stand together for safety
an australian oil and gas industry initiative

PROCESS SAFETY
WHO'S RESPONSIBLE
A GOOD PRACTICE GUIDE - 2016

SUPPORTED BY

NOPSEMA

appea

PREFACE

APPEA's Stand Together for Safety (STFS) Working Group was formed in 2012 by some of the region's most senior leadership (APPEA's CEO forum) to focus on the prevention of major accident events. Raising awareness of Process Safety, given the large number of new Oil & Gas facilities nearing start-up and the relative poor performance to-date within the Industry in this area, was the agreed priority initiative for this working group. The following document is one of several pieces of work intended to support that initiative. For further information on other products please visit the website.

CONTEXT

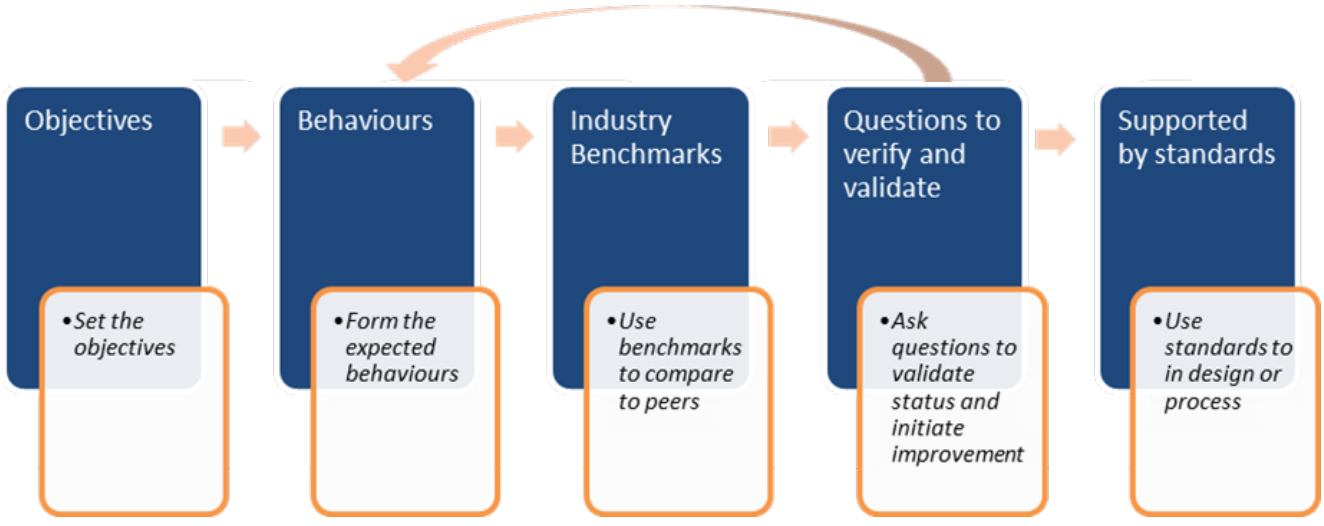
Researchers worldwide have found that Process Safety and the prevention of major accident events requires that the role of people in the operation, and their understanding of safety-critical systems, are as significant as engineering solutions.

The ability to hold informed discussions on a subject as complex and diverse as process safety can often be daunting for management, supervisors and personnel alike. Yet the ability for everyone to truly understand the status of plant is fundamental to ongoing safe operations. Equally important is the ability for everyone to be able to raise issues around process safety when the hazard may not be readily visible or the effects may not manifest for many years.

PROCESS SAFETY FLOW DIAGRAM

The management of process safety involves many aspects due to the often latent effects of barrier/controls failure. The impacts from design or construction deficiencies could manifest at commissioning or many years later during operations. Similarly an oversight during maintenance might not result in failure for some time. Activities during operations can impact the decommissioning. Therefore validation and verification is not only required for the activities of the day but is often required retrospectively or with consideration for the future. Each stage of an operation therefore has its own unique techniques but also many in common with others.

Irrespective of the project stage, effective process safety management involves the five steps outlined in the diagram below;



REPLICATING THE SUCCESS OF DEVELOPING AND IMPLEMENTING SAFETY RULES FOR PERSONAL SAFETY

The development and implementation over several years of "Golden Rules" for personal safety, and their associated behaviours, has been very successful in the reduction of fatal accidents in high risk areas. Key to the success of these Golden Rules has been;

- **Developing a concise list of "Golden Rules"**
  » Better to have 8 good rules rather than 12 poor rules
- **Organisations consulting widely internally to establish clarity on rules and behaviours**
  » Clearly define what are the SHALL and SHALL NOT behaviours for that organisation
- **The rules and behaviours are not ambiguous**
  » Avoiding "as appropriate" or "where necessary" or the need for deviations in rules
- **Identifying where poor barriers or practice make for poor compliance**
  » Use the hierarchy of controls to achieve more robust compliance
- **Regularly check Golden Rules and Behaviours after implemention, to ensure still effective**
  » Engagement is an ongoing activity

For personal safety, previous incidents were analysed to identify high risk activities resulting in fatalities. Such activities (e.g. Working at Heights) became the topics of each golden rule. Rules were then defined by specifying the behaviour(s) which prevent harm occurring during these activities (e.g. wear fall protection when working at heights).

This guide provides an opportunity to apply the same model, and for organisations, projects or facilities to develop "Golden Rules" for Process Safety management.

Figure 1 in the main document provides a graphical illustration of a group of existing Personal Safety Rules and new Rules. The existing Personal Safety Rules concentrate on high risk activities such as ground disturbance, confined space entry and working at heights.

As can be seen in the middle of this graphic some Golden Rules are equally applicable to Personnel and Process Safety, e.g. those related to safety devices, permit to work, management of change, and isolations. These bridge personal and process safety golden rules.

For Process Safety the structure and approach taken for the new golden rules, on the right hand side of the graphic, is slightly different. It can be seen that the topics for Process Safety Rules are organised in line with the stages of the project lifecycle (from Exploration through to Decommissioning). The new Process Safety Golden Rules focus on key areas of risk at each stage in an assets lifecycle and follow how an asset should be designed, constructed, commissioned, operated, maintained and decommissioned.

Overarching all the rules is the necessity to foster a strong Safety Culture within the organisation or operation. The components of a strong safety culture are necessary to develop, implement and successfully keep "Golden Safety Rules" golden.

APPEA hope that the new set of rules and this guidance document, and other associated Process Safety initiatives, will raise awareness throughout all Industries that manage processing hazards; and thus contribute to the prevention of MAEs / Process Safety incidents.

Lastly, this is a living document and we expect these rules and guidance to evolve over time. If you develop or discover improvements or better practices to these, please feedback to STFS or APPEA so we can review for future inclusion.

CONTACT

Contact APPEA or the Stand Together for Safety (STFS) Industry Initiative websites

Websites

APPEA	www.appea.com.au
Stand Together for Safety	www.stfs.com.au (partner site)

ACKNOWLEDGEMENTS

APPEA would like to acknowledge the efforts of the following individuals and groups who participated in the development of this guide.

Ivor Ferguson	Chairman / Author	Clough AMEC / Ferguson AP
Andrew Woodhams	Facilitator	APPEA Proj Dir
Paul Foley	Facilitator	APPEA
Melissa Stephens	Doc. / Grapics	Clough AMEC

STFS Working group members and reviewers

Clive Jones	BHPbilliton
Simon Bugg	Woodside Energy
Daniele Anelli	ENI Australia
S. Sreedhar	Santos
Martin Wypych	Chevron
Jennifer Lourie	Shell
Robin Wright	PTTEP
Steve Coull	Inpex
Steven Fogarty	Quadrant
Stuart Jeffries	Exxonmobil
Jeffrey Mayne	Conocophillips
Ivica Ninic	Origin Energy

Reviewers

Jenny MacKay	Origin Energy
Samantha McKenzie	Arrow Energy
Murray West	Conocophillips
Bill Bonner	Inpex
Brian Starkey	BHPbilliton
Kim Carroll	Santos

APPEA STFS Committee members

Email appea@appea.com.au

CONTENTS

HOW TO USE THIS GUIDANCE

This guidance document provides a framework for applying the successes of personal safety golden rules to the area of process safety. It is a guide to be reviewed by an organisation to determine if the adoption of Process Safety Golden Rules would help to clarify process safety requirements and ultimately deliver operational safety performance improvements similar to that which Personal Safety Rules have achieved.

If convinced that this approach may help an organisation, project, or facility, a resourced plan to incorporate these rules and supporting behaviours should be developed. The initial plan should identify the status of the safety culture, the extent that existing rules are understood, and the safety behaviours that are currently prevalent. The plan should then be further developed to provide the detail of how existing rules and additional rules will be integrated, drafted, consulted upon and implemented. The plan should extend far enough to highlight when the rules will be reviewed at future regular intervals; and based on feedback, revised accordingly.

DOCUMENT FORMAT & CONTENT OF EACH SECTION

1. GOLDEN SAFETY RULE OBJECTIVE

In each section of this document, the new Process Safety rule is represented by a graphic image with an overall tagline that describes the primary objective of safe operations in that lifecycle phase.

