

FIELD IMPLEMENTATION OF THE COMAH COMPETENT AUTHORITY STRATEGIC PRIORITY ON AGEING PLANT[†]

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This paper describes the development of the COMAH Competent Authority's (CA) Strategic Priority on Ageing Plant, the findings to date and the implications of these findings for industry, and Chemical Engineers in particular.

The CA's approach to the issue is underpinned by technical evidence gathered over a number of years. Initial research work, published in 2006 (Wintle, 2006), led to the introduction of the concept of 'ageing plant' as equipment which is degrading from its new condition, rather than something which is solely related to equipments' chronological age. This document set out a sound basis for establishing systems for the management of ageing and gives detailed advice on ageing mechanisms, their detection, measurement and assessment. By 2008 it was becoming clear that plant ageing was a key factor in major accidents across the world and that the CA needed to drive improvement in the UK onshore Chemical and Petrochemical sector. Further work was commissioned by HSE, aimed at providing statistical evidence that would underpin a proposed intervention initiative on the issue. This led to the publication, in 2010, of a second report (Horrocks, 2010) which provided this evidence and a basis from which a field delivery programme could be developed. This work took a wider view of plant ageing than the original work which was very much focused on mechanical engineering; this resulted in greater consideration of leadership issues and the introduction of ageing issues associated with control and instrumentation equipment.

THE STRATEGIC PRIORITY

The CA sets strategic priority topics which it sees as key contributors to the goal of minimising the potential for Major Accidents (MAs) at COMAH sites. In the case of ageing plant, the work reported by Horrocks, 2010 has shown that it is not only a contributor to potential MAs but also that there is evidence of it being a key factor in many actual accidents. For the 2010/11 workyear, and beyond, the CA adopted ageing plant as one of these topics; meaning that it attracts a high priority for intervention activity by field inspection teams.

The Ageing Plant Programme identified 7 key topics which are seen as fundamental to the effective management of plant ageing;

- Leadership
- Resources
- Asset Register
- Integrity of the primary containment boundary
- Integrity of safety critical mechanical equipment
- Inspection and test of safety critical instrumentation
- Dealing with obsolete and obsolescent instrumentation

This paper addresses the implementation in the field, from a mechanical engineering perspective, of the 1st 5 topics – that is it does not deal with the topics associated with instrumentation.

The first step in implementing the programme was to map the 5 fundamental topics against the mechanical engineering intervention work that had been carried out to date. This enabled us to both identify the 'gaps', where we had no information on a specific topic, and score the performance of sites against each topic. The gap analyses then

became live documents that are updated by our inspectors following subsequent interventions.

FINDINGS TO DATE AND IMPLICATIONS FOR CHEMICAL ENGINEERS

The work carried out in the first year of the programme suggested that, of the circa 200 sites for which we had data;

- 25% are performing acceptably
- 50% are partially compliant (i.e. some improvement is required)
- 25% are unacceptable (i.e. significant improvement required urgently)

In reviewing these results, the mechanical engineering team has found that operators are able to remedy immediate technical failings, with prompt enforcement where appropriate. However, operators often fail to address the root causes of these problems, that is a lack of effective business leadership supporting sound management of plant integrity. As a result, when we find poor technical performance we will concentrate further interventions, with the support of Regulatory colleagues, in this area.

In addition, we are finding that Chemical Engineers are often directly or indirectly, influencing the management of plant ageing on site. Either through their role as a business leader or site manager, or as one of perhaps a very few professional engineers managing the technical functions. We consider it vital that Chemical Engineers in leadership positions have a sound knowledge of the issues associated with successfully managing ageing plant, and that those managing the technical function have sufficient

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competence to act as an effective ‘intelligent customer’. This should enable;

- Leaders to set the right expectations, and be able to ensure they are delivered through their management teams and provide effective support to their managers.
- Management teams to develop and deliver an effective ageing management regime.
- Those buying in expertise to know enough to effectively perform the role of an ‘intelligent customer’ when dealing with 3rd parties.

More recently, early analysis of the results of interventions carried out in 2011 and early 2012 has shown that the picture established from the initial data, early in 2011 has improved somewhat. This analysis suggests that currently;

- 30% are performing acceptably
- 50% are partially compliant
- 20% are unacceptable

This is an encouraging start, but there remains much improvement to be achieved so the CA will continue to press for improved standards, using formal enforcement where necessary, in its interventions over the coming years.

