AN OPERATOR WITH BIG PICTURE THINKING ON PROCESS SAFETY

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Abstract

Historically, the APA business was a natural gas pipeline operator where standards like AS2885 were the primary influencer on operational safety. The APA operation has also seen diversified growth, including gas storage, gas processing, and power generation. The breadth and complexity of assets range from a simple natural gas scraper station to midstream gas processing, meaning APA has had to think more broadly around asset safety.

As APA engages in more complex operations, the risk of a catastrophic event and associated people impact increases. The threat to operation requires a more coordinated approach in process safety management to ensure risks are treated consistently throughout APA operations. APA has always operated with safety in mind, but now we have a one-stop-shop in the form of process safety that everyone at APA can participate in and support.

Understanding the big process safety picture is essential to ensure our efforts take us to an expected outcome. Getting to the big picture brings about challenges that APA needs to overcome:

• What does the big process safety picture look like at APA?

• How does process safety fit into an organisation that is predominantly thinking gas transmission?

• How do we shift process safety thinking from our executive committee through to operators?

• How do we deliver a process safety program to operations that span the remote locations of this country?

APA has gone on a journey from limited process safety understanding to winning an APGA safety award for our use of Process Safety Fundamentals to communicate process safety. This paper will highlight the challenges to expect, the approach that APA has taken, and any shared learning that may assist others in achieving a better outcome.

It may assist other organisations in bringing process safety into their workplace or contribute to process safety thinking within the industry.

Contents

1 Introduction

APA Group began developing process safety in July 2017. Improved process safety systems and a cultural training program were rolled out to the transmission and midstream operations from early 2019 through July 2020. APA is now expanding its process safety program through power and networks assets and various improvements to systems and processes. This paper is about the APA journey to develop process safety from the initial site roll-out, systems and process improvements, and moving onto other asset types. This paper will highlight the challenges to expect, APA's approach, and learnings to share. It may assist other organisations in bringing process safety into their workplace or contribute to process safety thinking within the industry.

1.1 What is process safety?

The APA process safety definition is the "safe operation of APA's asset such that there is no major accident event as a result of a harmful substance or energy release".

