13th Chemical Process Safety Sharing (CPSS)

Digitalization for LOC prevention (IOW)

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- How to set up IOW?
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Why GC Implement IOW?

- IOW is a system to **prevent loss of containment from unexpected equipment degradation**.
- Initially GC implemented OPW by using SHELL method and updated to be Integrity Operating Window (IOW) according to **API RP584** since **2021** and **now complete roll out** to 23 plants.
- IOW consists of **3 levels: Critical IOW, Standard IOW, Informational IOW.**

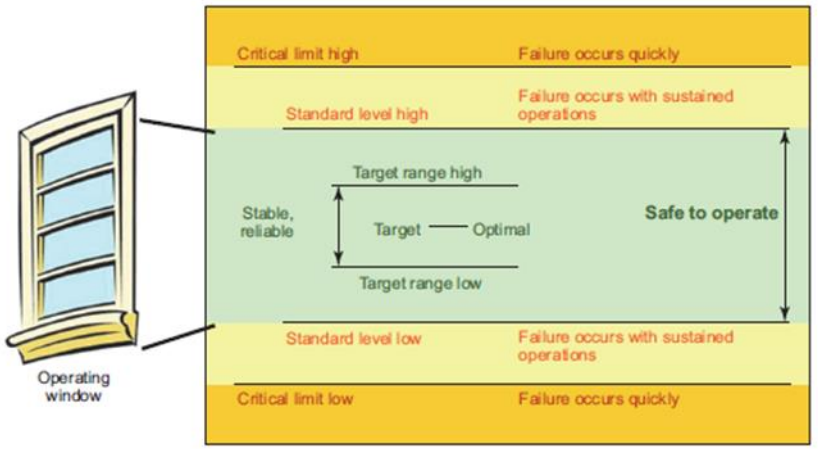
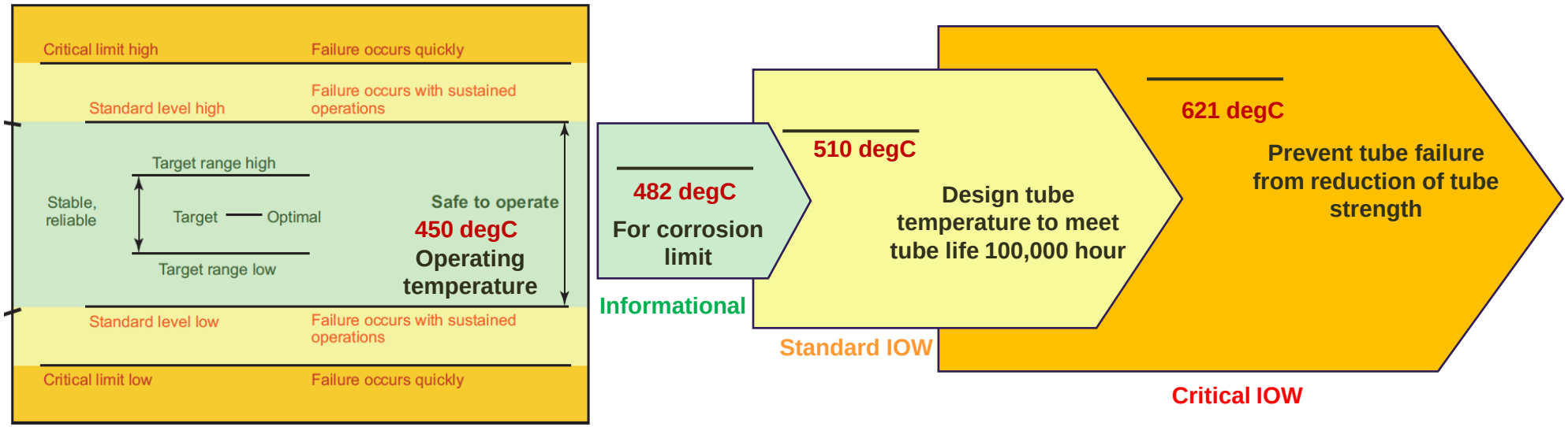


Figure 1—Zones of Operation Including Target Ranges with Standard and Critical Limits

- **Critical IOW Level:** That point at which an operator has the last opportunity to respond before **rapid loss of** primary **containment** may occur
- **Standard IOW Level:** That point above which sustained operation could cause **cumulative damage** possibly resulting in eventual loss of primary containment or **impact the long-term** unit performance and it's ability to meet turnaround run length expectations
- **Informational IOW Level:** Points that define stable, reliable, and profitable operations

Integrity Operating Window (IOW)

Example : Setting IOW of Heater Tube Temperature



How to set up IOW?

IOW Review

Develop
Tracking sheet

IOW Monitor

Out of IOW
Raise
incident

Review parameter every
Turnaround inspection

How to set up IOW?