INTRODUCTION

This paper will explain a little of the background of the approach taken by HSE’s Chemical Industries Division to the inspection of integrity management issues following the introduction of the COMAH regulations, but prior to the recent work on ageing noted above. It will then discuss the COMAH Competent Authority’s¹ development of the latest work on ageing (Horrocks, 2010) into its Strategic Priority on Ageing Plant, the implementation of this in the field and the initial results of the programme. Finally, the paper will touch on the relevance of ageing management to Chemical Engineers.

BACKGROUND – INTEGRITY INTERVENTIONS 1999–2010

With the advent of the COMAH Regulations in 1999, the Division set up to enforce them recognised a need for much greater involvement of specialists in the process. As a consequence, it set about recruiting the relevant expertise (primarily in process, mechanical and control and instrumentation engineering, then latterly in human factors). Once a suitable level of specialist staffing had been achieved the division made a step change in the way in which it deployed specialists, from providing primarily reactive support to Regulatory inspectors to giving them a proactive role in the inspection of their specialist subject area. Over the period, the specialist resource employed within the Division

¹The COMAH Competent Authority (CA) is made up of the HSE together with the Environment Agency (England) and the Scottish Environmental Protection Agency (Scotland).

has risen to a current level of 55 (against a fairly steady population of Regulatory inspectors of around 80). From the perspective of integrity management, this change led to mechanical engineering specialists carrying out interventions looking specifically at how sites manage plant integrity, and the quality of delivery from these systems. In addition, a similar task was performed with maintenance management systems, although to a lesser degree due to resource constraints. Outcomes from these interventions would more often than not be a series of specific actions placed on the site to address specific technical failings and, in some cases, technical management issues such as the effective implementation of Risk Based Inspection systems. There is no doubt that this approach led to improvements in performance, but we recognise that it also had its limitations, notably;

- It did not give us any idea of the overall performance of the industry or strong evidence to identify any particularly weak areas.
- It did not address any non-technical factors which might be underlying the poor technical performance—most notably the impact of site leadership.

The advent of the recent work on plant ageing presented an opportunity to re-visit our intervention strategy and develop an approach that addressed the two key issues noted above, maximising the impact of our necessarily limited resources.

THE COMAH COMPETENT AUTHORITY STRATEGIC PRIORITY ON AGEING PLANT WHAT IS A STRATEGIC PRIORITY?

In parallel with the research on plant ageing circa 2008/9, but as a totally separate programme, the COMAH CA embarked on a review of the way in which the COMAH regime had been regulated in the 1st 10 years, looking specifically for ways in which our approach could be improved. One of the outcomes of this ‘COMAH Remodelling’ process, was an intention to identify a small number of key topics which it was felt had the most significant impact on our goal of minimising the potential for major accidents at COMAH sites. These topics would then be the subject of targeted intervention, with sites being scored on their performance such that the impact of interventions could be more easily monitored. The work by ESR Technology [Horrocks, 2010] reported elsewhere at this conference, had confirmed that ageing is a very significant contributor to losses of containment that could potentially lead to major accidents, and so ageing plant was chosen as the 1st of these Strategic Priorities.

SCOPE OF THE STRATEGIC PRIORITY ON AGEING PLANT

The work carried out by ESR Technology (Horrocks, 2010), together with the initial work on plant ageing [Wintle, 2006], was used to develop the scope of the Strategic

Priority. The scope was purposely developed in such a way as to be compatible with the division's previous intervention work on ageing topics, yet encompass the broader coverage proposed, in particular by ESR Technology's work. This work was led by the field mechanical and control and instrumentation engineering teams and resulted in the identification of 7 key intervention topics;

1. Leadership
2. Asset Register
3. Integrity of the primary containment boundary
4. Integrity of safety critical mechanical equipment
5. Inspection and test of safety critical instrumentation
6. Dealing with obsolete and obsolescent instrumentation
7. Resources.

This paper deals with the implementation in the field of the topics above relevant to mechanical engineering; that is topic 1–4 and 7.

The CA's instructions to its inspectors on delivering the Strategic Priority are published in a Delivery Guide [HSE, 2010] which is available via HSE's website.

