LLOYD'S MARKET ASSOCIATION

KEY INFORMATION GUIDELINES FOR OIL, GAS & PETROCHEMICAL RISK ENGINEERING SURVEY REPORTS

ACKNOWLEDGEMENTS:

This document was originally developed and subsequently revised by Ron Jarvis (Swiss Re, London) and Andy Goddard (Talbot Underwriting Ltd, London) with contributions from the London market engineers within the LMA Onshore Energy Business Panel Engineering Sub-Group.

If there are any technical queries regarding this document please contact the LMA (dele.fajimolu@lmalloyds.com).

DOCUMENT REVISION HISTORY:

Version	Version Notes	Date of Revision
2015/001	Initial Publication	15/06/2015
2018/001	General Update including reference to findings in "An Analysis of Common Causes of Major Losses in the Onshore Oil, Gas & Petrochemical Industries – Implications for Insurance Risk Engineering Reviews"	19/12/2018
2024/001	Update to include new version of the above document	12/12/2024

FOREWORD

The primary purpose of insurance risk engineering is to allow (Re)Insurers to understand exposures and loss control features such that the (Re)Insurer can make an informed decision about the transfer of risk. (Re)Insurers would therefore consider themselves the primary (but not the only) customer. In addition, risk improvement is an important aspect of insurance risk engineering which is for the mutual benefit of (Re)Insurers and (Re)Insureds.

The risk engineering survey process and the subsequent market reports have remained essentially the same over a number of years and a review was undertaken in 2015 to refocus and modernise the approach in line with industry process safety developments and insurance loss experience.

This 2024 review has been carried out five years after the last issue, to update the documents in light of some shifting practices within the risk engineering community.

It is (Re)Insurers' belief that surveys should be planned and conducted in line with the following principles:

- A focus on process safety and loss prevention.
- An awareness of the common causes of losses in the industry.
- Inclusion of significant business interruption exposures in the scope of the survey, as these can constitute some 60-70% of the monetary value of losses.
- The importance of evidence-based risk engineering opinion.
- The effectiveness of implementation and compliance with site and best practice standards and procedures.
- Reporting of critical measures of process safety and loss prevention performance such as Process Safety Performance Indicators (PSPIs).
- The survey scope needs to be relevant to and cognisant of the terms of the insurance cover being purchased.

To that end, in 2015, three inter-related documents were developed to provide guidance on the development of survey programmes, conduct of surveys and key information to be included within market reports:

- Code of Practice for Delivery of an Oil, Gas & Petrochemical Risk Engineering Survey Programme (OG&P COPRES)
- Guidelines for the Conduct of Oil, Gas & Petrochemical Risk Engineering Surveys (OG&P GRES)
- Key Information Guidelines for Oil, Gas & Petrochemical Risk Engineering Survey Reports (OG&P IGRES)

During 2016, an analysis was conducted of common causes of major losses in the onshore oil, gas and petrochemical industries with a view that this would underpin the survey process and subsequent market reports. "An Analysis of Common Causes of Major Losses in the

Onshore Oil, Gas & Petrochemical Industries - Implications for Insurance Risk Engineering Surveys" was published in September 2016 with the intention to provide short updates as considered necessary. The 2018 review and update of the three risk engineering documents was intended to incorporate findings from the loss analysis study.

This review, in 2024, includes the findings from the recent update of the above document. In addition, the following document has also been published:

- Key Information Guidelines for Oil, Gas and Petrochemical Group-Wide Business Interruption Studies (OG&P IGBIS)

It is recommended that these guidance documents be adopted as far as practicable for the benefit of all involved parties.

Not only will the above approach provide the information requested by (Re)Insurers, it should also result in a more effective process for the (Re)Insured and will provide important process safety improvement opportunities.

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SECTION A: INTRODUCTION TO THIS DOCUMENT

1. Purpose

1.1. The purpose of this document is to outline the **key** information identified as important for inclusion in oil, gas & petrochemical risk engineering survey reports ('market reports') and to provide guidance to risk engineers responsible for producing such market reports.

2. Scope

2.1. This document identifies the key items of interest to (Re)Insurers rather than providing an exhaustive and definitive list of all possible information. It is recognised that, depending on the type of survey being undertaken, it may not always be possible to obtain all the information requested.

2.2. This document does not stipulate a specific format for market reports (section titles, order etc.). Ensuring that the information (Re)Insurers find most useful is present somewhere within a market report is far more important than the report format itself.

2.3. This document is intended to apply to a standard single site survey. It is recognised that other survey formats may be carried out such as property only coverage, recommendation update visits, focussed surveys or group level process safety management assessments. For non-standard surveys this document can be adapted as necessary.

2.4. This document is intended to outline information which would typically be available from a standard single site survey. With particular reference to business interruption, it is intended to outline information which should be available at the site level.

2.5. This document has been developed for onshore oil, gas & petrochemical assets.

2.6. This document has been developed by the Lloyd's Market Association (LMA) and hence is principally for reports produced for the London market, although this guidance could be adopted in other global markets.

3. General Principles

The following points are intended as general principles applicable to market reports.

Focus on process safety, loss prevention and causes of major losses

3.1. The focus of market reports should be on process safety with a view to assessing the adequacy of loss control elements. Whilst loss *mitigation* elements remain important (particularly when considering potential loss quantum), it is failures of loss *prevention* elements which lead to incidents and ultimately insurance claims and therefore there should be an increased focus on the latter.