IOW Review

Review team: - Process engineer - Operator - Inspector engineer - Safety engineer -Corrosion engineer

IOW limit setup:

1. Define **design and operating condition**
2. Identify **potential damage mechanism**
3. List all **process parameters** that could affect each identified damage mechanism
4. Set **upper and/or lower limits** above unacceptable range of each damage mechanism
5. Evaluate **risk**
6. Determine **LEVEL of IOW** for each parameter
7. Assign **response time and actions** case of excursion

How to set up IOW?

1. Define **design and operating condition**

Feed effluent exchanger Normal operate 360-405 DegC

2. Identify **potential damage mechanism**

Thermal fatigue due to dissimilar welding

3. List all **process parameters** that could affect each identified damage mechanism

Temperature

Example

Feed Effluent Exchanger

4. Set **upper and/or lower limits** above unacceptable range of each damage mechanism

Max 455 DegC (refer to RBI study)

RBI = Risk Based Inspection

5. Evaluate **risk**

Shell side damage (nozzle leak), feed loss of containment potential to unit shutdown

6. Determine **LEVEL of IOW** for each parameter

Risk = High Critical IOW

7. Assign **response time and actions** case of excursion

-Reduce feed and reduce reactor temperature
-Set alarm 410 DegC

How to monitoring and prevent LOC?

IOW Review

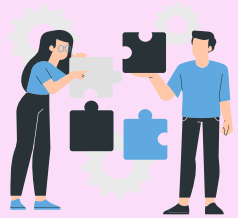
Develop Tracking sheet

IOW Monitor

Operator monitor by running tracking sheet every 12 hrs

Critical IOW hit limit

1. Operator immediately adjust to return variable back within the normal IOW level.
2. Shift manager raise incident investigation report.



3. Full incident investigate including Corrective Actions are developed to prevent future occurrences.

OPERATING WINDOW FOR PLANT XX / Area XX

Start time:	9/16/22 6:00 PM
End time:	9/17/22 6:00 AM

Note: Incident investigation report shall be raised when exceeding Critical IOW Parameters

	Input Day "D" or Night "N"
Date	16-Sep-22 N
Shift	B

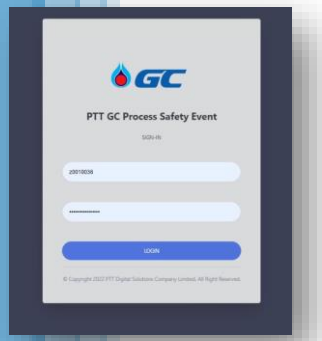
Description	Tag No.	Unit	Critical IOW Min.	Critical IOW Max.	Standard IOW Min	Standard IOW Max	Information IOW Min	Information IOW Max	Average 12 HR	Min value	Max value	Current value	Status	Action guideline
Depropanizer (C-xxx)														
OHVD Vapor Flow rate		kg/h		55000.00					54000.00		56000.00	56000.00	Outside Critical IOW	
Tower Delta Pressure (Upper)		KSCG	0.10	0.20	**0.12**	**0.18**		**0.10**	0.17	0.11	0.17	0.15	OK	
Tower Delta Pressure (Upper)		KSCG	0.10	0.20	**0.12**	**0.18**		**0.10**	0.15	0.13	0.17	0.13	OK	
Tower Delta Pressure (Mid)		KSCG		0.15		**0.14**			0.13		0.17	0.17	Outside Critical IOW	
OVHD Pressure		KSCG		18.90		**21.00**		**21.00**					Outside Critical and Standard IOW	
OVHD Temperature		oC	25.00	215.00	**15.00**	**225.00**	**15.00**	**225.00**					Outside Critical and Standard IOW	
BTM Temperature		oC	25.00	215.00	**15.00**	**225.00**	**15.00**	**225.00**					Outside Critical and Standard IOW	

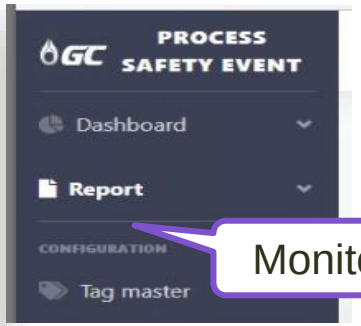
What digitalization can improve IOW?

