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GUIDANCE ON IN LINE INSPECTION FIRST RUN SUCCESS

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ABSTRACT

First run success is a key performance measure used in the BP Global In Line Inspection (ILI) Contract [1]. This drives effectiveness and efficiency in the processes supporting ILI and it is a key commercial performance indicator for ILI Suppliers. Although run success rates are often referred to across the industry there has been little standardisation in the terminology, or the factors that lead to a successful run.

Three definitions have been established for run success: Technical; Commercial and Operational. Each has a place although it is Operational run success that drives improvements between operators and suppliers.

The introduction of a performance measure for first run success increases the focus on getting things right the first time.

The financial cost of ILI run failure has probably been underestimated by the industry; although it is estimated that it could be as high as 30% of total contracted costs for ILI. For some projects the costs associated with a failed run can be far greater than the original project costs (e.g. additional vessel support costs for deployment or recovery during offshore operations). A failed run can also result in a delayed inspection and an associated increased risk as well as potentially compromising compliance with regulatory requirements.

The consequences of run failure vary in severity and can be presented in a pyramid similar to the typical representation of safety statistics. A stuck tool requiring intervention or a pipeline failure, as a result of an incorrect inspection report, would be at the top of the pyramid. The lower tiers would capture technical failures and the effectiveness of cleaning. Understanding the consequence of failures can help drive performance improvements across the industry.

As part of the BP continuous improvement process, ILI Suppliers and internal stakeholders were brought together for a facilitated workshop to understand the factors affecting first run success rates. The workshop identified a number of common themes which were consistent across all of the Suppliers addressing; both operational issues and tool performance.

A Guidance Note was then developed with the ILI Suppliers to drive improvements in first run success rates. This was shared with the Pipeline Operators Forum (POF) in October 2011 and has been further developed as a POF Guidance Document. A separate guidance note has been developed to address recommended practices for collecting and verifying field data.

Successful ILI requires good communication between all parties. As the industry starts to inspect more difficult and challenging lines it will be important to improve ILI run success rates. Across the industry we probably know how to do it, but doing it consistently is the challenge. The development of industry Guidance Notes represent a small step towards achieving this objective.

As ILI operations improve the focus will increasingly turn to the reliability of tools. There is much that can be learnt from other industry sectors, such as the motor or aviation industry, on improving reliability of components and systems. This will require an increased use of preventative maintenance practices. There is also a need to create a common basis for reporting reliability of inspection tools and for this to be taken into account when operators make their selection of ILI tools.

The Global ILI Contract has brought an increased focus to the performance of the overall inspection process which is driving improvements in first run success rates. It has facilitated the development of guidelines on best practice and is starting to set standards for reliability.

The high level of cooperation between suppliers and operators to drive improvements in this area is a measure of the importance of first run success rates to all parts of our industry.

Achieving ILI first run success requires both the operator and ILI supplier to work together. Whilst each has a key part to play effective communication from an early stage is essential.

INTRODUCTION

Whenever a pipeline is inspected, the objective is to collect a valid set of data to help assess the pipeline condition. ILI is typically the preferred method of inspection used by pipeline operators as part of a baseline survey or revalidation process.

A key indicator that can be used to measure performance is the ILI first run success rate. It is a measure of the performance of both the operator and supplier and how effectively they work together. After the ILI tool has been set up it then needs to be run with the right operating conditions. A complete data set then needs to be down loaded and analysed. The run is only complete when the report has been received, features verified and data quality confirmed. Achieving a high first run success rate requires close coordination between the pipeline operations teams and ILI suppliers.

DEFINITION

Although first run success is often referred to by ILI suppliers a consistent definition has not been used across the industry. To be able to start to drive improvements a common definition had to be established.

Working with the ILI Suppliers the following run success definitions were developed. The definitions apply whenever a tool has been mobilised to site and both the tool and pipeline system are ready to deploy.

Commercial	The supplier is paid for runs which may have failed due to operating conditions (e.g. line cleanliness). Some tool component failure may be acceptable provided that there is no significant data loss.
Technical	There are no component failures or data loss. This measure is tracked by suppliers to monitor the reliability of inspection tools.
Operational	The inspection is completed, delivering correct data, first time in accordance with contracted requirements (some sensor failure may be acceptable provided that the objectives of the inspection have still been met).

Use of the Operational run success performance measure helps drive improvements in performance of both the operator and the ILI supplier. Success is only achieved where both the operator and supplier have completed their parts and there is effective communication between the parties. It should be noted that the Operational run success rate is typically lower than Commercial run success rate. Examples of “operational” failed runs include; a tool mobilised to the field but not launched due to access problems; incomplete data capture due to a mechanical failure or due to poor pipeline preparation and degraded data due to speed excursions. Some of these may still be classed as a Commercial run success if the supplier has been paid for the run.

The Technical run success rate looks at the overall tool performance and reliability. Failures of tool components or systems are usually recorded.

A key measure of the effectiveness of an ILI operation is whether both the supplier and operator get everything right the first time. This is referred to as the first run success rate which is applied to the operational run success statistics.

Run success can also be considered in terms of the overall project success; where other performance measures such as HSSE performance, mobilization and invoicing are measured. Whilst these are important performance measures for a successful project they are not the focus of this paper.