Leadership

It has become increasingly clear that the leadership's understanding of, and attitude to, ageing issues has a direct impact on the technical delivery of ageing management on the site. Without a sound understanding within the leadership team of ageing, and its importance to both safety and business performance, together with a positive attitude to its management, it is unlikely that a satisfactory ageing management regime will ever be delivered; whatever the capabilities of the team directly charged with its implementation. Thus, the CA considers the leadership topic to be key to securing sustained improvements in ageing management performance across the sector.

In assessing this topic, we are looking to establish the extent to which site senior managers are aware of the performance of systems designed to maintain the integrity of safety critical assets, and their commitment to ensuring that those assets remain fit for service at all times.

Asset Register

Having a clear understanding of all the assets on-site, and clear identification of those that are safety critical, is a foundation of any effective ageing management regime.

In assessing this topic, we are seeking assurance not only that a comprehensive Asset Register exists and identifies safety critical equipment, but also that the process used to identify safety critical items is robust and effective.

Assuring the Integrity of the Primary Containment Boundary

Arguably the most significant intervention topic, as it is directly concerned with prevention of losses of containment, this is also a topic that had received a lot of attention from CA mechanical engineers prior to the adoption of the

Ageing Plant Strategic Priority. Whilst the aim of this topic is simple, its scope is broad, covering issues such as;

- Roles and responsibilities;
- Scope of equipment covered;
- Inspection scope and periodicity;
- Delivery of the examination process;
- Dealing with adverse findings;
- Postponement of examinations;
- Repairs;
- Performance monitoring;
- Interface with operations.

The level of intervention effort expended on this topic, as others, will be proportional to the potential major accident risks of the site but, for significant sites, would normally require a number of interventions. The initial intervention would seek to establish how the ageing management regime is structured and whether any key elements are missing. Subsequent interventions would deal in more detail with key elements as relevant to the site; for example operation of a Risk Based inspection system or strategy for dealing with corrosion under insulation.

Assuring the Integrity of Safety Critical Mechanical Equipment

This topic is concerned with mechanical equipment, for example pumps or compressors, which, if it were to fail could initiate, fail to mitigate or cause escalation of a major accident. As with the previous topic, the scope of interventions here is quite broad, covering;

- Identification of Safety Critical Equipment (SCE);
- Maintenance delivery;
- Performance monitoring;
- Postponement of maintenance of SCE;
- Spares holding policy;
- Spares quality assurance.

Resources

This topic simply addresses the level and competence of resources provided to deliver the ageing management regime. In many circumstances, the CA will establish sufficient information on this topic from the specific interventions against Primary Containment and Safety Critical Mechanical Equipment to make an intervention on resourcing inappropriate. Conversely, in some cases these technical interventions may identify resourcing issues that indicate the need for a specific intervention. Where there are indications of issues associated with competence they may ultimately be addressed under the Competence Strategic Priority (introduced in 2011).

Scoring

Once sufficient information has been gathered against a site's performance on a particular topic, a score is allocated as follows;

The gap analysis and scoring will be updated following each subsequent intervention to enable a record of a

Table 1. Performance Rating: Where there is an identified major accident risk associated with ageing plant

Performance rating	Description	CA action to consider	Score
Exemplary	Good practice or above in all respects. All success criteria fully met. Robust and effective ageing plant management regime in place. The rationale for the regime can be demonstrated.	No action required.	10
Good	Good practice in most respects. Most success criteria met. Effective ageing plant management regime in place, but some potential weakness.	Provision of advice or confirmatory letter only with no plans for follow-up in the short term.	20
Partially compliant	Some success criteria not fully met. Ageing plant management regime in place with some gaps and weaknesses. Inspections and maintenance of ageing plant are planned and prioritised.	Written confirmation of work required and agreed timetable. Short term follow-up action required.	30
Poor	Many success criteria not met/fully met. Ageing degradation mechanisms only partially identified. Ineffective ageing plant management regime in place.	Enforcement action likely – Improvement Notice.	40
Very poor	Majority of success criteria not met/fully met. Ageing degradation mechanisms only partially identified. No ageing plant management regime in place.	Enforcement action very likely – Improvement Notice, HSW or COMAH Prohibition Notice, consider prosecution.	50
Unacceptable	No success criteria met. Ageing degradation mechanisms not identified. No ageing plant management regime in place. No Inspections or maintenance of ageing plant.	Enforcement action inevitable – Prosecution, Improvement Notice, HSW or COMAH, Prohibition Notice.	60

site's performance to be kept, and to facilitate monitoring general performance across the sector.