3.2. "An Analysis of Common Causes of Major Losses in the Onshore Oil, Gas & Petrochemical Industries - Implications for Insurance Risk Engineering Surveys" analysed 150 major losses over a 25 year period considering causal factors. It identified

common Management System Failures (MSFs) as well as trends associated with the plant operating mode and remote isolation capability. Reference should be made to this paper for further detail but the key focus areas are reproduced here for easy reference:

- Mechanical Integrity
- Operations Practices & Procedures
- Process Hazard Analysis
- Control of Work
- Availability of Safety Critical Devices
- Management of Change
- Remotely Operated Emergency Isolation Valves

Report length

3.3. There is a growing tendency for market reports to exceed 80 pages. Whilst not an absolute target, it is considered that the information outlined in this document can be produced in a market report in the order of 50-60 pages. That said, the amount of detail provided within any market report should be commensurate with the exposures and associated risks.

3.4. A reduction in report length could be achieved through more succinct report writing, improved format and greater use of bullet points, tables, charts and diagrams. Certain pitfalls should be avoided:

3.4.1. Avoiding lengthy narrative and ensuring that text is relevant to risk quality assessment and the insurance cover being provided. Lengthy descriptions of the physical asset including the process should generally be avoided.

3.4.2. Avoiding repetition.

3.4.3. Avoiding report 'creep' by not simply adding more information to an existing market report following each survey, unless that information is considered to materially improve the report content. It is also important to ensure that historical information left in a report does not become obsolete.

3.4.4. Removing generic text from the main body of the report. Examples of generic text include standardised sections which appear in every report from the same engineering provider (e.g. the description of the loss estimating methodology). Such generic text could be provided within an appendix or even as a standalone document.

Evidence-based opinion

3.5. The risk engineer's opinion of the quality of individual risk control elements should be provided along with supporting evidence where possible. Reference should be made to the review of relevant documentation where applicable. Comments benchmarking against recognised good industry practice should also be provided where possible.

Implementation and compliance

3.6. A description of the features of a risk control element is normally provided in market reports, however commentary and evidence to support the *actual* implementation of an apparently sound system is often missing. Failures in implementation and non-compliance with established systems of work and procedures are a significant contributor to major losses making this is an important aspect to address within the report.

Performance data

3.7. Wherever possible, relevant performance data in the form of PSPIs and other Key Performance Indicators (KPIs) should be provided and can be used as evidence to support opinion and effective implementation (as above). Where possible, it is also important to comment upon trends and any exceptions to ensure the data is meaningful to the reader. For reference, a list of PSPIs is provided in Appendix 1 compiled from various industry bodies and other sources.

Audit and third party technical review

3.8. The limitations of the survey process are recognised in terms of the time available to carry out any depth of review. A key question, therefore, is what level of process safety auditing is being undertaken internally, externally to the site but from within the company (e.g. Group process safety audit) and externally by third parties. Details of any process safety auditing or third party technical review and in particular the key findings are of interest to (Re)Insurers. Should there be significant findings during a survey, then recommendations should be made to improve process safety auditing and/or conduct a third party technical review.

Risk quality rating

3.9. Overall risk quality ratings, while providing an easy to benchmark reference point, tend to average out strengths and weaknesses to such an extent that many risk engineers and (Re)Insurers consider them to be of limited value. In order for risk engineers and (Re)Insurers (particularly those not present on the survey) to undertake an independent analysis of any risk, it is therefore recommended that risk quality ratings be provided at individual Loss Prevention and Loss Mitigation element level.

Information not provided

3.10. Within the constraints of the survey process, it is recognised that not all of the information outlined in this document can be provided or revalidated at every survey. If information was not available or was not assessed then this should be stated within the market report.

Electronic format

3.11. All text, attachments and embedded files (EML output files, appendices, drawings, photos etc.) should be inserted such that they can be extracted and clearly read.

SECTION B: KEY INFORMATION GUIDELINES

EXECUTIVE SUMMARY

4. Executive Summary

4.1. An abbreviated narrative of the 'Plant & Operational Status', 'Loss Prevention' and 'Loss Mitigation' sections (these sections are more fully defined below).

4.2. A quality rating of individual 'Loss Prevention' and 'Loss Mitigation' elements. If deemed necessary an overall risk quality rating can also be included.

4.3. A list of the areas of the plant visited.

4.4. A list of the new and previous recommendations, indicating the current status.

4.5. A summary of the declared values and loss estimates.

PLANT & OPERATIONAL STATUS

5. Basic Plant Details

5.1. Provide a list of process units including the year of original commissioning and any subsequent revamps, technology licensor, current design capacity and current status (e.g. idled).

5.2. Provide a simplified Block Flow Diagram indicating the onsite interdependency between process units, utility systems and import/export facilities.

5.3. Provide basic details of the steam and electrical power supply systems including the current demand versus supply balance, redundancy and reliability. Provide basic details of any emergency power supply systems.

5.4. Provide a brief overview of the import, storage and export facilities.

5.5. Provide a legible site plot plan and opinion on the site layout, unit spacing, unit congestion, tankage spacing and layout, drainage and secondary containment.

5.6. Provide basic details of any recently completed or planned major capital projects (include schedule, cost etc.)

6. Operational Status & Reliability

6.1. Provide monthly production data for the last 12 months indicating capacity utilisation and plant availability (or equivalent metrics). Comment upon any significant restrictions to capacity utilisation and/or plant availability.

