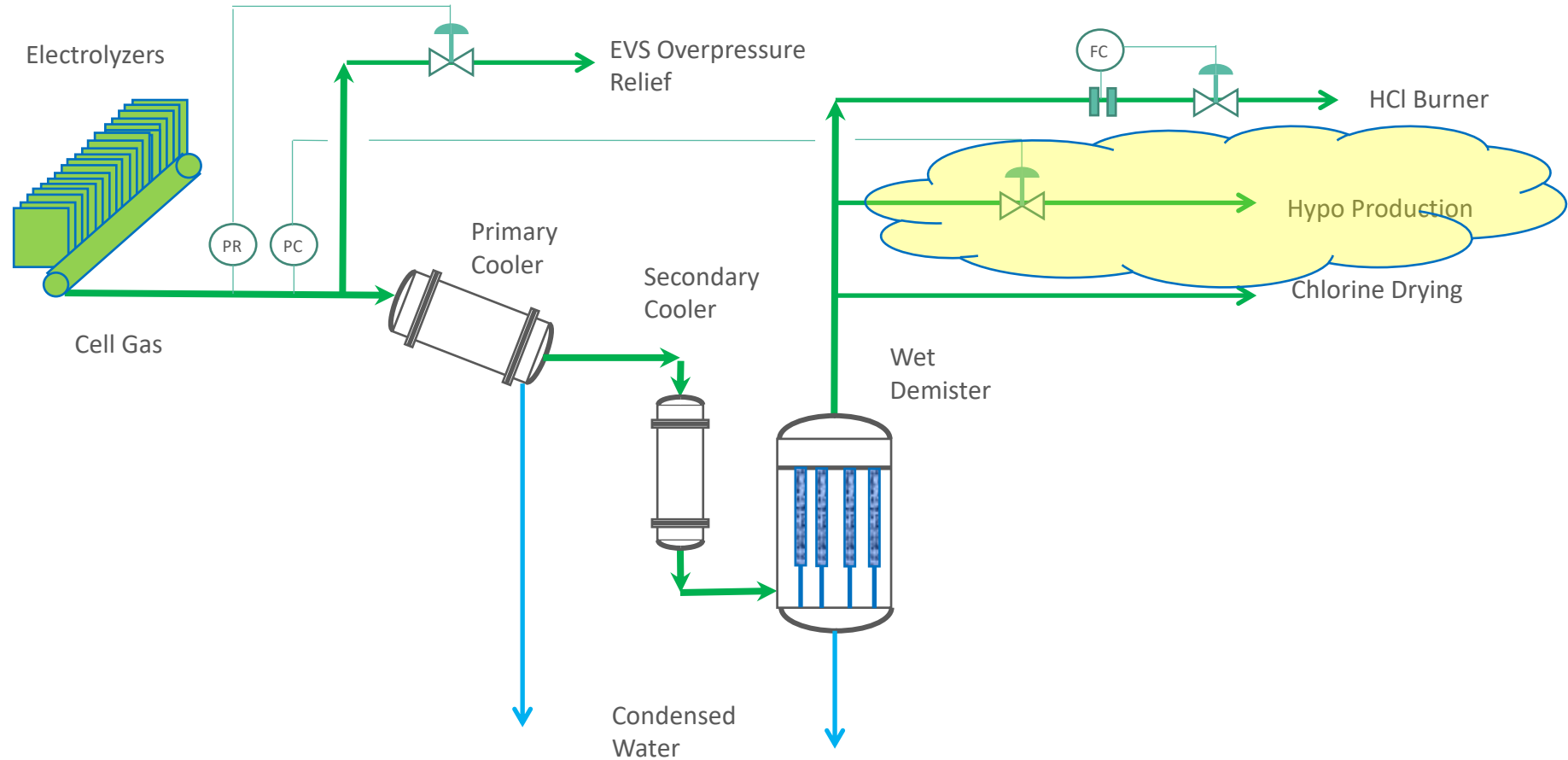
Chlorine Gas Line Inlet Conditions
Pressure 18 psia
Saturated With Water @ 65 Deg. F
Approx. 1.7 Mole % Water