INTEGRATING THE STRATEGIC PRIORITY WITH PREVIOUS INTERVENTION WORK ON AGEING ISSUES

Whilst developing our approach to interventions on Ageing Plant, we were aware that over the 1st decade of the COMAH regime, a lot of useful information had been gathered by the field mechanical engineering team. We therefore sought to ensure that this information was, where appropriate, integrated into our approach to the Strategic Priority; both to ensure that useful information was not lost but also to avoid duplication of cost recoverable work.

Gap Analysis

The method chosen to integrate the previous work on ageing topics with the new Strategic Priority was to carry out a Gap Analysis against the Delivery Guide (specifically Appendix 5) for each site with a history of intervention by Mechanical Engineering specialists. These gap analyses performed 2 functions;

- To identify which topics had been previously covered, and to what extent, thereby identifying topics required to be included in future intervention plans;

- To score the site's performance against each topic where sufficient previous intervention history was available.

In order to ensure, as far as practical, that the information was current a threshold of 5 years was taken as the maximum 'age' of information to be used in the gap analysis. This process led to gap analyses being produced for in the region of 200 sites.

Self Assessment Questionnaire

Resource limitations inevitably mean that specialist interventions are targeted at the highest risk sites, leaving a large number of sites that had not received any specialist intervention on ageing issues prior to the advent of the Strategic Priority. In order to provide intelligence on this group of sites, and to identify any that may require short term intervention, those considered to have the potential for ageing issues were sent a self assessment questionnaire. This questionnaire was developed by ESR Technology in their work Horrocks, 2010], and addressed 3 areas, to provide a picture of the potential risk represented by the site, these were;

- To what extent is the plant on site likely to be subject to ageing mechanisms?
- Is there evidence that ageing mechanisms are active?
- Does the inspection regime provide adequate coverage of those areas of the plant subject to active ageing?

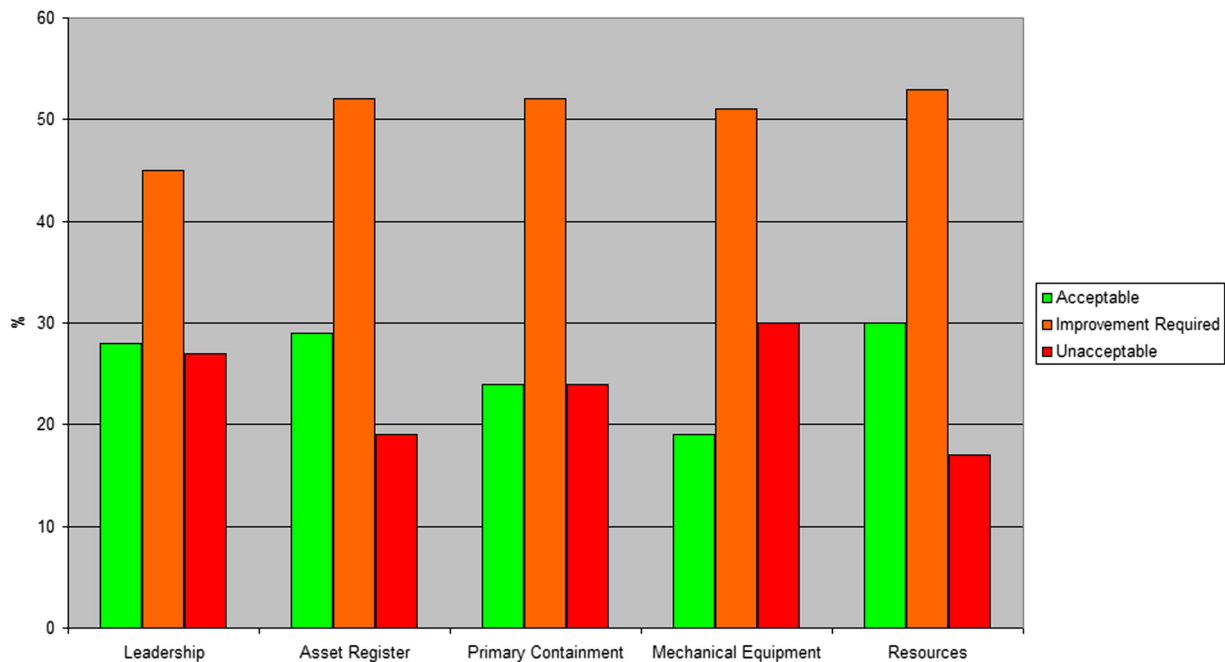


Figure 1. Performance across the sector March 2011

The returns from this exercise were used to identify any sites where the answers suggested a need for an urgent intervention (in the case of mechanical engineering 3 sites fell into this category) and to assign a broad priority to any future interventions on ageing issues.