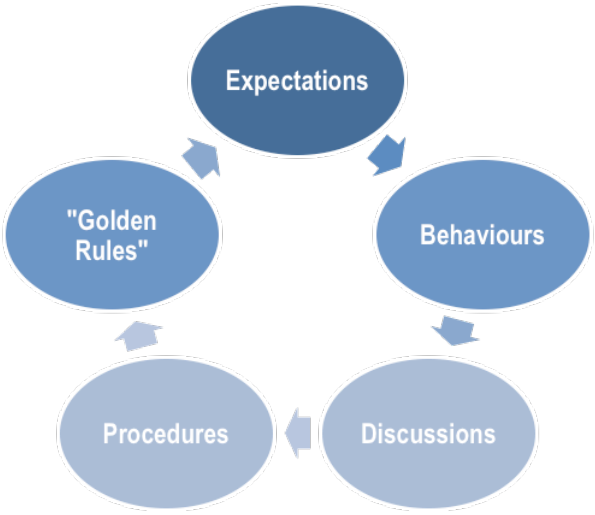
Golden Rules clearly define the expectations of the organization and some companies find that treating these as non-negotiable procedural requirements is a necessary approach to achieve high performance. Others adopt a less prescriptive approach, as suits their safety culture model. They may be generated from analysis of incidents / events at an organisation, or based on lessons learnt from others. Whilst many organisations will have common rules, variations are likely due to the varied nature of works conducted or the lifecycle phases they are in.

2. LIFE SAVING BEHAVIOURS

Everyone has a role to play in the improvement of Process Safety and the prevention of major accident events. Management set the expectation that determine the behaviours and discussions that occur. Procedures and key "Golden Rules" will then reflect the cultural values of the organisation. A strong culture of compliance and workforce involvement to continuously challenge and improve, coupled with robust procedures, are key to the prevention of harm.

A successful culture of **validate** (controls), **verify** (safeguards), and only **authorise** (work) is also key to a safe environment.

Each section of this document has a list of safe behaviours associated with the new rule.



3. WHAT GOOD MIGHT LOOK LIKE

PROCESS SAFETY METRICS- SELECTING, TRACKING AND INDUSTRY BENCHMARKS

The selecting and tracking of Process safety **metrics** are vital, to help us understand the state of our facilities and systems, as well as provide indication to us of impending issues. Importantly, while ***lagging*** process safety metrics will inform you of history, and can be compared and used to report

improvement, they will not necessarily predict the incidents of the future. For this, ***leading*** metrics are needed. The **metrics** provided in this document therefore focus mainly on leading indicators.

This is not a definitive list, but is an attempt to cover some of the key common Process Safety metrics that if not managed well have historically led to Process Safety events

The IChemE Process Safety Centre has published a Guidance document – "Lead Process Safety Metrics – selecting, tracking and learning 2015".

The IChemE Safety Centre has developed a set of lead metrics in consultation with a broad range of industries that manage process safety risks. These provide an opportunity to develop a benchmark data set of lead metrics to support continuous improvement in process safety performance.

The summary information provided in each section of this document titled 'What good might look like or Metrics' and the associated bullet points therein, are mainly taken from the IChemE publication above. For detailed description, definition and use of the summary KPI's provided, please refer to this publication.

Benchmarks are a valuable tool in assessing an operation's performance internally or against its peers. There are many sources for benchmarking including APPEA and other industry associations' safety statistics, Regulator's industry data, information shared by peers at seminars or industry forums.

Appendix 1, Process Safety KPI metrics / benchmarking, contains formats and some typical company examples of how and in what format Process Safety parameters could be monitored, measured and reported. This may be useful for constructing your own governance & assurance tracking systems.

4. PROCESS SAFETY ASSURANCE- QUESTIONS

Open and informed discussion is the basis of any process safety assurance program. Questions must be asked to determine if process safety is understood and well managed at all levels within the business. Discussions must also include those not directly involved in process safety management but whose actions can still influence outcomes. Whilst certain themes are applicable across many aspects of the industry irrespective of the project lifecycle, personnel with different responsibilities may have different emphasis on the questions asked.

It is important when discussing process safety that some preparation is conducted as unlike many personal safety situations the effects of barrier/control weaknesses may not be readily apparent and often take many years to manifest, and informed discussion can therefore be more difficult. This lack of an immediately obvious fault should not be the reason for ignoring it as the consequences of an associated process safety failure are usually significant and invariably catastrophic. Asking specific questions can often tease out some underlying warning signs to good process safety management such as poor time constraints, under resourcing, poor technical quality, incorrect materials supply, budget constraints, low competency, or diverse/conflicting priorities. Investigations after a major accident event invariably identify many obvious deficiencies that could have been identified with such simple exploratory discussions.

Each section in this document provides examples of questions that could be asked onsite to determine if process safety is understood and well managed at all levels within the business. There is a set of questions for each group of employees; "Managers, Supervisors & Everyone" (although each list should not be seen as being exclusive to each group). Therefore use the questions to initiate a discussion, and vary the conversation. They are not intended to be a definitive checklist or audit tool. Only selected and appropriate questions should be asked - not all of them. If uncertain about a response, follow up with a subject matter expert.

5. AUTHORITATIVE TEXTS / STANDARDS

Reference material, acknowledgements and standards used in the development of this document are provided at the end of each section, and also in Appendix 5. These may be local, national or internationally recognised and may in some circumstances be incorporated into legislation, and all support good process safety management systems.

FIGURE 1 - RULES AND BEHAVIOURS

"What is expected of me and what I can expect from others"

OVER ARCHING SAFETY RULE

SAFETY CULTURE

SAFE BEHAVIOURS PREVENT HARM

PERSONAL SAFETY RULES

DRIVING SAFETY

Comply with the law, seatbelts, fatigue, phone, speed, secure loads

GROUND DISTURBANCE

Obtain authorisation before digging

WORKING AT HEIGHTS

Verify protection from falls in place

CONFINED SPACES

Authorisation before entry, verify air quality

LIFTING OPERATIONS

Follow the safe lift plan, never walk under loads

COMMON SAFETY RULES

SAFETY DEVICES

Obtain authorisation before disabling

PERMIT TO WORK

Comply with valid permits

CHANGE MANAGEMENT

Re-assess risks following any change

ISOLATIONS

Verify isolations before working

PROCESS SAFETY RULES

DRILLING & WELLS

Wells are kept under control at all times

ENGINEERING & DESIGN

Design for safe operations

CONSTRUCTION & HOOKUP

Build to specifications with correct practices

COMMISSIONING & STARTUP

Control introduction of hydrocarbons and energy

OPS & MAINTENANCE

Operate and maintain within design parameters

DECOMMISSIONING

Controlled shutdown, deconstruct safely

*These are examples. Reference should be made to OGP Life Saving Rules (Report 459 April 2013) or existing company documentation

SAFETY CULTURE

OBJECTIVE **"SAFE BEHAVIOURS PREVENT HARM"**

LIFE SAVING BEHAVIOURS / CULTURE

Companies with a strong safety culture often define behaviour expectations for four themes: Standards, Communication, Risk Management and Involvement. Moreover, specific behaviour expectations for managers, supervisors and everyone explain how a strong safety culture is the sum of behaviours demonstrated by each role.

SAFETY CULTURE FRAMEWORK

Excellent personal and process safety performance requires more than safe plant and procedures. It also depends on people at all levels demonstrating behaviours that both comply with rules, and encourage and promote a strong safety culture.

The table below demonstrates that if managers set high standards for process safety and supervisors ensure compliance, then everyone will follow rules. Similarly if people are not following rules, this leads us to question if supervisors are doing the right thing to ensure compliance, and whether managers are setting high enough standards.

It is not sufficient to only focus on standards, compliance and rules. As the table indicates there are three other themes in a strong safety culture which are equally relevant to process safety performance. If people do not speak up, be mindful and get involved in process safety, focusing on rule compliance is unlikely to be successful.

The specific behaviours under each heading below are company specific and need to be developed through engagement of all concerned.

	Everyone	Supervisors	Managers
Standards →	← Follow Rules →	← Ensure Compliance →	← Set High Standards
Communication →	← Speak Up →	← Encourage the Team →	← Communicate openly
Risk Management →	← Be Mindful →	← Promote Risk Awareness →	← Confront Risk
Involvement →	← Get Involved →	← Involve the Team →	← Involve the Workforce

SOME TYPICAL TOOLS / USES:

This framework can be incorporated into existing processes and procedures; or used to develop new ones; with the purpose of ensuring human factors, leadership behaviours and good safety culture practices are considered at all stages of the business.

Some typical areas where this framework can be applied are:

- Personal Safety Contracts
- Performance reviews
- Inductions / Pre-start meetings – Establishing expectations
- On the job training, coaching & development
- Reward & Recognition
- Contractor engagement
- Post-event reviews
- HSSE Activity plans
- Audit

SAFETY CULTURE

Safe behaviours prevent harm

WHAT GOOD MIGHT LOOK LIKE - METRICS

Effective, safe organisations are also referred to as a High Reliability Organisations. They are characterized as those where people are;

- Alert to warning signs - they identify, debate and conscientiously act on them
- Empowered to stop work if unsafe.
- Worried about success breeding complacency
- Empowered to challenge if a culture of denial is being displayed (i.e. an attitude that is reflected by; "it can't happen here", a tendency to dismiss intermittent warning signs, an assumption that the warning signs are normal or that it is safe until proven dangerous)

SAFETY CULTURE; ASSURANCE QUESTIONS

For Managers

- How do our managers set standards for process safety?
- How, and with what frequency do our managers communicate with the workforce about process safety?
- What are our managers doing to confront process safety risk?
- How do our managers involve the workforce in process safety?
- How regularly do managers check effectiveness of controls?
- How do managers access and implement lessons learnt from elsewhere?