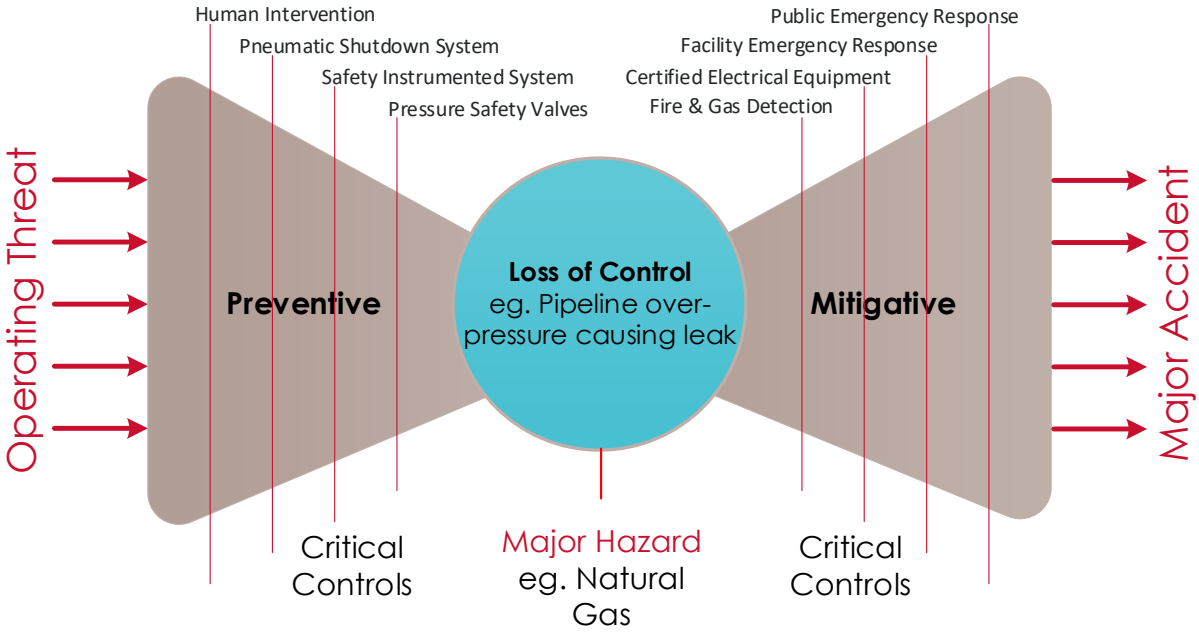

Figure 1: Example Process Safety Event Bow-tie Model

Process safety requires that major hazards such as natural gas, hydrogen sulphide, or steam are identified at each operating asset. For each major hazard, credible major accident scenarios are then assessed to determine the active threat that causes the loss of control event, which may escalate further towards a major accident event. For each major accident scenario, the critical controls are identified and are maintained throughout the in-service period.

2 The Natural Gas Pipeline Operator

Leading up to 2017, APA Group was predominantly a natural gas pipeline operator. As a pipeline operator, safety in operation was greatly influenced by the industry standard (AS 2885) for pipeline design, construction, and operation, including safety in operation. The responsibility and communication of operating safety risk was within various technical groups that were managing pipeline operation such as,

- Pipeline integrity: responsible for the underground pipeline assets between above-ground facilities.
- Corridor protection: responsible for protecting and coordinating work activities along the pipeline corridors or easement.
- Pipeline control system: responsible for controlling the pipeline operation within allowable limits.
- Facility mechanical reliability: responsible for ensuring the pipeline assets at above-ground facilities remain available for operation.

Engaging in safety discussions associated with the pipeline operation requires an understanding of each supporting area of operation. The needed specialist knowledge and was an obstacle that hindered wider organisational interaction, learning, and growth.

Supporting the operation groups are essential systems and processes to manage the pipeline operation such as,

- Permit to Work (PTW)
- Lock-out Tag-out (LOTO)
- Management of Change (MOC)
- Shutdown Function Testing
- Equipment Inspection

The natural gas pipeline operator has many discrete functions and systems of work delegated within the organisational structure. Operational safety risk, therefore, has many groups that influence and occupy the communication space. APA has always operated within industry safety requirements but had not considered a one-stop-shop safety approach similar to personal safety.

Personal safety in pipeline operations at APA is a well-established system to managing health, safety, and environment (HSE) called Safeguard. Safeguard is well embedded and supported throughout the organisational structure, with policy commitment, group procedures, and mandatory protocols. It was a framework that everyone was aware of and regarded as compulsory in operation. If you hear of an HSE incident, you automatically know that the incident is related to or could have resulted in someone being injured at work. The association with HSE hazards or incidents was clear and well understood within APA.

2.1 Where was the process safety conversation?

The process safety conversation at this particular point in time at APA was minimal. Significantly few people were aware of process safety as a way of maintaining safe operation. Discussions involving operational safety risks were often related to pipeline safety or existing processes such as permit to work and did not cover the full range of operational risks to manage APA's assets safely across its range of assets.

2.2 Why the need for process safety at APA?

APA during this time had grown considerably. There were more assets in the operations portfolio, and some assets were more complex or new to APA consisting of,

- Natural gas networks, grids, and hub operations.
- Natural gas storage and midstream major hazards facilities.
- Natural gas-fired and renewable power generation.

The growth and variety of APA operations, particularly major hazards facilities where process safety is more familiar, meant more opportunity for loss of control in APA's operations that could lead to a major accident event. It was recognised that the existing pipeline-based asset safety management system would not be enough to manage the safety of these assets. In addition, regulatory oversight and investor expectations were stepping up in these areas. Based on all these factors a decision was made to develop process safety at APA.

3 Thinking Process Safety throughout the Organisation

The first step to process safety development was ensuring APA was structured to support process safety. During an organisational change in 2017, a Senior Process Safety Engineer position was created as the owner of process safety. Process safety was set up as part of the new Asset Engineering team with support to the Senior Process Safety Engineer person initially given from a new process engineering team. This team was assigned the responsibility of establishing a process safety framework and leading the enactment of it.

The development of process safety began with board papers on process safety to inform and gain support for process safety integration within APA. Following the board papers, a series of awareness and information sessions across all APA operations were undertaken. This gave awareness of the upcoming development and change to thinking more aligned with process safety.