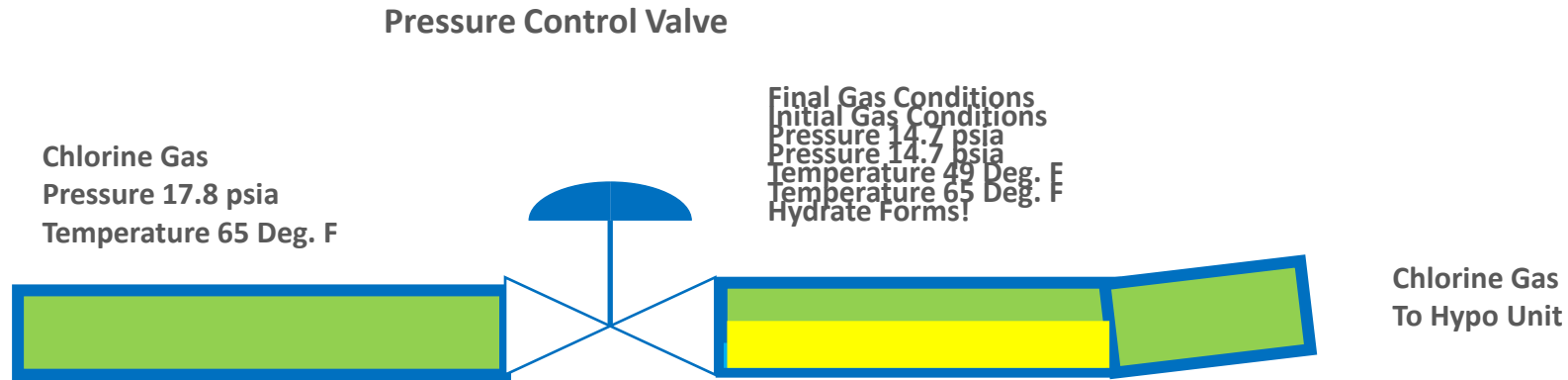
And The Bad Night Continues...

- After shutting down the HCl Burner the chlorine flow that was going to the burner needed to be diverted to the Hypo unit to control the Cl_2 HDR pressure
- As luck would have it the flow going through the line to the Hypo unit was very low due to low Hypo demand
 - Line temperature fairly cold due to low flow
 - May not be completely free of water pockets
 - The pressure controller opened up but chlorine pressure continued to rise
 - Electrolyzer rates had to be reduced to lower the chlorine HDR pressure

Problems With The Wet Gas Pressure Control To Hypo



Wet Cl₂ to Hypo Pressure Control Problems– What Exactly Happened?