For Supervisors

- How do our supervisors ensure compliance with process safety rules and procedures?
- How do our supervisors promote awareness of process safety hazards and risks?
- How do our supervisors encourage the team to strive for better process safety performance?
- How do our supervisors involve their team in process safety?

For Everyone

- Does everyone know what process safety hazards and risks are?
- Does everyone follow process safety rules and procedures?
- Do people speak up about process safety?
- Are people mindful of process safety hazards and risks?
- Does everyone get involved in process safety?

AUTHORITATIVE TEXTS

- See Appendix 5

DRILLING & WELLS

GOLDEN RULE OBJECTIVE
"WELLS ARE KEPT UNDER CONTROL AT ALL TIMES"

LIFE SAVING BEHAVIOURS

1. Well control risks will be identified and managed
2. Testing and verification criteria will be agreed between titleholder and operator prior to commencing drilling
3. Well control competencies will be defined and achieved
4. Everyone will know their safety critical tasks
5. Company's operating processes and procedures will be strictly followed
6. Critical prevention and control equipment will be tested and maintained
7. Operations will not be started unless agreed barriers have been verified
8. Action will be taken to verify and monitor barriers
9. Operations will be stopped when a barrier is compromised
10. Equipment status will be formally recorded and verified at system handover

WHAT GOOD MIGHT LOOK LIKE - METRICS

Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of drilling and wells processes:	Number of Deviations to well control critical equipment testing and operating specifications
	Number of deviations from barrier verifications
	% conformance with well control role competency requirements
	Number of process safety related audits to plan
	Number of corrective actions completed
	Compliance with safety critical procedures by observation

ASSURANCE QUESTION EXAMPLES

For Managers:

- What processes do we have to systematically identify and manage risks?
- How do we know that we have consistent standards for acceptance and verification of barrier elements?
- How do we verify that competencies are appropriate?
- How have we verified that the well design is properly peer reviewed?

For Supervisors:

- How are we ensuring that everyone knows their safety critical tasks?
- How do we ensure that maintenance of critical prevention and control equipment is adequate?
- What are the appropriate actions to be taken when the effectiveness of a well barrier cannot be verified?
- What measures are in place to verify that well control barriers are effective?

For Everyone:

- Is everyone aware of what barriers are in place and how they can become compromised?
- What actions are required to Stop work if a barrier is compromised?
- How helpful are procedures to your activities?
- How do you know your competencies are adequate for the tasks you are required to do?

AUTHORITATIVE TEXTS

- See Appendix 5

ENGINEERING AND DESIGN

GOLDEN RULE OBJECTIVE: **"DESIGN FOR SAFE OPERATIONS"**

LIFE SAVING BEHAVIOURS

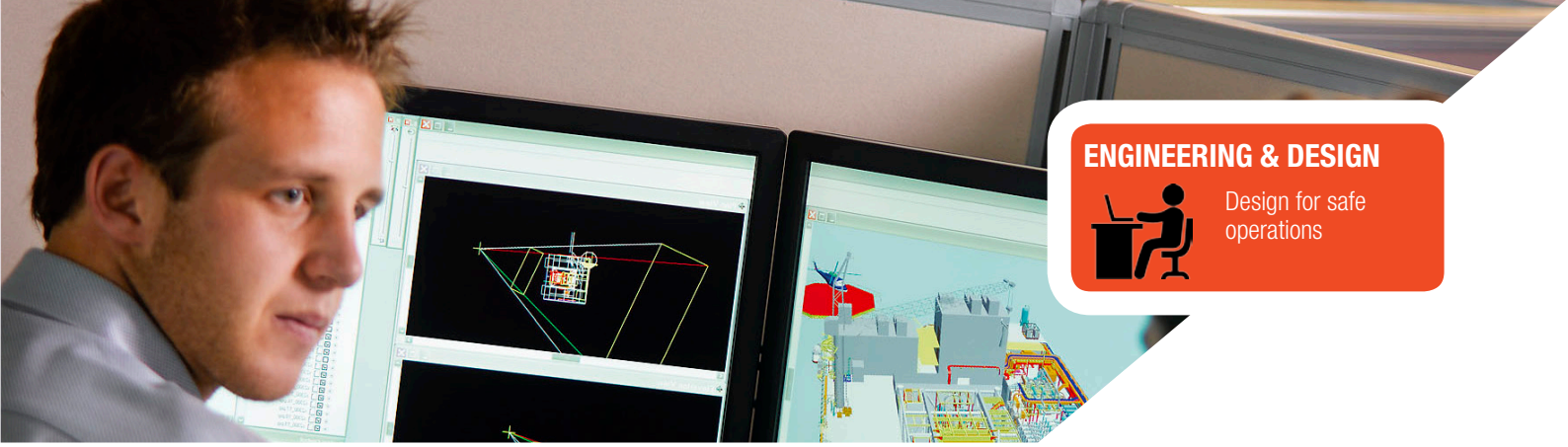
1. Inherently safe principles, human factors engineering and lessons learned are applied in engineering and design to reduce operational hazards and risk to ALARP
2. The purpose, performance standard and inspection & testing requirements for safety critical equipment is clearly communicated in design and engineering documentation
3. Appropriate expertise, including operations and maintenance involvement in hazard identification, is made available to engineering and design teams
4. The full life cycle is considered in the process safety aspects of engineering & design
5. Assumptions and uncertainties are clearly understood and communicated
6. Application and validation of applicable industry design standards
7. A process is in place to manage deviations from company standards and the design

WHAT GOOD MIGHT LOOK LIKE - METRICS	
Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of engineering and design processes:	Number of potential fatalities onsite / offsite from worst case, credible Major Accident Event (MAE). Is residual risks after barrier control design ALARP.
	Number of design changes to safety critical equipment operational and maintenance requirements
	Conformance with process safety related competency requirements for design personnel
	Number of key lessons learnt from previous post-project operational performance reviews incorporated in design
	Number of non-conformances found in process safety design audits
	Number of open process safety actions relating to engineering and design at handover
	Number of independent safety in design reviews completed
	Number of deviations from design standards at handover

ASSURANCE QUESTION EXAMPLES

For Managers

- What processes / activities have been implemented to ensure inherently safe principles, human factors and lessons learned have been considered in the design?
- How do we know that the design and engineering of safety critical equipment is appropriate?
- How do we demonstrate that the risk of this design has been reduced to ALARP / SFAIRP?
- How do we know that the design and engineering input has had adequately competent resources applied?
- How has the design been informed by lessons from operational experience?
- How do we know that actions remaining from key design hazard identification processes (e.g. HAZOP, HAZID, SIL) are acceptable to be carried forward at handover?
- How have deviations to standards been managed and how are they to be handed over to Operations?
- Have performance standards for safety critical equipment been defined?



ENGINEERING & DESIGN

Design for safe operations

For Supervisors

- How are the barriers that prevent loss of containment in our major accident event scenarios identified and how are they to be communicated?
- Have onsite / offsite risks been captured / assessed to ALARP / SFAIRP. How is this demonstrated?
- Is there a process to trigger corrective actions following results from inspection and testing of safety critical equipment?
- What processes exist to ensure process safety expertise is applied?
- How have learnings from process safety incidents been incorporated into our procedures, and training programs?
- What process safety design actions are open and how are they being addressed?
- Does anyone check integrity / effectiveness after design changes are made?

For Everyone

- What will be the operations and maintenance assurance systems & procedures in the operational phases that verify that loss of containment barriers are in adequate condition?
- What are the required performance standards for Safety Critical Elements (SCE) to safeguard plant operation?
- How do you know when to consult with process safety specialists?
- How effective is the communication of critical process safety tasks in the design and engineering deliverables?
- How do you know that the open process safety actions are understood at handover and have a feasible closeout plan?
- Does the design of the system make sense to you? Do any parts concern you?
- How do you know that design changes have been verified and assured as complete?