6.2. Provide monthly data for the last 12 months indicating the number of unplanned shutdowns. For each unplanned shutdown, provide brief details of the direct and root causes along with the remedial actions to prevent reoccurrence. Particular reference should be made to utility reliability.

6.3. For any new plant, provide details of the current status including any significant problems experienced during testing and commissioning or still outstanding (e.g. machinery failures, process capacity restrictions, warranty repairs etc.)

EXPOSURE ASSESSMENT

7. Exposures

7.1. Identify and comment upon any *unusual* fire and explosion exposures.

7.2. Identify and comment upon any technology risks such as novel or unproven processes and pioneering design (e.g. unproven design capacity).

7.3. Identify any onsite or offsite third party operations and comment upon the proximity and possibility of property damage accumulation.

7.4. Identify and comment upon any potential cross exposure associated with capital project works (e.g. simultaneous operations and construction (SIMOPS)).

7.5. Identify the key natural peril exposures along with the adequacy of associated controls, both physical (e.g. design standards, flood defences etc.) and procedural (e.g. hurricane preparedness procedures).

8. Values

8.1. **Property Damage (PD)**

8.1.1. State the basis for the declared values (historical book value, Actual Cash Value (ACV), Replacement Cost Value (RCV) etc.) to allow the adequacy of the declared values to be assessed.

8.1.2. Provide details of the last professional valuation including the date and performing company. Also provide details of any subsequent cost indexing applied to the valuation.

8.1.3. Provide a breakdown of values by process unit with separate values for utilities, storage areas and stock (where applicable/available).

8.2. **Business Interruption (BI) (Where Covered)**

8.2.1. State the basis for the declared values (gross profit, standing charges only etc.)

8.2.2. Provide a breakdown of values by process unit (where applicable/available).

9. Loss Estimates

The following information is requested in order to allow (Re)Insurers to independently verify and/or re-run the calculations using their own models/systems.

9.1. **Property Damage (PD)**

9.1.1. Consider the possible Estimated Maximum Loss (EML) (or equivalent terminology) fire and explosion scenarios and, in the case of Vapour Cloud Explosion (VCE) and/or High Pressure Vessel Rupture (HPVR) scenarios, provide a list of potential source terms. The source term list should include:

- Composition.

- Maximum and normal liquid operating volumes.
- Normal operating temperature and pressure.
- Location of vessel (or pipeline) source term.

Additionally for HPVR scenarios:

- Free gas volume.
- Vessel operating and design pressure.

9.1.2. State the explosion model and source-term utilised and include details of any adjustable factors within the model (e.g. liquid entrainment, yield factor, congestion factor, fire following, drift etc.)

9.1.3. Provide details of any escalation factors added to the calculated explosion damage (e.g. inflation during policy and/or rebuild period, firefighting, debris removal etc.)

9.1.4. State the basis for the values used (e.g. if declared values or engineering estimates).

9.1.5. Provide a plot plan in a format such that it can be used for independent verification of the explosion calculation. As a minimum, the scale should be clearly indicated.

9.2. **Business Interruption (BI) (where covered)**

9.2.1. Provide a qualitative (and wherever possible quantitative) assessment of the potential for BI in the following areas of the plant:

- Import facilities
- Process units
- Utilities
- Storage
- Export facilities

Consideration should be given to property damage events of a lower severity than the PD EML (but where BI consequences could still be significant).

In each area identify business critical elements and consider installed redundancy, flexibility of operation and potential mitigation. Include commentary upon the likely availability and practicality of any mitigation in the event of a loss (consider use of a BI scenario worksheet similar to that in Appendix 2).

9.2.2. Identify any critical process interdependencies with other plant(s) insured on the same policy. Comment upon the consequences and potential mitigation in the event of a loss at the producing or receiving locations.

9.2.3. Where applicable, identify other plant(s) insured on the same policy which could make-up any shortfall in production or take-up any excess in the event of a loss along with a qualitative assessment of the implications.

9.2.4. Develop and quantify the BI EML stating any assumptions made (the BI EML scenario may or may not be the same as the PD EML but the largest combined EML should be presented). The BI EML should include the impact of any interdependencies and take into account how the insurance policy would actually respond.

9.2.5. Quantified BI loss estimates should be based upon the site's Linear Programme (LP) or equivalent production planning tool. Also wherever possible, estimation should be made of the Increased Cost Of Working (ICOW).

9.2.6. Provide details of any site level Business Continuity Plan (BCP) covering critical property damage scenarios.

9.3. **Group (or Corporate) Level Business Interruption**

9.3.1. The calculation of BI EMLs for multi-location accounts requires careful analysis. The BI declared values may often not reflect the actual exposure at each location. Rather the figures may be expressed in a more arbitrary way or perhaps reflecting the (Re)Insured's internal accounting practices (internal allocation of revenue/profit). It may therefore be necessary to obtain BI interdependency information for multi-location accounts both for the insured locations and critical 3rd party suppliers and customers.

9.3.2. Individual sites often do not have this account information and therefore BI EML calculations conducted and included in survey reports for individual sites may not reflect the true account exposure.

9.3.3. Where (Re)Insurers agree that further BI information is required, the (Re)Insured should be requested to provide the required information based on a corporate level analysis. This may be beyond the scope of a standard single site survey and may necessitate specific meetings with the (Re)Insured's corporate functions to obtain the required information. Guidance on the requested content of a standalone BI study is provided in LMA OG&P IGBIS 2024/001.