The team also set out to formalise the process safety program and commitment at the board level. A corporate HSE policy amendment resulted from this board engagement. The policy update extended the HSE commitment to managing operating risks and critical controls that prevent or mitigate major incident events.

3.1 Process safety performance tracking

Once APA committed to establishing process safety, it was decided to start reporting process safety performance as one of the first steps. APA made use of the American Petroleum Institute Recommended Practice[1] in setting up the process safety performance indicators. The process safety performance indicators were incorporated into the APA asset management framework, and the organisation's performance was communicated routinely. Process safety performance was also communicated monthly to all levels of the organisation, such as executives, general managers, managers, and health, safety, and environment teams. Establishing performance reporting early was important as it created a common talking point around process safety. It also highlighted early areas for improvement to start the process safety improvement journey.

3.2 Process safety framework and fundamentals

Once the corporate commitment to process safety and performance reporting were in place, work began on the process safety management framework. There are a few process safety management frameworks to select from including:

- Energy Institute.
- Centre for Chemical Process Safety.
- DuPont.

[1] (American Petroleum Institute, 2016)

APA chose the Energy Institute.[2] The energy Institute guidance provided both a high-level and in-depth guide to setting up the process safety management system. APA's process safety management system was integrated into the existing HSE framework. Both frameworks had many overlaps, and it was sensible to have one framework for safety to avoid process duplication. The process safety framework however, was detailed and very difficult to communicate; hence a simple communication method was needed. APA looked to industry to find an approach. Widely used in other industrial operations, the process safety fundamentals are an effective communication tool. APA chose this approach as a result.

The process safety fundamental approach simplifies the process safety discussion down to the most important few things to manage process safety. It is an important concept to operationalise and embed process safety into asset operation. The process safety fundamentals are essentially the behaviours, supported by systems and processes, that are most important to the particular operator. As these are essential behaviours, they are in general kept between 8 and 10 fundamentals in total. APA reviewed the available industry process safety fundamentals and identified 8 critical items to apply in its fundamentals.

Figure 2: The APA Process Safety Fundamentals

[2] (Energy Institute UK, 2010)

Each process safety fundamental is supported by underlying systems and processes and is used in day-to-day operation.

The leading systems and processes are,

- APA's risk management system – to provide structure around assessing process safety risks.
- The operational incident management (OIM) system - used for incident reporting and investigation. The OIM system was updated to allow process safety incident reporting.
- Classification of safety critical procedures such as Permit to Work.
- Safety critical devices management - identified in the site-specific process safety dossiers or registers, such as pressure transmitters and shutdown valves in an overpressure protection function. Supporting safety critical device management is maintenance deferral and plant equipment impairment processes.
- Safe operating limit management – Limits were identified and recorded in a register, and an exception-based monitoring system was set up to report abnormal process operations.
- Alarm management - philosophy to ensure operators can respond to alarm indications.
- Management of Change - A process is in place to ensure the risk associated with modifications to assets and operations are managed, and the work activity authorised before implementation.

Behavior-based programs such as the process safety fundamentals are the basis of the process safety roll-out and the approach taken by APA to operationalise process safety. For each of these fundamentals, associated performance metrics and governance processes were also developed to ensure the processes were applied effectively.

3.3 Risk acceptance criteria

The process safety approach is risk-based. To determine if critical controls are adequate to address the particular major accident scenarios, the operator must ensure there is a clear risk acceptance guidance available for,

- Qualitative risk assessment using qualitative risk targets.
- Semi-Quantitative risk assessment using numerical risk targets.

As APA built up its process safety program, it was recognised that some improvements were required to align with APA's risk framework. The APA risk matrix was already set up well to manage major accident events by handling fatalities as a high consequence event. However, additional work was required to align to quantitative and semi-quantitative risks.

Numerical risk targets are required when assessing risk scenarios using methods such as a layer of protection analysis (LOPA). APA went through the process of establishing these in its risk framework. This was done by utilising documents such as HSE UK guidelines and NSW government land use

safety planning publications. Reaching the numerical risk target included a benchmarking process to ensure that APA had set these targets at a level aligned to the industry.