AUTHORITATIVE TEXTS

- See Appendix 5

CONSTRUCTION AND HOOK-UP

GOLDEN RULE OBJECTIVE
"BUILD TO DESIGN SPECIFICATIONS USING THE CORRECT MATERIALS & PRACTICES"

LIFE SAVING BEHAVIOURS

1. Construction phase is properly planned / scheduled and executed by pre-qualified / competent contractors
2. Ensure all client / contractor / vendor interfaces and communication processes are effective.
3. Ensure all roles, responsibilities and deliverables are clear
4. Verify correct engineering standards have been complied with and correct design materials have been installed. Effective QA / QC to ensure quality outcomes
5. System cleanliness verification prior to closing up / hooking up plant
6. System completeness validation before handover and any deviations / exceptions agreed by receiving party
7. Ensure corrosion protection is complete and effective before covering with insulation
8. All controlled documents are current / approved at time of handover
9. SIMOPS are planned and controlled
10. Effective Management of Change (MOC) procedures are in place to assess and approve change
11. Effective management systems are in place to ensure leaks are eliminated during commissioning, start up and ops.
12. Ensure effective preservation is applied to equipment if delay to next phase

WHAT GOOD MIGHT LOOK LIKE - METRICS

Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of construction and hook up processes:	Construction PTW checks performed to plan
	Number of QA / QC audits / checks conducted and fail rate of contractors deliverables
	Conformance with handover documentation requirements
	Number of open priority punch list items at handover
	Number of non conformances raised (cleanliness, overdue, rework)
	Number of incidents where MOC is a contributing factor
	Number of factory and site acceptance tests completed on SCE

ASSURANCE QUESTION EXAMPLES

For Managers

- What engineering standards have been applied to this project / item / facility? Who is verifying that they are being met in construction?
- How are deviations being managed / recorded; do they get reviewed for life cycle impact?
- How are potential contractors/vendors pre-qualified to participate?
- How do you assure that the construction trades are competent?
- How do we ensure that individuals understand the construction assurance processes?
- How are we certain that the materials supplied are to the design standard?
- How do we go about construction shift handover? Do you think that all key information gets transferred? How could it be done better?
- Is there a safe comprehensive hook up plan, SIMOPS plan and associated risk assessments in place?
- What improvements could be made to the construction permit to work system?

CONSTRUCTION & HOOKUP

Build to specifications with correct practices

- What high risk activities are being conducted during construction? Are these properly risk assessed / mitigated?
- Is there actual or perceived time / delivery pressure on the workforce to make progress to the deteriment of personal or process safety?
- How many construction items are incomplete at handover and does this feel safe?
- Is there a clear understanding of care, custody and control? Is this appropriately documented?

For Supervisors

- How are we confirming that designed engineering standards are being installed correctly?
- Are you familiar with hook up plan and associated risk assessments and controls?
- Are materials supplied to the design standard specified? How is this verified?
- Have we incorporated learnings from process safety incidents into our construction practises & procedures, and training programs? Do you have an example?
- How do we manage incremental change?
- What have we considered in the location and design of temporary buildings or refuges? Are we compliant ?
- What alarm overrides are in place during hook up and how are these controlled?
- What impact could each hook up activity have on other activities? (and vice versa)?.
- How do you validate that a task is safe to start? What would cause you to stop that task?
- How do you verify that all the isolations are in place / effective prior to hooking up to live plant?
- How are SIMOPS (simultaneous Ops) risk managed (e.g. with phased construction / brownfields build)
- Are there opportunities to perform hazardous activities (e.g. lifting over live plant) during a planned shutdown when hazards are not present?
- Are construction personnel operating machinery competent ?
- Are our emergency response plans adequate for the current construction activities and have they been drilled recently?

For Everyone

- How do you validate that a task is safe to start? What would cause you to stop that task?
- Have you seen any aspect of the plant you think could be improved? How do you go about reporting design flaws picked up in construction / hook up phase?
- How do we go about construction shift handover? Do you think that all key information gets transferred? How could it be done better?
- How many construction items are incomplete at handover and does this feel safe?
- Is there an effective SIMOPS plan when constructing within live plant
- Is everyone empowered to Stop work if an unsafe condition develops?
- How are priority punchlist items managed?

AUTHORITATIVE TEXTS

- See Appendix 5

COMMISSIONING AND START-UP

GOLDEN RULE OBJECTIVE
"ENSURE A SAFE AND CONTROLLED INTRODUCTION OF HYDROCARBONS & ENERGY"

LIFE SAVING BEHAVIOURS

1. The risks from SIMOPS are identified and understood, with mitigation measures in place
2. Construction documentation is complete and assures that it is safe to commence commissioning
3. Any uncertainties & risks associated with start-up conditions are understood and appropriate operational limits and automatic shutdown controls are applied
4. A fully risk assessed , approved start up plan is in place
5. All system and equip documentation (as builts etc) are authorized as complete and communicated widely before introducing hydrocarbons and start-up
6. All safety critical elements are in place and function tested against their performance standards
7. All operating procedures are in place and undertaken by competent commissiong / start up / ops teams
8. The complete integrity of the system is verified prior to hydrocarbon introduction
9. Process line up and isolation status is physically verified immediately before introduction of hydrocarbons
10. An effective PTW for hydrocarbons phase is in place to control all hazardous activities
11. Ensure there is a clear understanding of care, custody and control at handover points and that it is appropriately documented

WHAT GOOD MIGHT LOOK LIKE - METRICS

Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of Commissioning & Start up processes:	Conformance with SIMOPs risk barrier verification requirements
	Number of open critical / priority punch list items at start-up
	Number of trip inhibits / defeats in place during start-up
	Conformance with handover documentation requirements
	Time interval since confirmation of line-up and isolation status
	Effective Alarm management and process status
	Number of temporary operating procedures (TOPS)
	Number of personnel meeting competency requirements
	Number of temporary equipment items in place
	Number of incidents where MOC is a contributing factor

ASSURANCE QUESTIONS EXAMPLES

For Managers

- How do we know that the SIMOPs risks have been identified and are being appropriately managed?
- How do we know that our processes for documenting construction completion are adequate to assure that it is safe to commence commissioning
- How are safe operating limits been determined for the dynamic state of commissioning and how have these been communicated?
- Who has the accountability for ensuring that the introduction of hydrocarbons is safe and controlled? Is this appropriate?
- Is there a clear understanding of care, custody and control? Is this appropriately documented?
- Is there a procedure to physically check & verify process line up and isolation status?

COMMISSIONING & STARTUP

Control introduction of hydrocarbons and energy

- Do we understand the risks associated with open punchlist items; individually and collectively?
- Is there suitable support available for Operations team from project teams for any related issues?
- How are we minimising other activities to allow full focus and attention on hydrocarbon introduction and start up?
- Do we understand when the status / process safety risk profile of facility will change on start up and what additional controls are required, when?
- Are the emergency response arrangements commensurate with the change in risk?

For Supervisors

- What impact could this activity have on other activities, and vice versa?
- How do we know that the design and engineering standards have been met?
- How are trip defeats / inhibits and alarm overrides being controlled to sustain safe operating limits during commissioning?
- How do we know that authorisation of handover documentation has included the appropriate expertise?
- Do we understand any restrictions on any remaining temp buildings after plant status changes?
- How have we physically verified that the status of process line-up and isolations is correct?
- How do we verify the integrity of the plant prior to start-up?
- Has a comprehensive pre-start safety review and start up plan been completed / approved
- Are all operating procedures in place, approved and known to operations team?
- Are all operations personnel competent to start up and operate?
- Are all company and regulatory approvals in place for start up?
- Are all HAZOP actions closed out satisfactorily?
- Are all safety critical elements in place and function tested against their performance standards prior to start up?
- Have you sufficient focus on the start up and safe introduction of hydrocarbons? Can you suspend all other distracting activities to allow full attention on this critical activity?
- Are all non-essential personnel minimised onsite during hydrocarbon introduction?
- All controlled documents are current, complete and approved at time of start up

For Everyone

- How are permit to work approvals influenced by simultaneous commissioning activities?
- How do we know that the remaining punch list items can be safely implemented after start-up?
- How do we know what temporary equip and procedures remain in place on start up?
- How effective are the additional controls that have been established to compensate for trip defeats and alarm over-rides during start-up?
- How clear are individual responsibilities in the input to authorisation of handover documentation?
- How do we know that process line up and isolations are safe to allow introduction of hydrocarbons?
- Are you trained and competent to start up and operate this plant?
- Is everyone aware of the hazards associated with entering the commissioning / hydrocarbon introduction phase?

AUTHORITATIVE TEXTS

See Appendix 5

OPERATIONS AND MAINTENANCE

GOLDEN RULE OBJECTIVE
"OPERATE AND MAINTAIN PLANT WITHIN DESIGNED PARAMETERS"

LIFE SAVING BEHAVIOURS

1. Action is taken to ensure plant is proactively operated and maintained within safe operating limits
2. An effective PTW for hydrocarbons phase is in place to control all hazardous activities
3. Ensure all O&M documentation is current, accurate and approved
4. The integrity of Safety Critical Tasks and Equipment is verified appropriately and effectively communicated
5. Safety Critical Maintenance is completed as per schedule
6. Ensure all O&M activities are executed and supervised by properly resourced, trained, competent and approved personnel
7. Deviations from safe operating limits are investigated to identify potential improvements
8. Work approvals address risks from SIMOPS
9. Emergency response capability is tested regularly to demonstrate adequate competency
10. Alarms are managed to support effective response to operational events and plant upsets
11. Process Safety lessons learned are systematically considered to identify improvement opportunities
12. Temporary or permanent changes follow a formal Management of Change (MOC) process
13. Ensure there is a clear understanding of care, custody and control and that it is appropriately documented
14. Ensure effective shift handovers
15. Communicate awareness of process safety to all personnel.