9.4. **Contingent Business Interruption (CBI) (where applicable)**

9.4.1. Identify critical third party suppliers along with any potential mitigation in the event of a loss at a supplier. Consider the likely availability and practicality of any mitigation and quantify the consequences of loss of supply. Note that critical third party suppliers would not only include key feedstocks but any other process streams critical to production (e.g. third party supplied process gas).

9.4.2. Identify critical third party customers along with any potential mitigation in the event of a loss at the customer. Consider the likely availability and practicality of any mitigation and quantify the consequences of loss of a customer.

LOSS PREVENTION

10. Process & Equipment Safeguarding

10.1. **Basic Process Control, Emergency Shutdown & Isolation**

10.1.1. Provide basic details of the Basic Process Control System and any Emergency Shutdown (ESD) systems including the location and design of control buildings.

10.1.2. Provide basic details of the approach to Industrial Control Systems (ICS) cyber security. Given the likely areas of expertise of members of the survey team and plant representatives, it is not recommended that a detailed analysis of cyber security is undertaken. In the event that further information is required, further guidance on cyber security reviews can be found in the LMA's Cyber Security & Safety Considerations for Oil, Gas & Petrochemical Risk Assessment (LMA OG&P CSSC 2017/001).

10.1.3. Provide basic details of the pressure relief and flare systems (in particular any systems relieving to atmosphere).

10.1.4. Provide details of remote isolation, depressurisation and blowdown systems and in particular the provision and specification of ROEIVs.

10.2. **Equipment Safeguarding**

10.2.1. Provide basic details of the equipment safeguarding features in the following areas:

- Critical machinery and high hazard pumps.
- Fired heaters and boilers.
- Storage tanks (in particular overfill protection).
- Import and export facilities.

10.3. **Safety Integrity Level (SIL) Assessment**

10.3.1. State the scope of the last SIL assessment, when it was completed and the status of any necessary follow-up recommendations (testing and/or plant modifications).

10.3.2. If there is no SIL assessment in place, provide details of the alternate process to assure the integrity of safety critical instrumentation.

10.4. **Alarm Management & Safe Operating Limits (SOLs)**

10.4.1. Provide basic details of the alarm management programme along with any associated data and/or KPIs.

10.4.2. Provide basic details of the SOL programme along with any associated data and/or KPIs.

11. Leadership Responsibility & Commitment

11.1. Provide a copy of the site's management level organisation chart indicating the main functional departments and reporting lines. Comment upon the independence of critical functions such as Inspection and Safety.

11.2. Provide details of any recent or planned changes of ownership, reorganisation, downsizing or outsourcing initiatives. Where relevant, provide details of the associated risk assessment and the effect the change will have on the organisation and risk profile.

11.3. Identify any management level vacancies and comment upon the turnover of the management team members.

12. Process Safety

12.1. **Process Safety Framework**

12.1.1. Provide basic details of the process safety management framework including the status of the development and implementation of process safety standards.

12.1.2. Provide details of any dedicated process safety resources at both corporate (if applicable) and site level.

12.1.3. Provide details of any dedicated process safety committees including the committee make-up, involvement of senior management, scope of activity and frequency of meetings.

12.1.4. Provide details of process safety training from awareness campaigns to structured competency programmes.

12.2. **Process Safety Performance Indicators (PSPIs)**

12.2.1. Provide the site's suite of Process Safety Performance Indicators (PSPIs) including current and historic data. Comment on any trends and corrective actions.

12.3. **Process Safety Incidents**

12.3.1. Provide monthly process safety incident data for the last 12 months. Process safety incident data should be reported as it is defined by the (Re)Insured and including a severity categorisation.

12.3.2. For any significant incidents, provide brief and relevant details of the incident, consequences, root causes and corrective actions.

12.3.3. Describe the main elements of the procedure used for incident investigation and comment on the quality of incident investigation reports and root cause identification process.

12.3.4. Provide data and/or KPIs on the implementation of recommendations resulting from incident investigations.

12.3.5. Comment on learning from process safety incidents at other sites (within the (Re)Insured group as well as the wider industry).

12.4. **Process Safety Auditing**

12.4.1. Describe the main elements of the process safety audit programme (both internal and external) including the involvement of senior management.

12.4.2. Provide data and/or KPIs to support compliance with the audit programme and tracking of the follow-up actions resulting from the audits. Provide a

summary of the key recommendations resulting from the most recent audits and comment on the adequacy of the programme based on evidence observed during the survey.

13. Operations

13.1. Organisation

13.1.1. Provide a basic and brief outline of the Operations organisation including employee numbers, vacancies and turnover of personnel with trends. Include data where possible.

13.1.2. Provide the average experience levels and age profile of the staff.

13.1.3. State the criteria for the definition of minimum operator manning levels, including the minimum required and actual manning levels.

13.1.4. Comment on the use of additional manning and technical support for start-up. Also provide details of the ability for manning levels to cover vacation, absenteeism and training.

13.2. Shift Handover

13.2.1. Describe the main elements of the shift handover procedure. Comment and provide opinion upon the adequacy of the procedure and provide evidence of its implementation.

13.3. Standard & Emergency Operating Procedures (SOPs & EOPs)

13.3.1. Comment and provide opinion upon the quality of the SOPs.

13.3.2. Comment and provide opinion upon the quality, availability and usability of the EOPs.

13.3.3. Comment upon the use of signed and itemised checklists for critical operations (such as startup).

13.3.4. Comment upon the adequacy of the routine review process for SOPs and EOPs and provide data and/or KPIs on compliance with the process.