3.4 Thinking and doing process safety

Starting work on process safety, securing support within the organisation, developing systems and processes and training material take time and resources. After starting in late 2017, the upfront work to embed process safety and the fundamentals into the organisation took until January 2019 to be ready. APA decided to deliver the training face-to-face at every operation base across Australia, see Figure 3: APA Australia Operation. The face-to-face engagement was decided upon to engage with those most likely to be impacted by a process safety event, APA's frontline workers. The face-to-face campaign started with a pilot program that began in January 2019. For this a few APA operational assets were chosen at various locations around the country. From this, a broader program was initiated across all of the natural gas transmission and midstream operations bases. This roll-out was completed in July 2020.

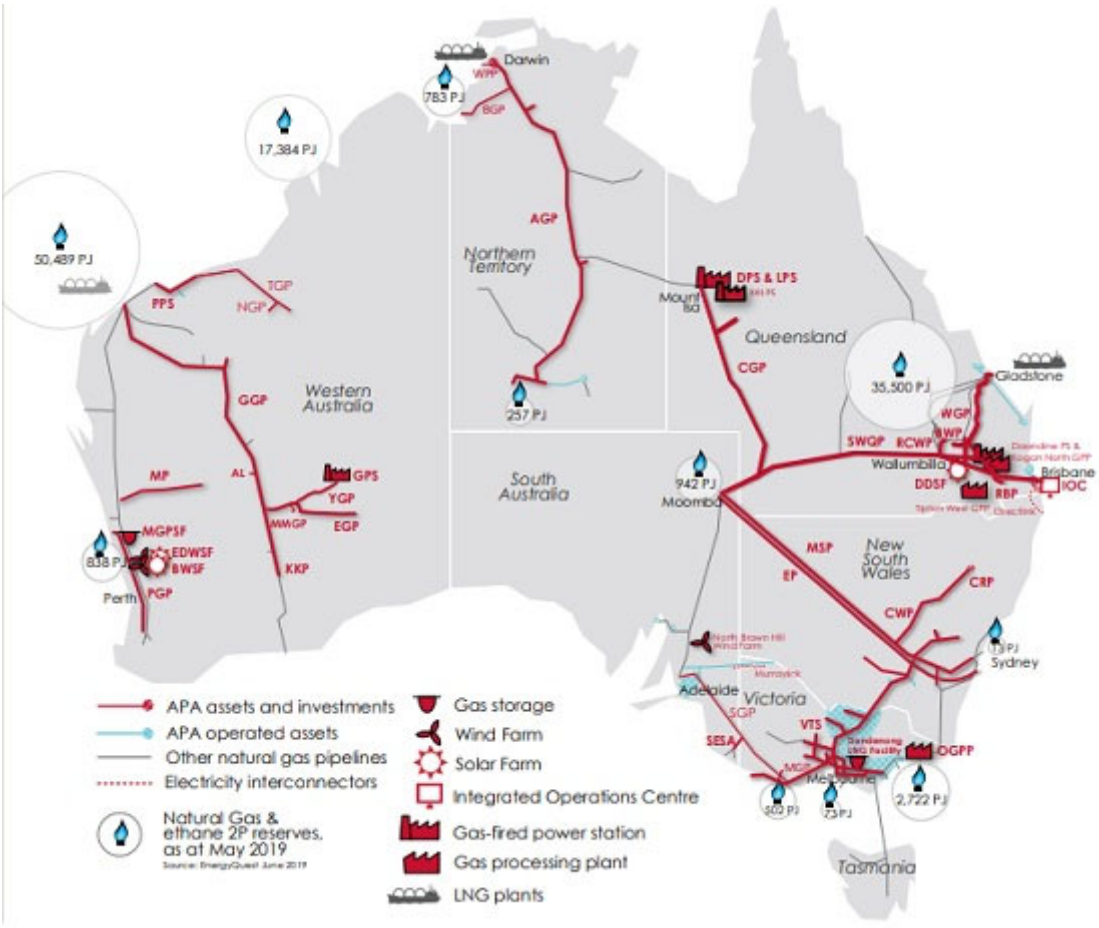

Figure 3: APA Australia Operation

Further work is now underway to roll out this program in our power and networks assets. In addition, systems are being built up to set up ongoing processes to improve the safety process proactively.