INITIAL FINDINGS FROM IMPLEMENTATION OF THE PROGRAMME

Baseline Position from Gap Analyses

Following the completion of circa 200 gap analyses, the scores allocated were assessed to provide the baseline picture of performance across the sector shown in Figure 1.

The situation indicated by Figure 1, with in the region of 75% of sites falling short of full compliance when averaged across the 5 mechanical engineering topics, is far from satisfactory. A position that is a concern to the CA as regulator, and should be of concern to the industry.

Note: In terms of the scoring system described above the descriptions in Figure 1 are related as follows;

- *Acceptable* – 10 or 20
- *Improvement Required* – 30
- *Unacceptable* – 40, 50 or 60

The report into the BP Texas City incident had raised the significance of leadership issues in the prevention of major accidents, so in reviewing the picture painted by this initial set of results, looking to see how we might drive improvements, it wasn't a great surprise to find that leadership is a topic central to achieving sustained improvements in site performance. Without a sound understanding of, and positive attitude to, ageing

issues amongst the site leadership, together with the ability to recognise when it is being managed effectively, it is unlikely that sustained improvements in performance will be achieved. To this end, where significant technical failings are found (specifically in the areas of Primary Containment and Mechanical Equipment) further intervention targeted specifically at leadership performance will be undertaken (resources permitting). In addition, in stakeholder engagement work carried out over 2011 and 2012 the following key messages to leadership teams have been promoted.

Site Leadership Teams should;

- Take *positive action* to ensure arrangements to address Ageing Plant issues are in place and fit for purpose.
- Ensure sufficient resource and appropriate levels of staff competence are in place to deliver the Ageing Plant regime.
- Put in place robust systems to review and assess the effectiveness of the Ageing Plant regime.
- If Ageing Plant activities are delivered by a third party organisation, ensure that their remit is correctly defined and that it fulfils the requirements of the Ageing Plant regime. Overall responsibility for safe plant will always remain with the Duty Holder.
- Have a realistic and accurate picture of their plants condition, its susceptibility to ageing and the implications of this now and in the future.
- Provide robust support to those charged with managing Ageing Plant where inspection findings indicate a need for investment (this might be resources, plant down time or capital) in order to be in a position to demonstrate that plant remains fit for service.