13.3.5. Provide details of any SOP/EOP improvement initiatives such as Human Factor reviews, Procedural HAZOP, Safety Critical Task Analysis or similar.

13.3.6. Provide details of the Operational Risk Assessment (ORA) process, or equivalent process which controls deviations from the SOP.

13.4. Training & Competence Assurance

13.4.1. Describe the main elements of the training and certification process for new operators.

13.4.2. Describe the main elements of the operator competence definition and assessment process.

13.4.3. Provide details of how operator rotations are used to assure ongoing competence.

13.4.4. Describe the main elements of the critical SOP and EOP refresher training programmes and provide data and/or KPIs on compliance with the

programme. In particular, details should be provided of any EOP scenario drills (for instance response to specific utility failures).

13.5. **Permit To Work (PTW)**

13.5.1. Describe the main elements of the PTW system and highlight any deficiencies versus industry good practice.

13.5.2. Provide evidence of compliance with the PTW system.

13.5.3. Comment upon housekeeping and other permit closure issues including caps and blanks on open ends, bolting standards of pipework, junction boxes etc.

13.5.4. Describe the main elements of the PTW audit process and provide data and/or KPIs for PTW compliance.

13.6. **Equipment Isolation**

13.6.1. Describe the main elements of the equipment isolation procedures (mechanical and electrical) and highlight any deficiencies versus industry good practice.

13.6.2. Provide evidence of compliance with the equipment isolation procedures.

13.7. **Safety Critical Instrumentation Override Management**

13.7.1. Describe the main elements of the safety critical instrumentation override procedure and highlight any deficiencies versus industry good practice.

13.7.2. Provide evidence of compliance with the override procedure.

13.7.3. Provide data and/or KPIs associated with the status and implementation of the override procedure.

14. Maintenance

14.1. **Organisation**

14.1.1. Provide a basic and brief outline of the Maintenance organisation including employee numbers, vacancies and turnover of personnel with trends. Include data where possible.

14.1.2. Provide the current maintenance budget and trend

14.1.3. Provide the average experience levels and age profile of the staff.

14.1.4. Describe the extent of the use of contractor workforce and the level of in-house supervision.

14.2. **Basis of the Maintenance Programme**

14.2.1. Provide basic details of the basis for the maintenance programme (Original Equipment Manufacturer (OEM) guidelines, corporate standards etc.)

14.2.2. Provide basic details of any equipment criticality assessment and how this relates to the programme definition, work prioritisation and spares holding.

14.2.3. Advise if Safety Critical Equipment (or equivalent terminology) has been defined and if so the scope and implications of such a classification.

14.3. **Planning, Prioritisation & Performance**

14.3.1. Provide basic details of the systems and processes used to plan and prioritise maintenance work.

14.3.2. Describe the procedure for deferral of maintenance work on Safety Critical Equipment (or equivalent terminology).

14.3.3. Provide details of the turnaround plan (schedule, frequency etc.), any interim planned shutdowns (catalyst change etc.) and the procedure for deferral of turnarounds.

14.3.4. Provide details of the performance of the most recent turnaround including such items as personal and process safety, cost and schedule versus plan, key maintenance and inspection findings, achievement of the work list and any deferrals etc.

14.3.5. Provide the site's suite of maintenance KPIs (include actual data, trends and details of any corrective actions). Particular focus should be on completion of Safety Critical maintenance activities (planned and corrective).

14.3.6. Provide comment and opinion on the general condition of the plant and equipment.

14.3.7. Provide details of the bolted joint procedure for routine and turnaround maintenance and comment upon the integrity of bolted joints as observed in the field.

14.4. **Reliability**

14.4.1. Describe the processes utilised for reliability improvement (e.g. bad actor programmes, Reliability Centred Maintenance, Failure Mode and Effects Analysis).

14.4.2. Provide data and/or KPIs associated with plant and equipment reliability (e.g. plant mechanical availability, Mean Time Between Failure).

14.4.3. Provide details of any significant equipment mechanical failures since the last survey and the processes used to investigate such failures.

14.5. **Rotating Equipment Maintenance Programmes**

14.5.1. Provide basic details of the rotating equipment preventive and predictive maintenance programmes for the different types of rotating equipment (type and frequency of activity etc.) and comment upon the quality of the programmes and output results.

14.5.2. Provide a tabulated list of all critical rotating machinery including basic design details, replacement cost, impact on production in the event of failure, spares holding and estimated time to repair/replace.

14.5.3. Provide details of the maintenance and testing programmes for critical rotating machinery protective systems (overspeed trips, non-return valves etc.)

14.6. **Electrical Equipment Maintenance Programmes**

14.6.1. Provide details of the electrical equipment preventive and predictive maintenance programmes for the different types of electrical equipment

(type and frequency of activity etc.) and comment upon the quality of the programmes and output results.

14.6.2. Where BI is covered, list any critical transformers including basic design details, impact on production in the event of failure, spares holding and estimated time to repair/replace.

14.6.3. Provide details of the maintenance and testing programmes for electrical protective systems (protective relays, circuit breakers etc.)

14.6.4. Provide details of the maintenance and testing programmes for emergency power supply systems (Emergency Diesel Generators (EDGs), Uninterruptible Power Supply (UPS) etc.)

14.7. **Testing of Safety Critical Instrumentation**

14.7.1. Provide details of the programme for testing of safety critical instrumentation (Emergency Shutdown (ESD) systems, safety trips/interlocks etc.) including the basis, frequency and type of testing.