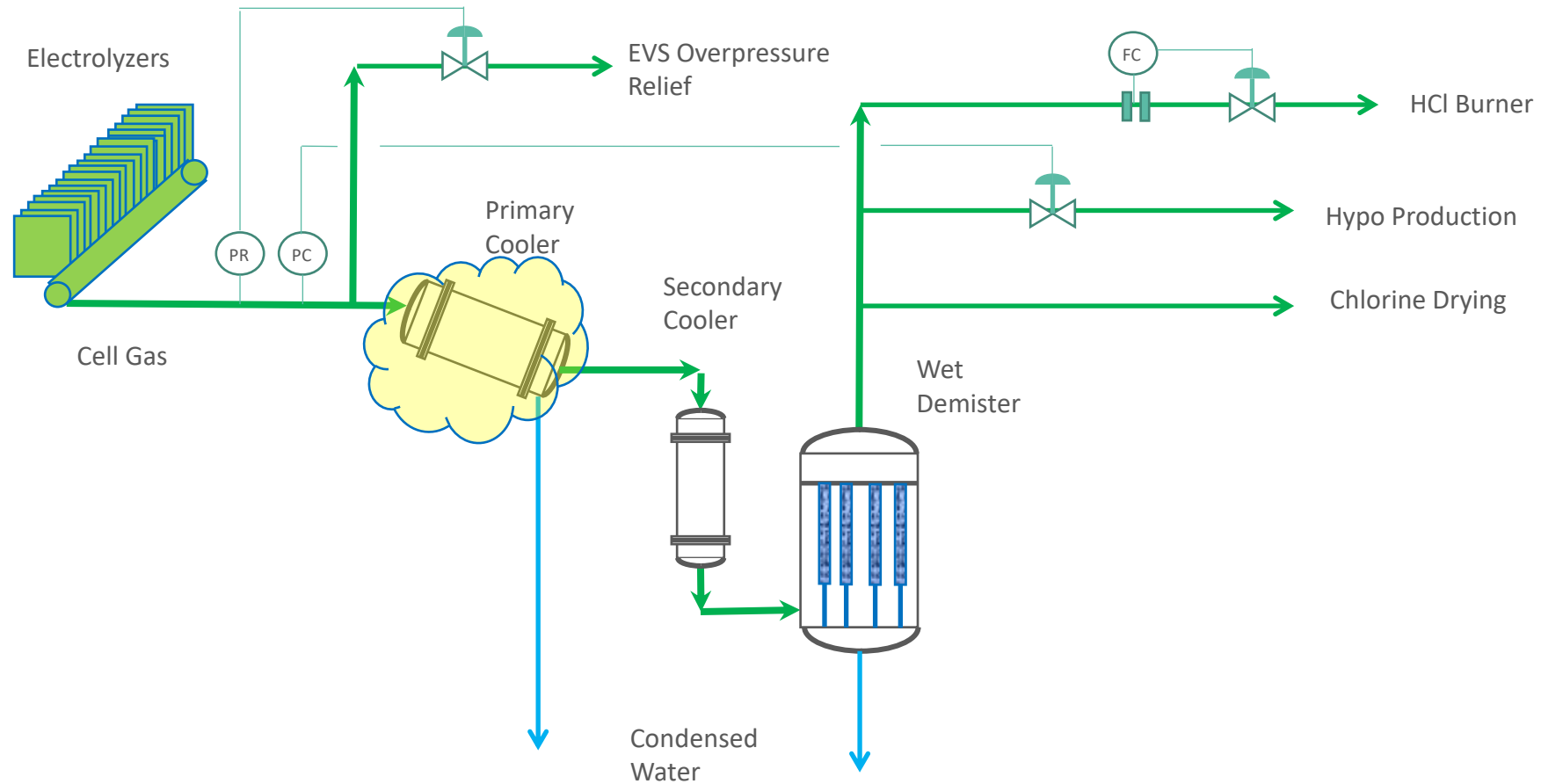


- Line downstream of control valve may always contain some water
- Normally not a problem
- Except the flow was low allowing the line to cool down to ambient conditions
- And ambient conditions happened to be below the hydrate conditions
- Hydrate restricts the flow preventing the gas pressure control to be effective