WHAT GOOD MIGHT LOOK LIKE - METRICS

Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of Operations and Maintenance processes:	Demand on Safety Critical Equipment; Failure to meet performance standard on test/inspection
	Compliance with critical procedures by observation; Procedural failure on demand or test
	Number of corrective actions arising from reviews of deviations from safe operating limits
	Number of process safety system interactions impacted by SIMOPs plan
	Number of process safety related emergency drills to plan
	Critical alarms per hour; Standing alarms
	Number of improvement opportunities implemented related to process safety lessons
	SCE Maintenance / inspection deferrals
	Maintenance backlogs (PM & CM)
	Number / quality of Permit to Work compliance checks vs plan
	Number of Process Safety audits / open audit items
	Number of Process Safety events that could have resulted in MAE
	Conformance with Process Safety related competency requirements
	Number of expired temporary changes or equipment
	Number of incidents where MOC is a contributing factor

ASSURANCE QUESTIONS EXAMPLES

For Managers

- How do we know for each of our facilities, that the operating envelope is appropriate for the condition of the plant and equipment?

OPS & MAINTENANCE

Operate and maintain within design parameters

- What processes exist to provide the information that verifies the integrity of our safety critical tasks and equipment?
- How do we know that safe operating limits have been exceeded and what is the process for applying lessons from such events?
- Who is accountable for approving SIMOPs during operations and how are risk management principles applied to support decision making?
- How are we assured that emergency response capability is adequate to address process safety events?
- How many alarms are overridden currently and what is the plan to address this?
- How many process safety improvements have been implemented in the past year?
- Is there a formal Process Safety competency structure to properly assess, control & approve deviations?
- Are SCE PMs appropriate. How do you know?
- Is there an effective process for managing MOC?
- Is there a process for managing risk when SCE fail to meet performance standards?
- Is there Process Safety awareness across all levels of the business?
- Is everyone is empowered to stop the plant if an unsafe condition arises?

For Supervisors

- What are the conditions of the assets here and how do we know that safe operating limits are appropriate?
- Do you know how many overrides, inhibits and ineffective barriers currently exist and how do you know it is still safe to operate?
- How are safety critical tasks and performance standards verified?
- Is there a recognised structure of Process Safety technical authorities / competencies?
- What happens when a safe operating limit is exceeded and how does this trigger improvement?
- What influence do simultaneous operations have on work controls?
- How effective is our emergency response capability for process safety events?
- How manageable is the frequency of alarms during steady state and plant upsets?
- What's the most common lesson that arises from process safety incidents and how could this be better addressed?
- Do we have all the current, accurate, approved operational documentation in place?
- Are ops and maint personnel competent to fulfil their roles?
- Are emergency repsonse procedures adequate and regularly drilled?
- How is incremental change managed / controlled?
- Does shift handover capture and address process safety issues?
- Does everyone understand the process safety hazards associated with their work environment?

For Everyone

- What are the conditions of the assets here and how do we know that safe operating limits are appropriate?
- Is the quantity and frequency of process alarms reasonable / manageable?
- Is safety critical information up-to-date and accurate?
- Does there appear to be too many temporary overrides, temporary equipment, plant deviations, equipment out of service situations that could impact overall facility integrity?
- Is there Process Safety awareness amongst all levels on the facility?
- Are personnel competent to fulfil their roles?

AUTHORITATIVE TEXTS

See Appendix 5

DECOMMISSIONING AND SHUTDOWN

GOLDEN RULE OBJECTIVE
"SHUTDOWN IN A CONTROLLED MANNER AND DECONSTRUCT SAFELY"

LIFE SAVING

1. A proper shutdown plan is in place and status updates are communicated at all changeovers to ensure a common understanding; and followed
2. Plant inventories are verified to be in acceptable safe condition (Energy / hydrocarbon free, de-pressured, flushed, vented, clean) before breaching containment, disconnecting, etc
3. Action is taken to ensure that approved isolations are installed and kept in-place
4. Ensure all associated activities are executed and supervised by properly resourced, trained, competent and approved personnel
5. Ensure right location, right equip before commencing work / breaching containment
6. Interfaces between process release and shutdown/decommissioning teams are managed systematically
7. Work on plant that is to be re-instated is managed to acceptable operations and maintenance standards
8. Re-apply construction, hook up / commissioning, start-up Golden Safety Rules (GSR's) to safely reinstate plant on shutdown, modifications and turnarounds.
9. Conformance with SIMOPs risk barrier verification requirements
10. Adequate safety barriers are verified to be in place whilst energy sources and hazards are present
11. Risk associated with scope change, changing plant conditions and emergent work, are continually assessed and managed. Ensure effective MOC

WHAT GOOD MIGHT LOOK LIKE - METRICS

Measurement / tracking of the following metrics may contribute to the ongoing assessment of the effectiveness of Decommissioning and Shutdown processes:	Number of non-conformances found in process safety audits
	Number of conforming gas tests
	Number of isolation deficiencies identified in process safety audits
	Number of process safety audits to plan
	Conformance with process safety role competency requirements
	Number of deviations to Safety Critical Equipment
	Number of Temporary Operating Procedures open (TOPs)
	PTW checks to plan
	Number of Process Safety events that could have resulted in MAE

ASSURANCE QUESTION EXAMPLES

For Managers

- How do we know that all stakeholders have a common understanding about the decommissioning plan and status?
- Has enough time been allocated for all shutdown / decommissioning work to be completed safely – including unexpected contingent work?
- How do we know that our process safety audits are enough to verify that the interfaces between the various teams are being effectively managed?
- How often are we getting the right people out to conduct process safety audits and what level of comfort do you have that enough audits are conducted?
- How do we maintain control of process isolations to support safe work?

- What is the process for managing the interfaces between the operations and shutdown/ decommissioning teams?
- How do we know that we have adequate process safety support throughout the handover and shutdown/decommissioning phase?
- How do we know that isolations are being adequately controlled?
- How are we applying the hierarchy of controls in developing the decommissioning scope?
- How do we ensure effective re-application of approved construction / commissioning rules to safely reinstate plant on turnarounds.

For Supervisors

- How do we know that the status of plant is adequately communicated and understood?
- How often are we witnessing breaches of containment to verify that our process release is to the right quality?
- How frequently are we verifying the status of isolations and associated controls?
- Is there a suitable amount of PTW audits being done, commensurate with the levels of activities?
- How do we know that we are sustaining appropriate control of work to maintain our operations and maintenance standards?
- What is the status of our process safety risks, associated control and mitigation barriers?
- Are the risks associated with scope change, changing plant conditions and emergent work, being continually assessed and managed?
- How do we ensure proper construction / commissioning practises to safely reinstate plant on turnarounds?

For Everyone

- What is the process to assure that it is safe to break containment?
- How do we ensure that the work progress status, any hazards and other information is handed over properly at each shift change? Is there a better way?
- How much confidence can be attributed to gas test results based upon previous experience?
- How effective is our permit to work system in reducing the risk of an isolation deviation?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- How do we know that isolations are all in place?
- How do you know you are working in the right location on the right equipment?
- Are other GSRs being followed in the reinstatment of plant following shutdown and modification?

AUTHORITATIVE TEXTS

See Appendix 5

APPENDICES

APPENDIX 1. PROCESS SAFETY KPI METRICS & BENCHMARKING

Throughout this document various examples of Key Performance Indicator (KPI) metrics are provided (mostly from the IChemE publication) that could be considered in assessing process safety performance within your organisation / at your facility(s).

Measurement / tracking of these metrics could contribute to the ongoing assessment of the effectiveness of the processes applied at each stage of the facility's life cycle.

Below is a procedural example and format of how some companies apply process safety KPI measures and use associated benchmarks to design their own assurance systems.

As yet the Industry has still to harmonize / standardize Process Safety metrics. An agreed common Industry set of Process Safety metrics would enable Industry wide benchmarks and targets to be set that would improve Industry wide Process Safety performance. The IChemE is proposing that it's lead process safety metrics be considered for this purpose and the metrics on the following table are provided for information:

Metrics	Target	Stretched Target	Frequency of Capture	Frequency of Analysis
Conformance with Process Safety related role competency requirement	95%	98%	Weekly	Monthly
Deviation to safety critical elements (SCE)	< 10	< 5	Weekly	Monthly
Short Term deviation to SCE	< 5	< 2	Daily	Monthly
Open management of change on SCE's	< 10	< 5	Monthly	Monthly
Demand on SCE	< 10	< 2	Weekly	Monthly
Barriers failing on demand	< 10	< 2	Weekly	Monthly
SCE inspections performed versus planned	95%	100%	Monthly	Monthly
Barrier fail on test	< 20	< 5	Monthly	Annually
Damage to primary containment detected on test / inspection	< 10	< 5	Monthly	Monthly
SCE maintenance deferrals (approved corrective maintenance deferrals following risk assessment	< 10	< 2	Monthly	Monthly
Temporary operating procedures (TOPs) open	< 5	< 2	Weekly	Monthly
Permit to work checks performed to plan	95%	100%	Fortnightly	Monthly
Permit to work non-conformance	< 5	< 2	Fortnightly	Monthly
Number of process safety related emergency response drills to plan	95%	100%		Annually
Number of process safety related audits to plan	90%	100%	Monthly	Annually
Number of non-conformances found in process safety audits	< 5	< 2	Quarterly	Annually
Compliance with critical procedures by observation	90%	95%	Monthly	Monthly
Critical alarms per operator hour (EEMUA, 1999)	< 20	< 6	Monthly	Monthly
Standing Alarms (EEMUA, 1999)	< 30	< 10	Daily	Monthly
Open process safety items	< 5	< 2	Monthly	Annually
Number of process safety interactions that occur	20	30	Weekly	Monthly