14.7.2. Provide details of the test procedures and the reporting and investigation process followed should safety critical instrumentation fail on test.

14.7.3. Provide data and/or KPIs associated with the testing.

15. Inspection

15.1. **Organisation**

15.1.1. Provide a basic and brief outline of the Inspection organization including employee numbers, vacancies and turnover of personnel with trends. Include data where possible.

15.1.2. Describe the qualifications and experience of the Inspection personnel.

15.1.3. Describe the training and competence requirements for Inspection personnel.

15.1.4. Comment on the adequacy of employee numbers and the use of contractors and other third parties.

15.2. **Basis of the Inspection Programme**

15.2.1. Describe the inspection philosophy (e.g. time based, risk based etc.) and the standards used to develop the programme (e.g. government regulation, American Petroleum Institute (API), corporate standards).

15.2.2. Establish the extent to which process equipment and piping is included within the inspection programme.

15.2.3. Describe how damage mechanisms have been identified and documented (Corrosion Control Documents, Damage Mechanism Reviews or equivalent).

15.2.4. Provide details of how the type and frequency of inspection is established and documented on an equipment specific basis (e.g. Written Scheme of Examination) and how this links to the identified damage mechanisms.

15.2.5. If Risk Based Inspection (RBI) is implemented (or being implemented), provide details of the system used, specialists involved and the data used to justify the RBI study output.

15.3. **Equipment Specific Programmes**

15.3.1. Describe the inspection programme for the following equipment types:

- Pressure vessels.
- Piping (Inside Battery Limit (ISBL), Outside Battery Limit (OSBL) and underground) – this is considered to be a critical item.
- Pressure Relief Devices (PRDs).
- Storage tanks.
- Fired heaters and boilers.

15.3.2. Describe the inspection programme for the following specific damage mechanisms (these are often conducted on a separate 'campaign' basis):

- Corrosion Under Insulation (CUI)
- Corrosion Under Fireproofing (CUF)
- Corrosion Under Pipe Supports (CUPS)

15.3.3. Describe how areas subject to enhanced damage are managed (e.g. deadlegs and other no/low flow areas, injection points, small-bore piping due to vibration induced fatigue etc.)

15.4. **Planning and Deferment Management**

15.4.1. Provide basic details of the systems and processes used to plan inspection work and specifically provide data and/or KPIs on any overdue inspections. Where applicable, state the reasons why inspections have become overdue.

15.4.2. Provide details of the procedure used to defer any planned inspection work and make particular reference to risk assessment and management approval. Include data and/or KPIs where possible.

15.5. **Equipment Deficiency Management**

15.5.1. State how end of life criteria have been defined, including arbitrary retirement thickness (or an equivalent minimum thickness definition).

15.5.2. Provide details of any process equipment or piping which is operating beyond end of life criteria, is under a special inspection regime and/or has undergone a 'fitness for service' assessment.

15.5.3. Provide details of the procedure for the installation, interim inspection and removal of temporary repairs. State how many temporary repairs are in place in hydrocarbon service, for how long and when they are due to be removed.

15.5.4. Provide details of how inspection recommendations are issued, prioritized and tracked through to completion and support this with evidence of implementation.

15.5.5. Provide details of the procedure followed should PRDs fail on test and support with data and/or KPIs.

15.6. **Operational Changes and Deviations**

15.6.1. Provide details of the mechanisms in place to ensure that any process or operational changes that may affect mechanical integrity, for example changes in feedstock, are reported to the inspection department.

15.6.2. State whether or not Integrity Operating Windows (IOWs) have been defined and, if so, how these are monitored.

15.7. **Material Verification**

15.7.1. Provide a brief overview of the main materials of construction including any alloy material installed for corrosion resistance and any recently completed or planned material upgrades, including the rationale for those upgrades.

15.7.2. Provide details of the material verification programme for the receipt, warehousing and installation of alloy materials (ensure consideration given to both maintenance and project activities).

15.7.3. Provide details of any retrospective material verification programme for existing alloys installed within the plant.

15.8. **Records & Analysis**

15.8.1. Describe and comment on the quality of the inspection reports, making particular reference to the identification and coverage of Thickness Measurement Locations (TMLs) on isometric and/or mechanical drawings (including ordinarily inaccessible locations), the capturing of Non-Destructive Testing (NDT) data and corrective recommendations.

15.8.2. Describe and comment on the effectiveness of the inspection data management system, making particular reference to data population, corrosion rate and remnant life calculations.

15.9. **Performance Monitoring & Audits**

15.9.1. Describe what inspection performance metrics and information is monitored and routinely reported to management. Provide and comment on the data including any targets and trends.

15.9.2. Describe what internal and external audits of the Inspection function have been undertaken and summarise the most significant findings.

16. Technical & Engineering

16.1. **Process Hazard Analysis (PHA)**

16.1.1. Describe the key features of the PHA procedure applied to existing plant including methodology, scope, team make-up etc. Comment and provide opinion on the adequacy of the procedure.

16.1.2. Provide particular commentary on how all operating modes (e.g. startup) are reviewed and if and how Safety Critical tasks are identified and reviewed.

16.1.3. Provide details of the revalidation frequency, type of revalidation and the current status of PHA reviews including data and/or KPIs where applicable.

16.1.4. Comment and provide opinion on the implementation of the procedure and quality of the PHA reviews. Provide details of any quality assurance and audit activities.

16.1.5. Provide details of how PHA recommendations are prioritised, tracked through to completion and validated as closed. Provide data and/or KPIs indicating the current status of PHA recommendations.