Bad Night Continues... It Just Gets Worse

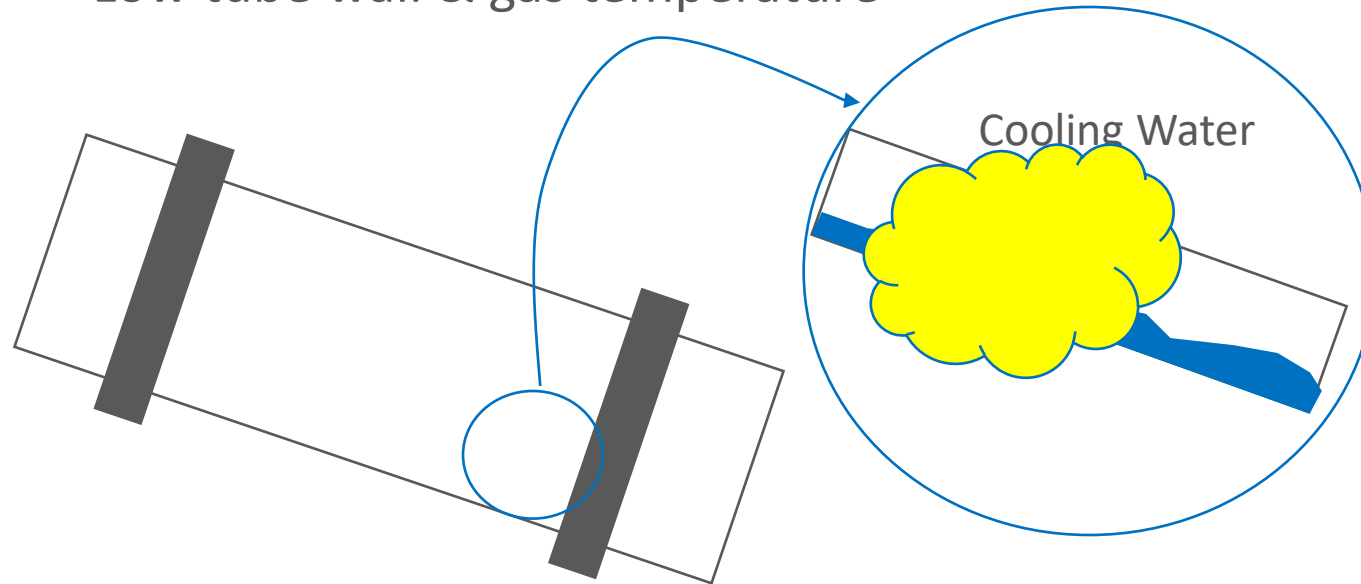
- As a result of shutting down the HCl burner & reducing rates on the electrolyzers the load on the cooling tower dropped significantly
- The cooling tower water temperature struggling to remain at 60 Deg.F dropped precipitously to around 50 Deg.F
- And now the chlorine header pressure is beginning to rise again!

Problems With Back Pressure Associated With The Primary Cooler



Problems With The Primary Cooling Causing The Cell Header Pressure to Rise

- Cooling water temperature dropping to 50 Deg. F due to reduced load
- Reduced electrolyzer load also through the primary cooler
- Low tube wall & gas temperature