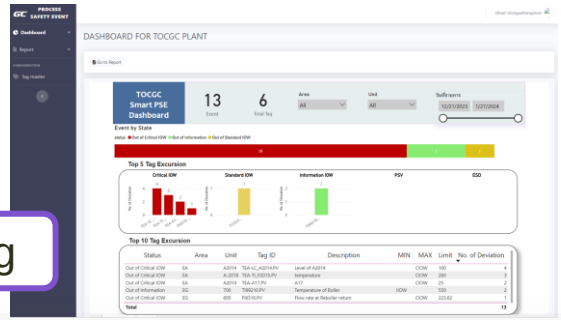
Digital improvement system gap

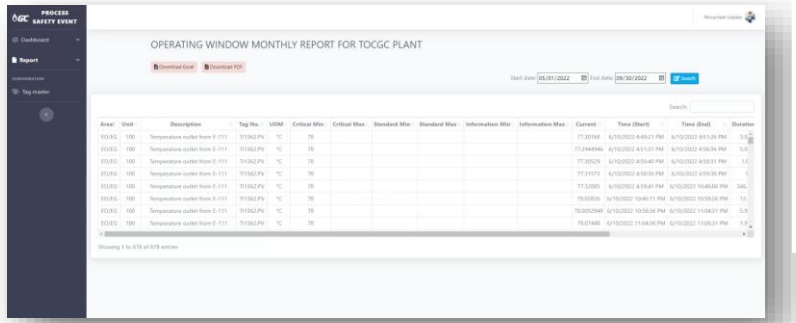
- Change method of monitoring from **excel sheet to digital software (PI AF)**.
- Strengthen in IOW monitoring and **incident investigation governance**.
- **E-mail notification system and auto raise incident report when operating condition deviate from IOW**.
- **Live dashboard** to show number of Critical/Standard/Information IOW exceedance.

Operator monitor by running excel spreadsheet every 12 hrs









From: PIMS Alert <pims@pttgcgroup.com>
Sent: Monday, November 27, 2023 10:02 AM
To: Bongkoch Y <R-P1-TE/1553> <Bongkoch.Y@pttgcgroup.com>; Chanyanutch S <R-P1-TE/1600> <Chanyanutch.S@pttgcgroup.com>; Pawat S <R-P1-TE/1464> <Pawat.S@pttgcgroup.com>; Pisut V <R-P1-TE/1597> <Pisut.V@pttgcgroup.com>; Pralachoak P <R-P1-TE/1552> <Pralachoak.P@pttgcgroup.com>; Samak K <R-P1-TE/1575> <Samak.K@pttgcgroup.com>; Suppanat C <R-P1-TE/1579> <Suppanat.C@pttgcgroup.com>; Thanawat U <R-P1-TE/1475> <Thanawat.U@pttgcgroup.com>; Wirinya K <R-P1-TE/1759> <Wirinya.K@pttgcgroup.com>; Noraniti Wongnoen <z0007590@pttgcgroup.com>; Thongchai Tansao <thongchai.t@pttdigital.com>
Subject: PSE Digital Alert

Dear All Concerned,

This is automatic email from PSE digital program to warning about operating deviation from the control limit
The consequence of deviation in term of equipment failure is reported in the detail as table below

Time	Location	Description	Tag	UOM	Critical IOW		Actual valve	Status	Impact level	Excursion impact to equipment integrity
					Min	Max				
11/27/2023 10:02:12 AM SE Asia Standard Time (GMT+07:00:00)	REF/R-P1/Reactor Section	R-1504 Inlet Temperature	15TRCA010.MEAS	deg C	549		532.8	Out of Critical IOW	High	Mechanical design temperature at 549 degC

Best Regards,
PSE digital software

What digitalization can improve IOW?

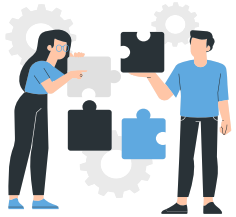
Step to implement IOW monitoring by PI-AF

IOW Review

Input IOW data in format

Area, Unit, PI tag, Description, UOM,
Min/Max Critical IOW, Standard IOW, Information IOW,
Min/Max Control Guideline
Consequence, Recommendation, If Excess, raise NCR/IIS?

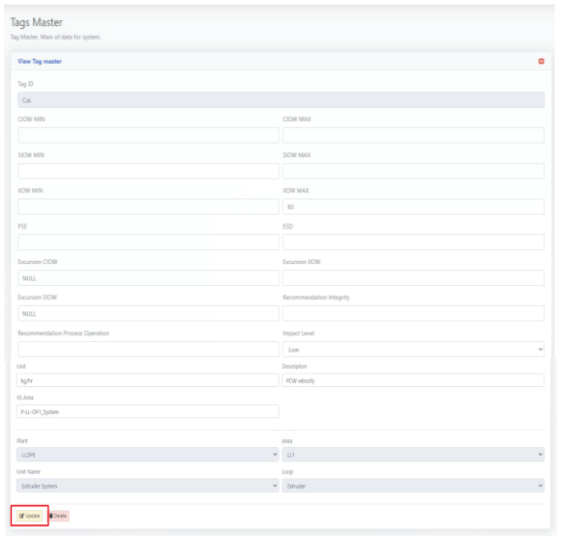
Email recipient for notification



IT develop IOW in web-based

In case IOW parameter remove/add/change setting

Process engineer who has *authorize can edit in web-based*



Key take away

1. IOW is the tool to monitor process parameter to prevent pressure equipment fail and possible consequence to loss of containment.

2. Advantage of implement Digital tool is real time monitoring and immediately alert to concern party.

Chemical Process Safety Sharing

Thank you for your attention