To deliver these outcomes and the process safety resource commitment, a team consisted of approximately three permanent personnel and up to 3 contracting personnel was established to support the workload.

4 What APA have Learnt with the Process Safety Development and Rollout

APA has learned a lot through the establishment of process safety in the business. Significant learnings APA has seen are:

- If the leaders don't make process safety important, it won't be.
- Have your leaders in the room!
- I missed the roll-out, is there another opportunity?
- Support personnel with easy-to-use systems.
- Systems that can scale to the risk or complexity of the operation.
- Making it visual
- It takes time and effort to remove noise
- Keep the conversation going!

4.1 If the leaders don't make process safety important, it won't be

Support for the process safety program needs to be driven from the top down. The support needs to be understood and acknowledge all the way to the board level and the outcome communicated through the organisation. In 2017, HSE management committee and board papers enabled senior leaders and board understanding and support for the process safety program. The support ensured that resources were maintained to deliver the program and that senior leaders ensured this was important to their people.

Leaders within the business are icons or broadcasters within the organisation. Leaders at all levels were brought along the journey through involvement in working groups, decision-making, and roll-out sessions. When leaders have participated, it was found those leaders took the message to their people, and process safety was enacted well. When leaders didn't participate, an order of magnitude more effort has been required.

4.2 Have your leaders in the room!

APA was committed to delivering the face-to-face process safety training to all operating bases, including capital city offices. The face-to-face training imparts to the participants that process safety is essential to the company. It then looked to establish this same support from the front line workers in establishing the process safety fundamentals. A handshake commitment was undertaken at each session, and the feedback from trainees and local leaders was used to ensure that the necessary engagement took place.

APA ensured that the trainers used to deliver training had hands-on industry experience and know-how to communicate to the frontline workforce (site technicians). Enable Leadership based in Queensland were external trainers engaged by APA to roll out the site-based training for this reason. Each session had trainers who had more than 40 years of experience in the oil, gas and energy

industry. Each trainer had many stories from personal experience to share, including a personal story from a trainer who had been personally impacted by one of Australia's largest major process safety incidents.

Having conducted all of the training sessions across Australia a key learning was that the personnel receiving the training are very much influenced by the local leader. Therefore it is essential to ensure the leaders are present at each roll-out session. The on-site training sessions were proximately 4 hours in duration. In capital city offices, where these teams were mostly operations support personnel, the most senior leaders in each location (such as general managers) opened and participated in the training session. The city office training sessions were condensed to 2 hours given that process safety was not as new a concept to the people in these locations.

Figure 4: Wallumbilla Operation Process Safety Rollout

4.3 I missed the roll-out, is there another opportunity?

Not everyone was able to attend the planned training sessions. However, a reasonable number of sessions were be allocated due to work shifts and availability of personnel due to annual leave, training, or other operational engagement activities. This included deliberate follow up vistis where key personnel were missed.

To ensure that all personnel are trained, APA have developed online e-learning module. This ensures that as people enter the organisation, expectations around process safety are set early. It has taken some time to develop and taken multiple re-edits to ensure that it was effective. It will be set up as part of APA's onboarding program around it's key safey protocols and will go live this year.

APA has also created additional learning modules to support the process safety fundamental systems and processes such as management of change. This provides more detailed learning around

application of the fundamentals and supporting processes. This ensures that those who need to apply these in more detail, have the understanding and knowledge to do so.

Figure 5: Upcoming Process Safety E-Learning Module

4.4 Support personnel with easy-to-use systems

APA took the time to align the process safety framework to the existing business safety systems. The alignment was essential to receive the already established benefits, such as familiarity, practice and following. Alignment with the current safety system would also make the process safety program easier to develop and deliver.

Underlying systems and processes support the process safety fundamentals. APA also utilised existing safety management tools where possible to create an easy-to-use system for the end-user. For example, APA used the current incident reporting database but added additional features such as denoting it as a process safety incident in the database and adding sections where release quantities could be added.

Systems that support personnel to efficiently deliver their activity reduce conversation around system frustrations and move them onto thinking about the why behind process safety during the roll-out and training sessions.