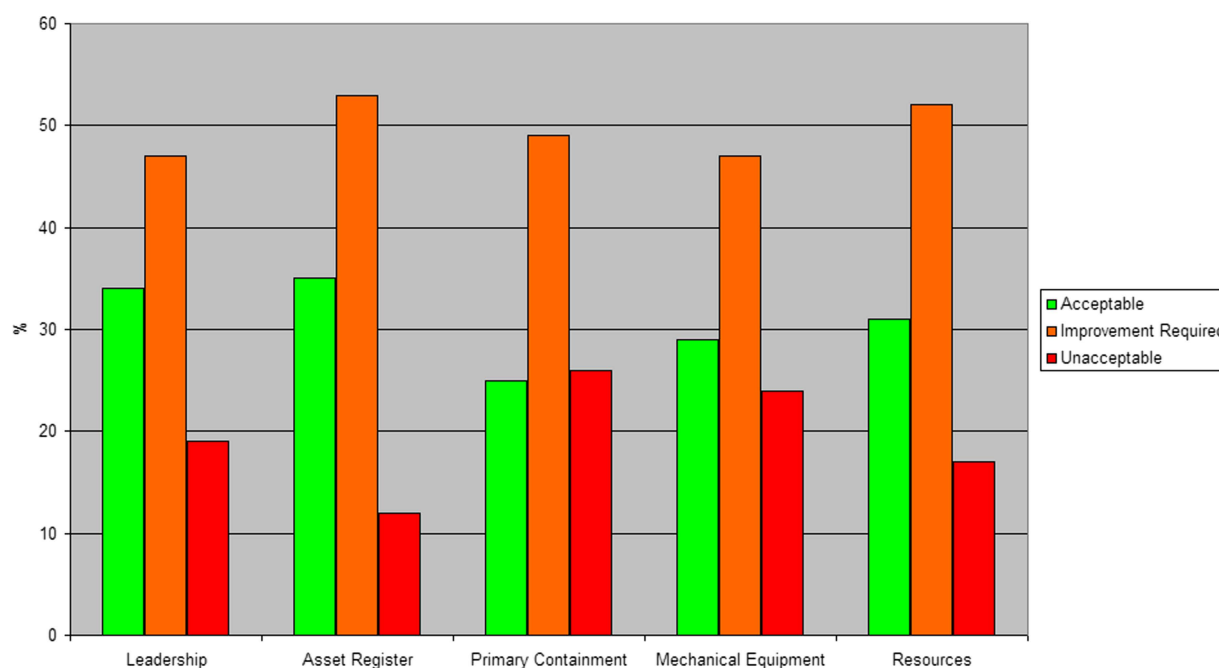


Figure 2. Performance across the sector March 2012

Initial View of Position After 2011/12

Whilst there are still a significant number of results to be assessed, initial scoring from work carried out between April 2011 and March 2012 indicates the position shown in Figure 2.

Although these more recent data have yet to be fully analysed, the initial results do suggest that there has been a small improvement in performance year on year, with the percentage of sites falling short of our expectations falling, approximately, from 75% to 70%. So, there are signs that industry is responding to the challenge of ageing plant but there is absolutely no reason for complacency and the CA will continue to seek improved performance, using formal enforcement where appropriate, at sites where standards fall short of our expectations.

RELEVANCE TO CHEMICAL ENGINEERS

The management of plant ageing would normally be considered the realm of Mechanical and Control & Instrumentation Engineers. However increasingly, evidence gathered from the CA's interventions is suggesting that at many sites there is no professional mechanical or control engineering resource so responsibility for the management of ageing can in these circumstances, fall to Chemical Engineers. In such circumstances it is probable that the delivery of the ageing management regime will be by 3rd party organisations, so it is important that Chemical Engineers in these roles have sufficient knowledge of ageing issues to be able to act as an effective intelligent customer – ensuring that the 3rd party delivers what is required by the site and, where necessary, challenging performance.

Similarly, site leaders are also often Chemical Engineers and in this case it is important that they understand the significance of ageing, and the difficulties faced by those tasked with managing integrity on site such that, as leaders, they can provide effective support.

This paper has not attempted to cover the detail that Chemical Engineers would need to know when operating in these roles. It has however, hopefully, provided a degree of insight onto the COMAH CA's approach to Ageing Plant and its significance to plant safety, together with our expectations of business leaders and chemical engineers fulfilling management and leadership roles.

CONCLUSION

Work conducted on HSE's behalf by ESR Technology has confirmed the view that the management of ageing is a major factor in a significant proportion of loss of containment incidents at high hazard sites, providing support to the adoption by the COMAH Competent Authority of Ageing Plant as one of its Strategic Priorities.

The ESR work has been developed into a practical form for implementation by the COMAH CA in the field, with initial results showing that significant improvements are needed in ageing management before either industry, or the CA as its regulator, can gain assurance about risk management by MH operators. Leadership has been identified as the key factor in driving sustained improvements and will be a focus for future interventions, where appropriate, in ageing management.

Initial results have indicated that significant improvements are required before the issue of plant ageing can be

said to be being properly addressed. In a mature industry where effective and systematic management of process safety is an unchallenged priority – this is extremely worrying and does not fill us as the regulator with a great deal of confidence that the risks presented by plant ageing are being properly managed.

Whilst the most recent data appears to be indicating an improvement, there remains a need for action now from the industry to improve – from specialists in this field, and senior and operational managers within major hazard businesses.

Many Chemical Engineers will have a role to play in delivering effective ageing management regimes at their sites; either through having direct responsibility for, say, 3rd parties carrying out integrity work or through their

position on the site leadership team. It is essential that those who perform these roles have an appropriate level of understanding of and competence in ageing plant issues to ensure that this vital issue is properly managed.

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