16.2. **Management of Change (MoC)**

16.2.1. Describe the key features of the MoC procedure including definition and types of change (including organisation change, feedstock changes, etc), stepwise process flow, hazard identification and risk assessment, training, documentation etc. Comment and provide opinion on the adequacy of the procedure.

16.2.2. Describe the key features of the Pre-Start-up Safety Review (PSSR) procedure and comment upon the quality of the procedure and its implementation.

16.2.3. Comment and provide opinion on the implementation of the procedure and quality of the MoC reviews with particular reference to the hazard identification and risk assessment stage.

16.2.4. Provide details of how the status of MoCs is tracked from initiation to close-out and include data and/or KPIs associated with MoC close-out.

LOSS MITIGATION

17. Passive Protection

17.1. Provide a description and opinion of the extent and condition of structural support fireproofing.

17.2. Provide a description and opinion of the extent and condition of fireproofing of ROEIVs, critical instrumentation and power cabling.

18. Active Protection

18.1. **Fire & Gas Detection**

18.1.1. Comment upon the adequacy of the coverage and 'as found' working condition of fire, gas and smoke detection systems and their associated alarms.

18.2. **Firewater System**

18.2.1. Identify the worst case firewater demand scenario and associated flow rate requirements.

18.2.2. Provide basic details of the installed firewater system and comment upon its ability to meet the worst case firewater demand. Considerations should include capacity redundancy, backup diesel for electric pumps, security of power supply to electric pumps etc.

18.2.3. Comment upon the design and availability of the firewater system in terms of its ability to rapidly respond to an incident. Considerations should include the pump start mechanism, firewater main pressurisation, any significant impairments, integrity of the firewater main etc.

18.3. **Fixed Protection**

18.3.1. Comment upon the provision of fixed protection to process, storage and utility areas. In particular for the process areas, state coverage provided for pressure vessels, high hazard pumps and business critical machinery including the associated lube oil skids.

18.4. **Fire Protection Improvement**

18.4.1. Provide details of any structured programmes, such as Fire Hazard Analysis (FHA), to identify gaps in the provision of fire protection features. State the methodology utilised and the output.

18.5. **Testing**

18.5.1. Provide basic details of testing and maintenance procedures for firewater pumps and other fire protection equipment, identify any deficiencies with the test procedures and include evidence of compliance with the stated procedures.

18.6. **Impairment Management**

18.6.1. Verify that a fire protection system impairment procedure is in place and provide evidence of compliance with the stated procedure.

19. Emergency Response

19.1. **Organisation**

19.1.1. Provide basic details of the emergency response organisation (onsite, offsite and any mutual aid schemes).

19.1.2. Provide basic details of the training programme with data and/or KPIs on compliance with the stated training programme.

19.1.3. Provide opinion on the ability of the emergency response organisation to fight a major hydrocarbon fire (manning, training, equipment etc.)

19.2. **Mobile Firefighting Equipment**

19.2.1. Provide a list with basic details of the onsite mobile firefighting equipment.

19.2.2. Comment upon the adequacy and condition of the mobile firefighting equipment.

19.3. **Emergency Response Planning**

19.3.1. Provide basic details and comment upon the adequacy and quality of the Emergency Response Plan.

19.3.2. Provide basic details and comment upon the adequacy and quality of the fire pre-plans.

19.4. **Emergency Response Exercises**

19.4.1. Provide basic details and comment upon the adequacy and quality of the emergency response exercises including follow-up reports and recommendations.

19.4.2. Provide data and/or KPIs on compliance with the stated exercise schedule.

19.4.3. Provide details of the process for handling recommendations with data and/or KPIs on recommendation tracking.

19.5. **Emergency Response Audit**

19.5.1. Provide details of any third-party audits of the emergency response capability.

RISK IMPROVEMENT RECOMMENDATIONS

20. Risk Improvement Recommendations

20.1. Recommendations should be directly relevant to the insurance cover being provided and of sufficient importance to risk quality improvement.

20.2. Recommendations should be written in a clear and succinct manner and follow Specific, Measurable, Achievable, Relevant, Time-related (SMART) principles.

20.3. Recommendations should be presented as observations and actions. The observation should outline the background to the identified issue and include references to standards or established best practice. The action should be the recommendation itself. The recommendation title should include what is the required action (e.g. identify need for, improve, complete, etc).

20.4. Where recommendations are in multiple parts, each sub-recommendation should be individually identified with a separate letter (e.g. a, b, c etc.) or number (e.g. I, ii, iii, etc.). Bulleted lists should be avoided as they cannot be easily referenced.

20.5. Provide a summary and the current status of any previous recommendations (continual addition of status updates year on year should be avoided). Status flags should either be: In Progress; No Progress; Under Review; Completed; Superseded; Rejected; or Withdrawn. These status flags are not sufficient without additional explanation and justification.

20.6. The response of the (Re)Insured to any new recommendations should also be provided, including their view of, and intent to, address each recommendation.

APPENDIX 1-- Process Safety Performance Indicators (PSPIs)

1.1. It is recognised that the (Re)Insured may have their own PSPIs and where that is the case these should be presented in the market report in each section as appropriate.

1.2. However, the (Re)Insured's own list of PSPIs should be compared with and could be supplemented by a selection of PSPIs from the following list whenever the necessary information can be obtained during the survey. It should be emphasised that the (Re)Insured is not necessarily requested to measure or report the PSPIs listed below, merely that the inclusion of some of these within the market report will aid the risk engineer to assess process safety performance.