Along with the systems, providing people with a place to get help and people to get help from on process safety following roll-out is essential. APA created a one-stop-shop intranet page for process safety. Users can navigate the process and systems associated with each process safety fundamental. Other information and updates on process safety are also available from this intranet page. Simple web links were also added to the operations portal and HSE homepage to allow more users easy access to the process safety homepage. The intranet page also lists people who can provide support when additional help is needed.

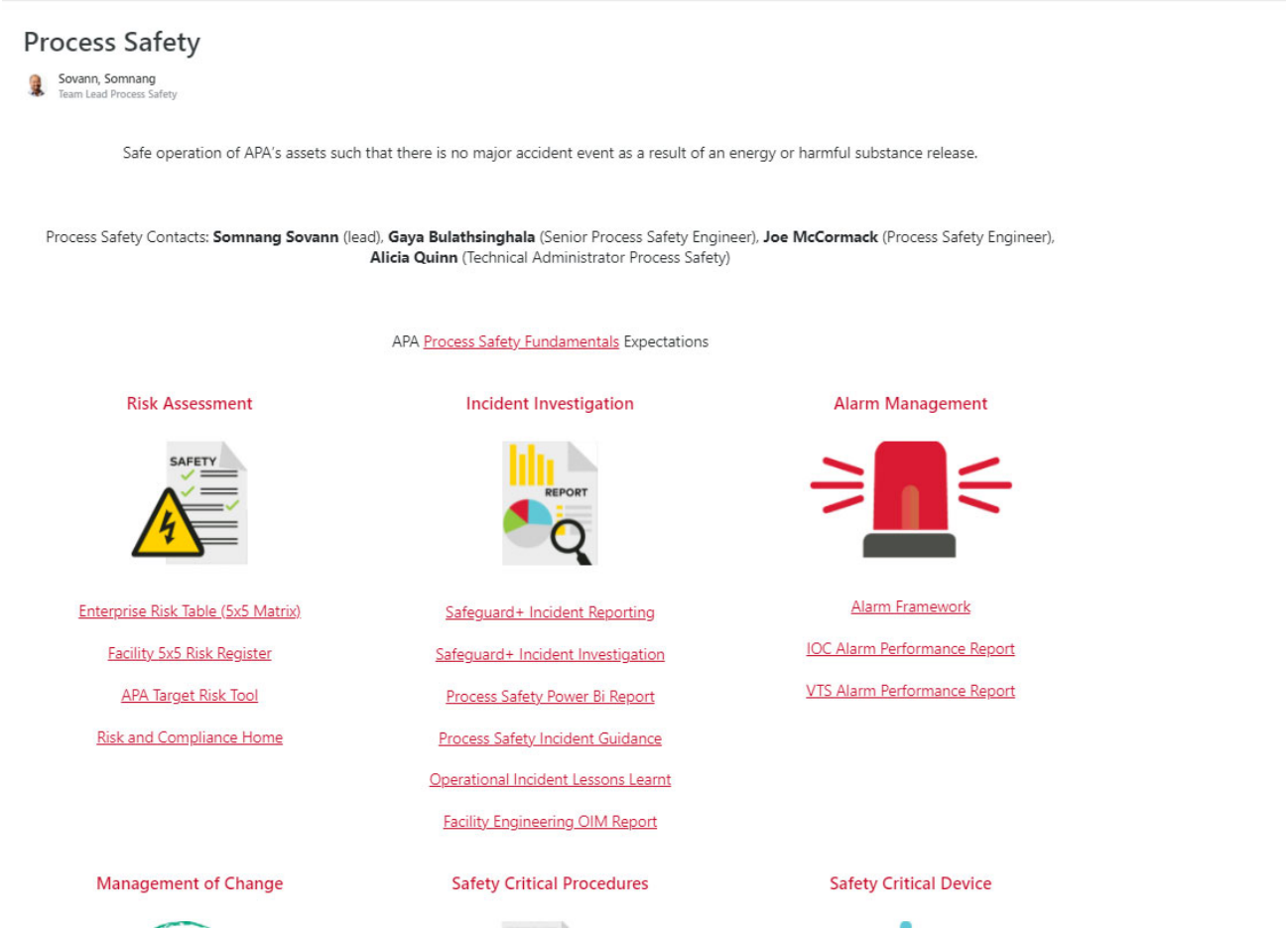

Figure 6: APA's Process Safety Intranet Page

4.5 Systems that can scale to the risk or complexity of the operation

The systems and processes are set up to support process safety fundamentals that must be scaled to the risk or complexity of the operation. The flexibility allows the systems and processes to be applied to a wide variety of assets.