APPENDIX 2. MORE DETAILED LIFE SAVING BEHAVIOURS

ENGINEERING & DESIGN

1. Adopt and implement good practice engineering into all phases of the design process.
2. Design equipment with safe operations (process stability , trip limits, fail to safe) and safe maintenance in mind (maintainable equipment)
3. Adopt 'inherent safety' principals to the design and modification of facilities.
4. Ensure that hazards are identified, risks assessed and eliminated. If elimination is not possible, risk controls are implemented to manage to ALARP levels considering the hierarchy of controls.
5. All engineering changes for operating facilities follow a rigorous Management of Change process.
6. Designs are simple with minimal operator intervention and design requirements are consistently applied across the design.
7. Document the requirements for the inspection & maintenance of Safety Critical equipment in performance standards.
8. A formal system is in place to manage temporary deviations to safety critical elements
9. Design to minimize the size of isolatable inventories of hazardous materials.
10. Design to minimize the potential failure points (e.g. joints, flanges, small bore tee pieces) valves)
11. Ensure correct engineering standards are in place and confirm compliance with regulatory requirements.
12. Ensure sufficient and competent resources are employed in the design process supported by access to experienced operations and maintenance personnel.
13. Ensure correct material selection / specs are used
14. Use a range of different hazard identification and risk assessment techniques in the design process to ensure robust analysis; and then implement outcomes throughout the design lifecycle including the response to design changes. Document the outcomes of these activities comprehensively.
15. Ensure there is focus on high consequence, low frequency events by analyzing Major Accident Events (MAE's) to identify loss of containment scenarios & demonstrate the effectiveness of safety critical elements
16. Analysis of the design to avoid known risks such as cold embrittlement and vibration induced fatigue
17. Adopt previous 'lessons learnt' into the design process.
18. Consider human factors in design to reduce the potential for human error; and design systems which are tolerant of, or reduce / eliminate human error. Where possible, standardize and automate.
19. Ensure safe location / design of temporary buildings
20. Ensure Alarm management can be effective. Incorporate previous learnings into design

CONSTRUCTION AND HOOK-UP

1. Ensure Construction phase is properly planned / scheduled
2. Ensure work is executed by pre-qualified / competent contractors
3. Ensure contractor interfaces and communication processes are effective
4. Verify correct engineering standards have been applied
5. Verify correct design materials have been installed.
6. Effective QA / QC to ensure quality outcomes
7. All pipework and vessels to be checked to ensure cleanliness before closing system up
8. Ensure system completeness is validated before handover to next phase authority
9. Ensure corrosion protection is complete and effective before covering with insulation
10. All controlled documents are current / approved at time of handover
11. Ensure all Hook-up interfaces are within tolerances when connecting together
12. Challenge anything that does not look properly installed or designed

COMMISSIONING AND START-UP

1. Documentation complete and authorized before start up
2. Isolation status, line up for hydrocarbons is known
3. Effective equipment cleanliness assurance in place prior to hazardous inventory introduction
4. Leak testing criteria has been met and approved

5. Emergency controlled shutdown plan is in place
6. All PS trips have been tested fail safe
7. Any uncompleted systems are isolated from main system and interaction known
8. Materials sparing in place for operations
9. Effective reporting mechanism are in place to record / authorize status
10. Ensure approved Commissioning & Start up plan and associated risk assessments and controls in place and effective
11. Ensure Start- up authority / Single point of accountability for start-up is clear
12. Ensure correct material specs have been used
13. Ensure MAE controls in place for start up
14. Ensure all small bore lines. Exposed equipment are monitored for vibration fatigue during start up
15. Ensure full understanding of all system & plant overrides / inhibits required for startup, and all scenarios fail safe
16. Ensure safe, clean and completed plant for start up
17. Ensure everyone is empowered to Stop work if an unsafe condition develops

OPERATIONS AND MAINTENANCE

1. Operate equipment within specified safe , design and environmental limits
2. Always address abnormal conditions – Operate in a safe and controlled condition
3. Accountabilities and responsibilities for integrity management are defined, implemented and maintained
4. Inspect and maintain Safety critical equipment in line with approved schedules and material specs.
5. Key operating parameters are defined and measured, and non-conformities are analysed, reported and rectified.
6. Report anything that is leaking or looks like it is about to
7. Investigate all leaks to determine root cause
8. Ensure ongoing analysis of corrosion and vibration hot spots
9. Assess simultaneous operations in all planned work
10. Integrity performance is measured, reported, analysed and managed - have an effective corrosion & inspection program
11. Ensure Safety Critical tasks are executed in timely manner as per Performance Standards requirements
12. Always use equipment that is 'Fit for Purpose'
13. Ensure Alarm Management is effective / under control
14. Ensure continuous improvement / Lessons learnt process in place
15. Ensure escalation barriers are effective
16. Ensure Emergency Response preparedness
17. Critical equipment, systems, procedures and activities are identified, documented and maintained.
18. Information management systems are in place to ensure critical Integrity information is accessible and current.
19. A management of change process is in place to ensure integrity is maintained in the event of temporary or permanent changes to technology, facilities, operations or organisation.

DECOMMISSIONING AND SHUTDOWN

1. When Plant / equip / work changes, re-assess risks to maintain controls
2. Drawings & documentation all validated / up to date before reinstatement
3. Shift handovers; good coms to ensure safe status for all partially completed work / equipment
4. Complete repairs within specified timescales
5. Ensure correct material are used in repairs
6. Register / control of all abnormal plant conditions etc.
7. Impact of all design modifications, organisational change has been risk assessed & authorized
8. All software change is pre-tested and controlled
9. Ensure equipment is hazard free before breaching containment.
10. Ensure isolations plan and Industry / company isolation standards are followed.
11. Verify safety devices are in place and functioning. Minimize / understand temporary defeats
12. Have all safety equipment standing by in event of a release.

APPENDIX 3. MORE DETAILED ASSURANCE QUESTIONS

ENGINEERING & DESIGN

For Managers

- What design analysis process do we have to identify all loss of containment scenarios?
- What have we done to demonstrate that inherent safety has been implemented in the design?
- Are there robust close outs of actions raised from key design hazard identification processes (e.g. HAZOP, HAZID, SIL) in place prior to handover?
- What engineering standards do you apply to this project/item/facility?
- How have learnings from previous MAE's for similar plant and within the broader industry been incorporated in this design? Some examples?
- Can members of the workforce describe what the safety critical elements implemented as part of the design are and how they function to keep the facility safe?
- How do you incorporate learnings from process safety incidents into procedures and training programs? Do you have an example?
- Explain how alarm management will be conducted, and how it will be effective in a Process Safety incident.
- Do we have a consistent design standard for isolations? (e.g. all valves or power switches close the same way). What are some examples?
- What are we doing from a design prospective to manage known hazards (e.g. cold embrittlement of materials, corrosion, and vibration induced fatigue)?
- How do we capture small/incremental management of change?
- How do we know that there are no engineering modifications that have not been subject to a formal documented management of change process?
- Have all the right people being involved in or consulted with in the design process?
- Have the right level of review and rigour been applied to the design activities?
- What processes / activities have been implemented to ensure human factors is considered in the design?
- What are design safeguards to avoid 'plant out of control scenarios' e.g. tank overfills?
- What have we considered in the location and design of buildings or refuges?

For Supervisors

- When is the last time we reviewed potential loss of integrity scenarios?
- How are we confirming that designed engineering standards are being applied to this project/item/facility?
- How have previous MAE for similar plant been incorporated in this design? Some examples?
- Have we incorporated learnings from process safety incidents into our procedures, and training programs? Do you have an example?
- Can members of the workforce describe what the safety critical elements implemented as part of the design are and how they function to keep the facility safe?
- Are there robust close outs of actions raised from key design hazard identification processes (e.g. HAZOP, HAZID, SIL) in place prior to handover?
- What are we doing to avoid cold embrittlement of materials?
- What are design safeguards to avoid 'plant out of control scenarios' e.g. tank overfills?
- Explain how alarm management will be conducted?
- How do we capture small/incremental management of change?
- What have we considered in the location and design of temporary buildings or refuges?

For Everyone

- Are there any items that have a history of abnormal wear or fail prematurely?
- Has anyone explained the impact/reason for doing this design change task?
- Does the design of this system make sense to you? Would you like more information?
- Does anyone check this design modification after you have finished? How do they go about that?
- Have you been involved in any incident investigations? Have there been any design changes since then? Did you think you added value to the investigation team? What would improve the investigation or lessons learnt?

APPENDIX 3. MORE DETAILED ASSURANCE QUESTIONS CONT.

- Can you show me the proposed process for ongoing inspections of plant to monitor design integrity once operational?
- What aspects of design have changed since the last incident/near miss/ industry alert?
- Can you show me examples of design improvement?
- Are there any parts of the plant design that concern you?
- Would you like me to explain the operational /functional design of this? Can you show me how you operate it? Can you explain your understanding of this?
- Did you receive the information about a process safety failure at a similar plant? Have we made any design changes to eliminate reoccurrence?