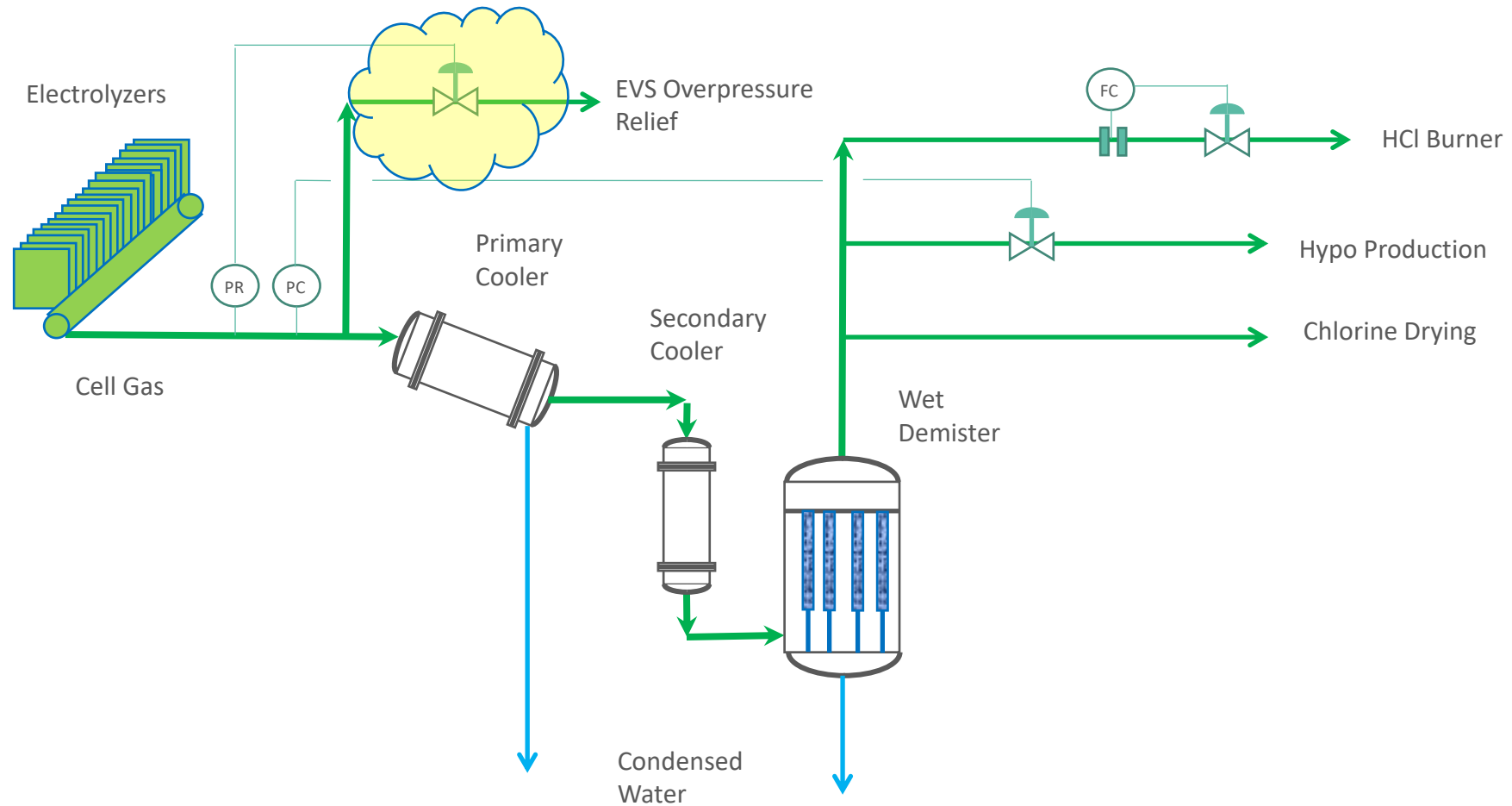


- Gas temperature may not even need to be at hydration point as long as the liquid temperature is
- Condensed water runs down the bottom of the tube
- Hydration occurs causing cell HDR backpressure