For example, in the incident investigation process for minor incidents. APA investigates these incidents on record sheets using simple qualitative risk assessment and 5-Whys causal analysis. For significant, major or high potential incidents, a more in-depth investigation analysis is required, such as the Incident Cause Analysis Method (ICAM).

Other examples include the impairment and deferral process. These processes at APA were developed to consider all types of asset equipment, including those identified as safety critical.

4.6 Making it visual

Simplifying process safety information and making it more visual significantly assists in communicating process safety. APA reports process safety using Microsoft Power BI and other application-specific software such as PI Vision.

The monthly process safety performance reporting is summarised in Power BI from process safety incidents entered into the maintenance management system (Maximo). The reports use a combination of charts, trends and tables to visualise performance.

To ensure safety critical devices identified in the process safety dossiers or registers are readily identified on our assets, a program is underway to tag these devices on-site physically. While the long-term goal is to configure the critical devices in the maintenance management system, site tagging will allow easy identification for site personnel during walk-around checks, maintenance and breakdown situations.

Figure 7: Safety Cruel Device Labelling On-Site

4.7 It takes time and effort to remove noise

System noise is a part of the process safety monitoring systems. For example, system noise includes,

- Safety critical trips that are indicated as common trips.
- Safe operating limit exception base monitoring that is indicating poorly configured signals.
- Process alarm noise to the operator can be attributed to alarm configurations, equipment settings, and process conditions.

APA has developed standards on how to structure configurations and equipment settings to minimise noise as changes are enacted and on new equipment put into operation. APA has also spent signiticant time and effort to address these issues for equipment already in operation to manage this noise and allow our operational personnel to effective apply the process safety fundamentals.