CONSTRUCTION AND HOOK-UP

For Managers

- What engineering standards have been applied to this project/item/facility? Who is verifying that they are being met in construction?
- How do you assure hook up to live plant is safe before commencing?
- How are potential contractors/vendors pre-qualified to participate?
- How do you assure that the construction trades are competent?
- How are we certain that the materials supplied are to the design standard?
- Have we properly considered the design and location of refuges and temporary buildings?
- How do we go about shift handover? Do you think that all key information gets transferred? How could it be done better?
- How do you verify that all the isolations are in place / effective prior to hooking up to live plant?
- Is there a safe comprehensive hook up plan and associated risk assessments in place?
- Have you seen any aspect of the plant you think could be improved? How do you go about reporting design flaws picked up in construction / hook up phase?
- What improvements could be made to the permit to work system?
- Is everyone empowered to Stop work if an unsafe condition develops?

For Supervisors

- How are we confirming that designed engineering standards are being applied to this project/item/facility?
- Are you familiar with hook up plan and associated risk assessments and controls?
- Are materials supplied to the design standard specified? How is this verified?
- Have we incorporated learnings from process safety incidents into our procedures, and training programs? Do you have an example?
- How do we go about shift handover? Do you think that all key information gets transferred? How could it be done better?
- How do we capture small/incremental management of change?
- What have we considered in the location and design of temporary buildings or refuges?
- What alarm overrides are in place during hook up?
- What impact could each hook up activity have on other activities? (and vice versa)?.
- How do you validate that a task is safe to start? What would cause you to stop that task?

For Everyone

- How do you validate that a task is safe to start? What would cause you to stop that task?
- Are materials supplied to the design standard specified? How is this verified?
- How do we go about shift handover? Do you think that all key information gets transferred? How could it be done better?
- Have we incorporated learning's from process safety incidents into our procedures, and training programs? Do you have an example?
- Is everyone empowered to Stop work if an unsafe condition develops?

COMMISSIONING AND START-UP

For Managers

- What engineering standards have been applied to this project/item/facility?
- Who is verifying that they are being met before start up?
- How are potential contractors/vendors pre-qualified to participate in commissioning & start up?
- How do you assure that the trades are competent?
- How are we certain that the materials supplied are to the design standard?
- Have we properly considered the design and location of refuges and temporary buildings within plant areas that are potentially about to be made live?
- How do we go about shift handover? Do you think that all key information gets transferred? How could it be done better?
- Have you seen any aspect of the plant you think could be improved? How do you go about reporting design flaws picked up in commissioning & start up?
- What improvements could be made to the permit to work system?
- Is everyone empowered to Stop work if an unsafe condition develops?

For Supervisors

- How are we confirming that designed engineering standards are being applied to this project/item/facility?
- Are materials supplied to the design standard specified? How is this verified?
- Have we incorporated learning's from process safety incidents into our procedures, and training programs? Do you have an example?
- How do we capture small/incremental management of change?
- What have we considered in the location and design of temporary buildings or refuges?
- What alarm overrides are in place?
- How do you verify that all the isolations are in place?
- How do you validate that a task is safe to start? What would cause you to stop that task?
- What impact could this activity have on other activities? (and vice versa).
- Is everyone empowered to Stop work if an unsafe condition develops?

For Everyone

- How are we confirming that designed engineering standards are being applied to this project/item/facility?
- Are materials supplied to the design standard specified? How is this verified?
- Have we incorporated learning's from process safety incidents into our procedures, and training programs? Do you have an example?
- How do you validate that a task is safe to start? What would cause you to stop that task?
- Is everyone empowered to Stop work if an unsafe condition develops?

OPERATIONS AND MAINTENANCE

For Managers

Throughout Simultaneous Operations

- How would you describe the conditions of the assets here?
- Can you give me an example of where activities were stopped to reduce process safety risks? Do you feel empowered to intervene and if necessary stop operations if not safe?
- If you had a process safety concern, who would you go to validate that things were ok? Is that the best person?
- Have you seen any aspect of the plant you think could be improved? How do you go about reporting design flaws?
- Are local managers visible in the field?

APPENDIX 3. MORE DETAILED ASSURANCE QUESTIONS CONT.

- Do we have a mechanism for capturing lessons from PS events (internally and externally) and how to apply them to our operations? Have you applied findings from previous incidents and can you provide examples?
- What would be a major incident scenario for this operation and how could it escalate from a minor incident. What barriers do we have in place to prevent that occurring?
- What are the current focus areas to prevent a MAE? Can you demonstrate "continuous improvement"?
- On a typical shift how often do alarms activate? How do you manage alarms? How do you deal with alarm overrides? How many alarms are currently being overridden? Who authorises that? How long have they been like that?
- How do we go about shift handover? How is process safety issues handled at shift handover?
- How do you verify that all the isolations are in place prior to starting a task?
- What do you think process safety is about? Do you think there is sufficient awareness about what process safety is? Do we devote sufficient attention in our procedures/JSA everyday work on "Keeping product contained"
- What improvements could be made to the permit to work system?
- Do we have written procedures and sequences for the task? How valuable are they for the frontline personnel to complete the task? What improvements could be made?
- How do we report process safety incidents/ or learnings? Who does what? Give an example of how we have made changes after reporting an event? How could we do it better?
- When was the last Emergency Response Drill on Process safety? What was it about? What did you learn?

During Maintenance

- How would you describe the conditions of the assets here?
- What is the safety critical equipment on this plant? How can we demonstrate that maintenance of safety critical equipment is planned and executed on this facility?
- Can you tell me of any equipment that broke down (not planned shut downs) recently? How did it occur? What lessons have we learnt and changes made? Do these breakdowns occur often?
- What is the backlog of maintenance of safety critical equipment? - Who monitors this? Who authorises its delay?
- Do we understand the associated collective impact of multiple Safety Critical (SC) equipment in backlog?
- How many SC "temporary repairs" are currently on the plant? Are they strictly registered controlled and monitored by technical authorities sign off? How long have they been in place? Why haven't permanent repairs been conducted? Who authorises the deferment of the permanent repairs?
- How do you check that permit to work requirements are suitable?
- Show me how the requirements in the permit to work are being met?
- Do we have the equipment ready to deal with a process safety incident in accordance with our Emergency Response Plan? Do we have additional ability - maybe to assist others?
- How do we go about shift handover?
- How do you verify that all the isolations are in place?
- What improvements could be made to the permit to work system?
- Do you know the corrosion integrity of the plant?

During Audit/Inspection/Test/

- Do you know and understand the PS performance measures and expectations set for this facility?
- What is the backlog of inspection/test of safety critical equipment? Who monitors this? Who authorises its delay?
- When was the last time a process safety scenario was used in an emergency response drill? What was the scenario? What was learnt? Did it involve external stakeholders as well?
- How many alarm overrides are in place at the moment?

For Supervisors

During Operations

- How would you describe the conditions of the assets here?
- When is the last time we reviewed potential loss of integrity scenarios?
- How are we confirming that designed engineering standards are being applied to this project/item/facility?
- How have previous MAE for similar plant been incorporated into our operations? Some examples?
- Have we incorporated learnings from process safety incidents into our procedures, and training programs? Do you have an example?
- What are we doing to avoid cold embrittlement of materials? Are our frontline personnel aware of this hazard?
- How do we avoid tank overfills? How do we safely control / manage an overfill?
- Can you give me an example of where activities were stopped to reduce process safety risks? Do you feel empowered to intervene and if necessary stop operations if not safe?
- If you had a process safety concern, who would you go to validate that things were ok? Is that the best person?
- Do we have a mechanism for capturing lessons from PS events (internally and externally) and how to apply them to our operations? Have you applied the findings from previous incidents and can you provide examples?
- What would be a major incident scenario for this operation and how could it escalate from a minor incident. What barriers do we have in place to prevent that occurring?
- What are the current focus areas to prevent a MAE? Can you demonstrate "continuous improvement"?
- On a typical shift how often do alarms activate? How do you manage alarms? How do you deal with alarm overrides? How many alarms are currently being overridden? Who authorises that? How long have they been like that?
- How are process safety issues handled at shift handover
- How do we go about shift handover?
- How do you verify that all the isolations are in place and effective prior to starting a task?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- What improvements could be made to the permit to work system?
- Do we have written procedures and sequences for the task? How valuable are they for the frontline personnel to complete the task? What improvements could be made?
- How do we report process safety incidents/ or learnings? Who does what? Give an example of how we have made changes after reporting an event? How could we do it better?
- How do we capture small/incremental management of change?
- How would you describe the conditions of the assets here?
- How many safety over rides are currently in place in your area? Who authorised them? What percentage of your alarms is currently not functioning?
- On a typical shift how often do alarms activate? What percentage are "nuisance" alarms?
- Are the operating limits for all process equipment clear?

Maintenance

- How would you describe the conditions of the assets here?
- How many safety critical maintenance items are overdue?
- What percentages of alarms are currently not functioning?
- How can we demonstrate that maintenance of safety critical equipment is planned and executed on this facility?
- What is the backlog of maintenance of safety critical equipment? - Who monitors this? Who authorises its delay. Is this acceptable / controllable?
- Do we understand the associated collective impact of multiple SC equipment in backlog?
- How do you ensure that all steps in the maintenance procedure are followed?