1.3. The list has been compiled based upon commonly agreed important PSPIs amongst the London energy risk engineering community and also from the following publications:

1.3.1. *Energy Institute. Research Report Human Factors Performance Indicators for the Energy and Related Process Industries. 1st Edition. December 2010.*

1.3.2. *HSG254. Developing Process Safety Indicators. HSE. 2006.*

1.3.3. *API 754. Process Safety Performance Indicators for the Refining & Petrochemical Industries. April 2010.*

1.3.4. *Marsh Risk Engineering Position Paper-- 04. Process Safety Performance Indicators – PSPIs.*

1.3.5. *CCPS. Process Safety Leading & Lagging Metrics. 2011.*

1.3.6. *iChemE Safety Centre Guidance – Lead Process Safety Metrics – Selecting, Tracking and Learning. 2015*

1.3.7. *OGP Process Safety – Recommended Practice on Key Performance Indicators, Report 456. November 2011.*

The following table has been developed to be broadly in line with the sections of the main document:

Section/Subsection	Metric
Process Safety	
Incidents	Number of process safety incidents classified by severity (#)
Incidents	Number of Loss Of Primary Containment (LOPC) incidents classified by severity (#)
Incidents	Number and proportion of overdue actions from incident investigations (# and %)
Process Safety Committee	Number and proportion of overdue actions from the process safety committee (# and %)
Audits	Number and proportion of overdue actions from process safety audits (# and %)
Operations	
Plant Performance	Capacity utilisation (actual versus design capacity) (%)
Plant Performance	Plant availability (proportion of time available to produce) (%)
Plant Performance	Number of unplanned shutdowns (#)
Organisation	Number of vacant positions (#)
Organisation	Average overtime worked per operator (hrs)
Organisation	Annual operator turnover (%)
Organisation	Average operator experience (yrs)
Shift Handover	Shift handover compliance as per audits (%)
Operating Procedures	Procedure reviews completed as per plan (%)
Training	Training completed as per plan (%)
Permit To Work	Permit audits completed as per plan (%)
Permit To Work	Permit compliance as per audits (%)
Override Management	Number of safety critical instrument overrides and by duration (>1 day, >1 mth, > 3 mths) (#)
Alarm Management	Average alarm rate per operator (# per hr)
Alarm Management	Number of standing alarms per console (#)
Safe Operating Limits (SOL)	Number of SOL exceedances (#)
Safe Operating Limits (SOL)	Number of activations of safety systems (SIS, PRDs etc.) (#)
Operational Risk Assessments (ORAs)	Current number of live ORAs

Maintenance	
Organisation	Average overtime worked per technician (hrs)
Planning	Amount of overdue planned maintenance work (ie. backlog) (weeks)
Planning	Proportional split of maintenance work orders by priority (%)
Planning	Proportional split of reactive (corrective) and proactive (planned) maintenance by manhours (%)
Planning	Safety Critical planned maintenance compliance (%)
Planning	Safety Critical corrective maintenance compliance (%)
Reliability	MTBF for different equipment types (months)
Reliability	Plant mechanical availability (%)
Safety Critical Instruments	Number and proportion of overdue safety critical instrument testing (# and %)
Safety Critical Instruments	Number and proportion of safety critical instrument failures on test (# and %)
Safety Critical Instruments	Proportion of corrective maintenance on safety critical instruments overdue (%)
Inspection	
Planning	Proportion of hydrocarbon piping systems on the inspection schedule (%)
Planning	Number and proportion of overdue inspections as per plan by equipment type (# and %)
Planning	Number and proportion of overdue PRD testing per plan (# and %)
Planning	Number of inspection deferrals in place by equipment type (#)
Equipment Deficiency	Number of inspection results outside acceptable limits (#)
Equipment Deficiency	Number and proportion of PRV failures on test (# and %)
Equipment Deficiency	Number of temporary repairs in hydrocarbon service (#)
Integrity Operating Windows (IOW)	Number of IOW exceedances (#)
Performance	Number of leaks through metal (#)
Technical & Engineering	
Process Hazard Analysis (PHA)	PHA reviews completed as per plan (%)
Process Hazard Analysis (PHA)	Number and proportion of overdue PHA actions and by risk category (High, Medium, Low) (# and %)
Process Hazard Analysis (PHA)	PHA procedure compliance as per audit (%)
Management of Change (MoC)	Number of MoCs beyond predefined close-out period after start-up (ie. overdue) (#)
Management of Change (MoC)	Number of temporary changes beyond original reinstatement date (ie. overdue) (#)
Management of Change (MoC)	MoC procedure compliance as per audit (%)
Management of Change (MoC)	Proportion of audited changes subject to MoC (%)

Emergency Response	
Testing	Number and proportion of overdue fire protection equipment testing (# and %)
Testing	Number and proportion of fire protection equipment failures on test (# and %)
Impairment	Number of fire protection systems under impairment and by duration (>1mth, >3mths) (#)
Training	Training completed as per plan (%)
Emergency Exercises	Exercises completed as per plan (%)
Emergency Exercises	Number and proportion of overdue actions from emergency response exercises (# and %)

APPENDIX 2 - Business Interruption Scenario Worksheet

Plant Area	Critical Loss Scenario(s)	Unmitigated Loss	Mitigations	Mitigated Loss
Import Facilities				
Process Units				
Utilities				
Storage				
Export Facilities				