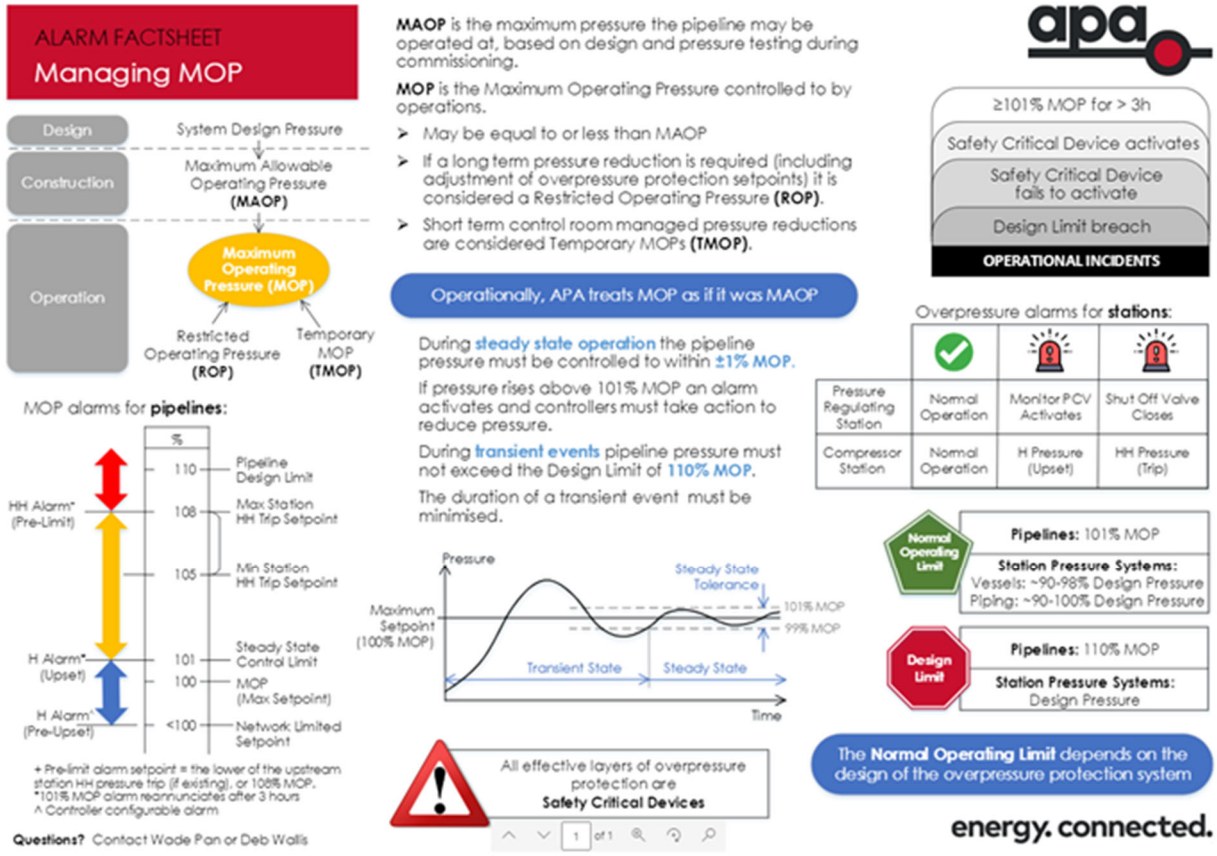

Figure 8: Example Alarm Configurations Standard Guide Sheet

4.8 Keep the conversation going!

What the process safety roll-out has achieved at APA is enabling everyone to join in the process safety conversation. Participation is achieved by equipping employees with the ability to recognise process safety risks through storytelling. Many example of these stories were used throughout the training program. With each example, trainees were asked to reflect on the process safety

fundamentals, i.e., which of the process safety fundamentals could have changed the outcome of each example if followed.

By following on from the process safety training, the storytelling continues through lessons learnt from the operation, system improvement works that foretell a brighter future, or identifying more effective ways to apply process safety through process observations or management interactions.

Our assets are designed, constructed, and operated by people. Therefore, people have the most significant influence on the plant operating safely. To keep the conversation going, APA is developing a follow-up training program to support leaders in having the process safety conversation with their teams. The program centres on discussions relating to the process safety fundamentals. The program will equip leaders to undertake management interactions and to have more in-depth process safety fundamental conversations. The use of management interactions will feedback the number and quality of conversations applied following the training.

5 Moving Towards Process Safety as Business As Usual

As an energy asset operator, APA needs to develop process safety thinking beyond a natural gas operator. There are more major hazards in the mix, such as electricity and steam.

5.1 Making process safety proactive and sustained

The roadmap for process safety improvement requires essential operating information to be kept up-to-date to continue the process safety conversation. To support these improvement works, APA is rolling out a retrospective HAZOP program and a process safety assurance program. They aim to work with the operations team to understand and detect any latent risks before they become an incident. Through this, full confidence can be gained that process safety risks are being managed well. Any issued detected can then also feed into future planning such as capital project planning.

5.2 Process and Energy Safety

Power generation and renewable energy are now part of the APA operation. The process safety approach for the power generation operation contains less guidance and application in the industry. Although the application is less common, some power generation companies have taken the process safety approach; for example, Scottish Power, CS Energy, and Origin Energy have applied process safety in power assets.

Applying process safety to power generation and renewable energy operations is not entirely relatable. The concept for loss of containment does not hold because a small amount of electrical leakage occurs in normal operation. Some terminology and concepts need broadening to capture the power generation and renewable energy operation. For example, loss of containment as used in the process safety definition has been widened to a loss of control. Consideration should also be given to highlighting the importance of energy safety which is more applicable to this operation.

The big picture for process safety at APA is to align all APA operations under a common process safety approach to manage asset safety. This alignment may consider exploring a new name such as process and energy safety to make it more relatable to power generation. Other changes may include updating the process safety definition from loss of containment (which is less relevant to electrical energy) to loss of control.

Fundamentally the principles of process safety are applicable in the power generation space because there exist major hazards that can cause major accidents, and the operating risk management approach with critical controls is very similar.

One learning to share when developing process safety in the power generation and renewable energy operation is to seek and utilise power experienced people, particularly those who have rolled out process safety before, to ensure the application is practical.

The roll-out to the power generation operation is currently in progress and is planned for completion by December 2021.

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