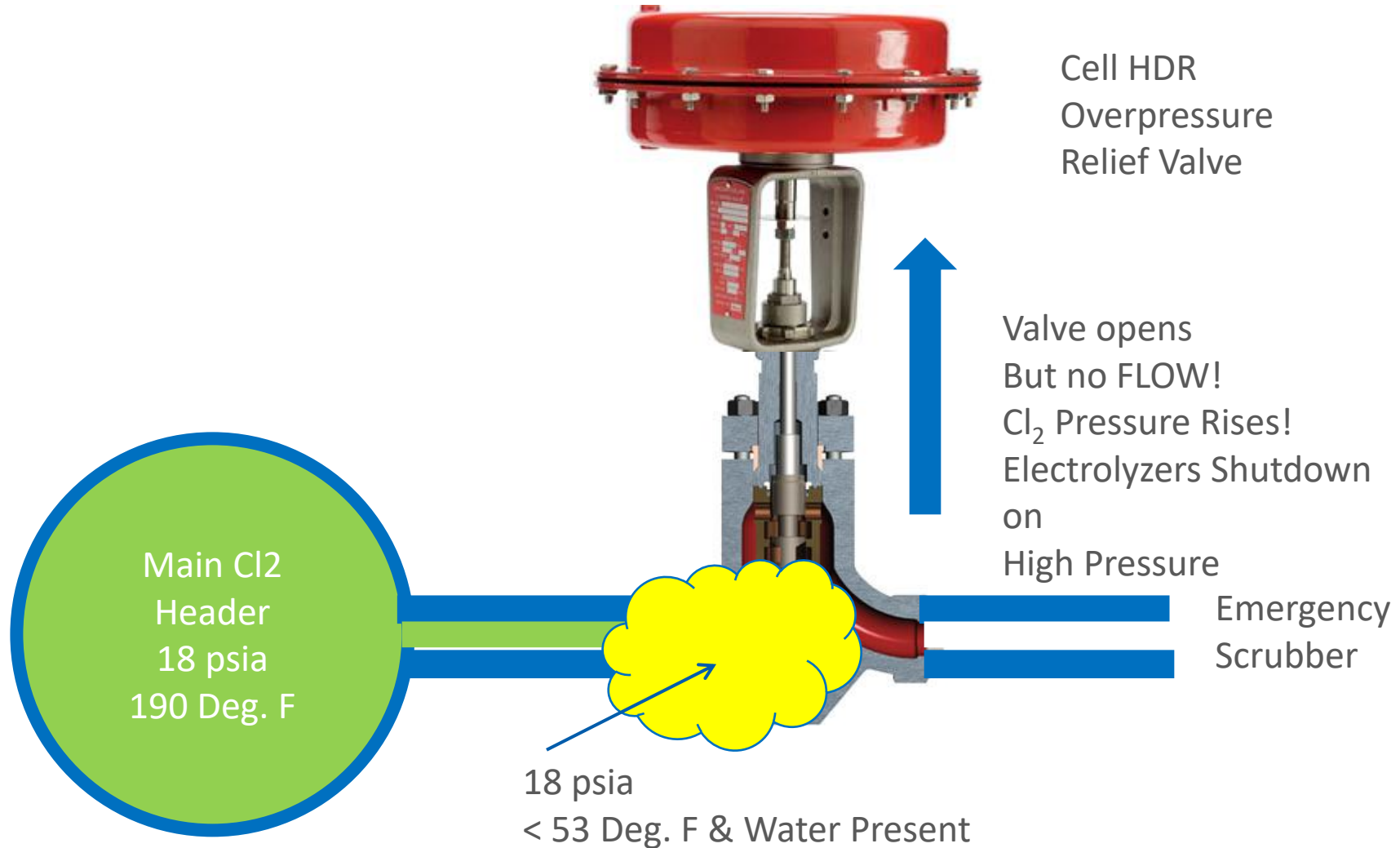
Bad Night Continues... Really!


- In response to the chlorine/water hydrate on the primary cooler causing backpressure the electrolyzer overpressure valve on the main header begins to open
- Remember it is kind of a cold night....
- Remember that the chlorine/water hydration temperature rises as the pressure rises
- The overpressure valve opened & the chlorine pressure still kept rising
- Electrolyzers/Plant shutdown on high cell HDR pressure. Problem solved!

Problems With The Cell HDR Overpressure Relief Valve



Cell HDR Overpressure Relief Valve Problems





Summary Of The “Bad Night” At The Chlorine Plant

- This was NOT a real incident, although anyone with plant operations experience would believe this could happen
- Individual scenarios are mostly fictional but all have their basis in fact from the past incidents throughout the years
- Hopefully these don't happen in any of your units, especially not all at once as they unfolded here!
- These are only a few of the process safety possibilities involving chlorine/water hydrates
- Perhaps you can think of more?

Path Forward

- If this presentation has peaked your interest, I encourage you to take a fresh look at your facilities armed with:
 - Knowledge of the Hydration temperature & pressure relationships
 - Particular attention & focus on areas within your wet chlorine processing where water could accumulate
- From a CI perspective maybe little more fleshing out of chlorine/water hydrate process safety issues might be in order

Chlorine Water Hydrates

Questions?

Annual Safety Seminar 2024

Thank you for your participation!

Please contact tva@cefic.be in case of questions

18 November 2024