Audit/Inspection/Test

- Do you know and understand the PS performance measures and expectations set for this facility?
- What is the percentage inspection of welds?
- What is the weld fail rate?
- What are the main causes of weld failure?
- How many leaks have been encountered?
- What is the identified cause of any leak?
- How have we tested the integrity of this item?
- Do you know the corrosion integrity of the plant?

APPENDIX 3. MORE DETAILED ASSURANCE QUESTIONS CONT.

For Everyone

Operations

- Could you explain the operating limits of this process equipment? What should I do if it approaches the limits? Who is authorised to allow operation outside this limit?
- What were the key learnings from the last Emergency Response Drill?
- Can you verify that the isolations are all in place?
- Do we have any outstanding maintenance items on this plant?
- Are there any alarm overrides in place for this plant?
- Is this procedure the most up to date? When was it reviewed?
- Do we have the right people here to do the JSA? Do we need any other technical experts or experienced people who have done this before?
- Is there anything that does not look right or has someone an experience where something similar failed before we should discuss, before we start this up?.
- When was the last time this was inspected and verified ok? Has anything changed since?

Maintenance

- Could you explain the operating limits of this equipment? What should I do if it approaches the limits? Who is authorised to allow operation outside this limit?
- Can you verify that the isolations are all in place?
- Do we have any other outstanding maintenance items on this plant? Could this impact on my task?
- Are there any alarm overrides in place for this plant?
- Is this procedure the most up to date? When was it reviewed?
- Do we have the right people here to do the JSA? Do we need any other technical experts or experienced people who have done this before?
- Who should I see if the scope of the work changes or we need to vary the JSA?
- Will this task impact on others? Will I impact others with this task?
- How are we going to ensure that the work progress status, any hazards and other information is handed over properly at each shift change? Is there a better way?
- Have we completed the prestart and restart toolbox talks well. Should anybody else be present?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- Have conditions (plant operating status, weather, personnel, and equipment) changed? Should we relook at the JSA and procedures?

DECOMMISSIONING & SHUTDOWN

For Managers

- How are we absolutely sure that an item is no longer under pressure or contains hydrocarbons or toxic materials.
- How are we sure that items are free of contaminants before sending to scrap or sale.
- How do we go about shift handover?
- How do you verify that all the isolations are in place?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- What improvements could be made to the permit to work system?

For Supervisors

- How are we absolutely sure that an item is no longer under pressure or contains hydrocarbons or toxic materials?
- How are we sure that items are free of contaminants before sending to scrap or sale?
- How do we go about shift handover to ensure plant equip status is known?
- How do you verify that all the isolations are in place?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- What improvements could be made to the permit to work system?

- Before shutting down the plant could you explain the operating limits of this equipment? What should I do if it approaches the limits? Who is authorised to allow operation outside this limit?
- Can you verify that the isolations are all in place?
- Are there any alarm overrides in place for this plant?
- Is this shutdown / decommissioning procedure the most up to date? When was it reviewed?
- Do we have the right people here to do the JSA? Do we need any other technical experts or experienced people who have done this before?
- Who should I see if the scope of the work changes or we need to vary the JSA?
- Will this task impact on others? Will I impact others with this task?
- Will the shutdown of this equipment destabilize other parts of the plant?
- How are we going to ensure that the work progress status, any hazards and other information is handed over properly at each shift change? Is there a better way?
- Have we completed the prestart and restart toolbox talks well. Should anybody else be present?
- Have conditions (plant operating status, weather, personnel, and equipment) changed? Should we relook at the JSA and procedures?

For Everyone

- How are we absolutely sure that an item is no longer under pressure or contains hydrocarbons or toxic materials before breaking containment?
- How do you verify that all the isolations are in place?
- How do you validate that a task is suitable to start? What would cause you to stop that task?
- Could you explain the operating limits of this equipment? What should I do if it approaches the limits? Who is authorised to allow operation outside this limit?
- Can you verify that the isolations are all in place?
- Are there any alarm overrides in place for this plant?
- Is this procedure the most up to date? When was it reviewed?
- Do we have the right people here to do the JSA? Do we need any other technical experts or experienced people who have done this before?
- Who should I see if the scope of the work changes or we need to vary the JSA?
- Will this task impact on others? Will I impact others with this task?
- How are we going to ensure that the work progress status, any hazards and other information is handed over properly at each shift change? Is there a better way?
- Have we completed the prestart and restart toolbox talks well. Should anybody else be present?
- Have conditions (plant operating status, weather, personnel, and equipment) changed? Should we relook at the JSA and procedures?


NO SMOKING
GEOGA

APPENDIX 4. KEY TERMS AND DEFINITIONS

ALARP	As Low As Reasonably Practical. A common term used in the assessment of risk.
APPEA	The Australia Petroleum Production & Exploration Association.
Assurance task	A task designed to test the health of a barrier, taking into account the multiple failure modes possible.
Barrier	A physical structure which blocks, prevents, detects, controls and mitigates a major accident.
Competence	The ability to be able to perform an activity to the expected standard
Controls	Precautionary measures which reduces or eliminates risk.
Deviation	Where a failure mechanism occurs, making a system no longer operate as designed, or where it has been taken out of service or is bypassed.
Failure on Demand / Test	A barrier may be deemed to have failed on demand or test when it has been called upon to perform its designed function and has not met its requirements, or it no longer meets the defined standard.
GSR	Golden Safety Rules
Leading Metric	A measure that proactively looks at the effectiveness of the barriers in place. Can look at barriers always being strong and present, OR track the weaknesses in a barrier after they have happened
MAE	Major Accident Event
Management of Change (MOC)	The change control process wherein changes to the scope of a project, plant or an organisation are formally assessed, approved, introduced and controlled safely.
PTW	Permit to Work. A safe system of work.
Process Safety	Process safety generally refers to the prevention of unintentional releases of chemicals, energy, or other potentially dangerous materials (including steam) during the course of chemical processes, that can have a serious effect to the plant, people and the environment. Other terms include, Technical Integrity or Asset Integrity
Risk	The result of Hazard severity vs Likelihood of occurrence
SC	Safety Critical
SCE	Safety Critical Elements. These are barriers that have been risk assessed and deemed to be critical to safeguarding the facility or organisation. SCEs can be hardware, control system related, or administrative, such as procedures.
SIMOPS	Simultaneous operations. Hazardous activities being performed at same time.
STFS	Stand Together For Safety- An Australian Oil & Gas industry safety leadership initiative dedicated to promoting the highest standards of safety

APPENDIX 5. REFERENCES

Other useful published guidance, regulations, reports, standards etc.

PREFACE

1. Charles Haddon-Cave QC (2009) The Nimrod Review
2. OGP 459 (2003) Life Saving Rules
3. API 754 (2010) Measuring Process Safety
4. IChemE Safety Centre Guidance (2015) Lead Process Safety Metrics – selecting, tracking and learning
5. OGP 368 Human Factors

SAFETY CULTURE

1. Anthony Hopkins; Lessons from Longford
2. Lardner, R; McCormick, P; and Novatsis, E. (2011) "Testing the validity and reliability of a safety culture model using process and occupational safety performance data", Paper 039 – Presented at IChemE Hazards XXII conference, Liverpool UK – 13-15 April 2011
3. Reason, J.T. (1997) Managing the Risks of Organisational Accidents
4. Patrick Hudson (2001) Safety Management and Safety Culture

DRILLING

1. 1API 754 (2010) Measuring Process Safety

ENGINEERING & DESIGN

1. UK HSE (1996) OTH 96 521 Improving Inherent Safety
2. OGP 454 Human Factors Engineering in Projects
3. HSE UK (1996) Design & Construction regs (DCR) "A guide to the integrity, workplace aspects of the offshore installations and wells Design and Construction regulations

CONSTRUCTION & HOOK UP

1. OGP 415 (2008), "Asset Integrity – The Key To Managing Major Incident Risks"
2. AIChemE (2007) "Guidelines for Performing Effective Pre-Startup Safety Reviews"

COMMISSIONING & START-UP

1. HSE UK (2006) "The safe isolation of plant and equipment", HSG 253

OPS & MAINTENANCE

1. EEMUA 191 Alarm Systems - A Guide to Design, Management and Procurement (1999)

DECOMMISSIONING & SHUTDOWN

1. HSE UK (2006) "The safe isolation of plant and equipment", HSG 253

GENERAL REFERENCES

1. OGP 210 Guidelines for the development and application of Health, Safety and Environmental Management Systems
2. OGP 415 Asset Integrity – The key to managing Major Incident risks
3. OGP 510 Operating Management System Framework
4. HMSO DOE (1975) The Flixborough Disaster – Report of the Court of Inquiry

stand together for safety
an australian oil and gas industry initiative

FURTHER INFORMATION

APPEA Contact Details
APPEA Program Director-Safety
Level 4 190 St Georges Tce (HSBC Building)
PERTH WA 6000

Stand Together for Safety Initiative
www.stfs.com.au
PO Box 7039, Cloisters Square WA 6850

NOPSEMA appea
CLOUGH amec ConocoPhillips Government of Western Australia Department of Mines and Petroleum bhpbilliton ExxonMobil
eni woodside origin Chevron PTTEP
Santos We have the energy. QUADRANT FERGUSON Asia Pacific Pty Ltd arrowenergy go further INPEX