Failures can have a range of outcomes: from the need to repeat a run (where the line has not been adequately cleaned or the tool has been run outside the speed envelope resulting in degraded data quality) to a more significant impact; such as a severely damaged ILI tool or, in the worst case, a stuck tool which then has to be cut out (which can have specific process safety risks and operational impacts).

Tool failures can be presented in a similar format to health and safety incidents. In this case, the highest consequence, which is a stuck tool, would be presented at the top of the pyramid and events such as minor damage or data loss are presented towards the bottom of the pyramid. Visualizing the effects of failed runs helps prioritise incidents and target areas where improvements need to be made.

Whilst suppliers have tracked the commercial run success rates the operational costs associated with failed runs have had less visibility.

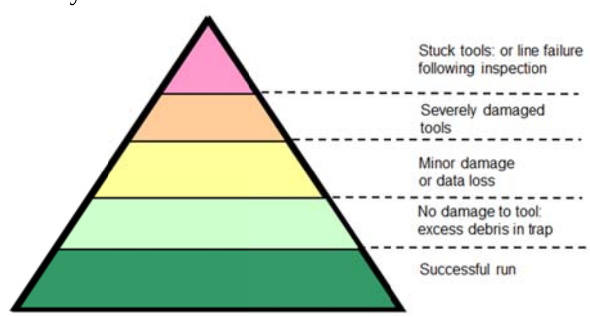

FIGURE 1: CONSEQUENCE OF FAILURE

As the industry increasingly addresses more difficult offshore pipelines the costs of failed runs can be more significant; particularly where offshore support vessels are involved. These costs alone can exceed $500,000 per day, which is far more than the cost of the inspection run. Inspection of deep water pipelines may also require changes to production to allow inspection, particularly where flow loops are used. In these cases the consequence of failure can have a significant commercial impact.

As the industry increasingly looks at how to inspect pipelines in these challenging environments the importance of achieving first run success will become more significant.

Through development of closer working relationships with the ILI Suppliers an opportunity was provided to take a fresh look at the factors involved in achieving first run success. Through performance monitoring it was recognised that operations which ran pigs on a regular basis often had higher first run success rates than areas where tools were run occasionally. Interestingly it was also noted that, in experienced operations groups, the performance by different suppliers could show significant variations.

Recognising that there would be benefits from improving first run success rates a programme was initiated in 2010 that is slowly changing the way in which operators and suppliers work together. Whilst the initial work addressed the interfaces between operators and suppliers the programme is now starting to focus on the reliability of ILI tools.

WORKSHOP 2010

In February 2010 BP brought together the ILI Suppliers and key operators from across the BP Group in a facilitated workshop to explore the factors needed to achieve first run success. Given the participants at the workshop detailed discussion of tool component failures was avoided to preserve commercial confidentiality.

The workshop focused on the interface between the operator and the ILI supplier. This included the definition of first run success and the ILI process from project initiation to completion and the importance of sharing lessons learned. All of the failure data presented during the workshop was shared in a non-attributable format.

Root cause analysis techniques, using a series of fish bone diagrams, were used to develop a potential failure map for each of the key stages of the process.

The failure analysis shared within the group illustrated that two areas need to be addressed if improved first run success is to be achieved. The first relates to the interface activities between operators and suppliers from tool preparation to data analysis and field verification. It was also noted that a significant number of failures were associated with bore restrictions which deserved a separate category.

The second group is associated with tool reliability and covers tool preparation, set up and operation. This can then be split into Electrics (cables, connectors and batteries): Computing (software or firmware) and Components (mechanical failure of components). These activities are managed by the supplier and will be reflected in the overall tool reliability. The relative proportion of the causes observed in 2010 is illustrated in Figure 2.

Whilst there will always be debate as to which of these sectors is the primary cause of failure (for example was the mechanical failure of the component due to a bore restriction or due to the design not being sufficiently robust) the Figure helps highlight those areas where improvements need to be made if run failures are to be avoided.

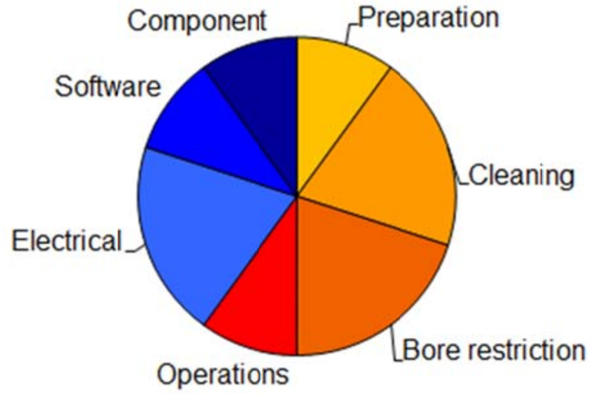

FIGURE 2: FAILURE ANALYSIS IN 2010

It was recognised by all of the workshop participants that improvements to ILI run success could be achieved if all parties involved in the process were to follow some consistent steps.

GUIDELINE DEVELOPMENT

As a result of the workshop a BP Guidance Document was developed that addressed the key steps in the process.

Some of the key factors affecting first run success in each of these steps are described in subsequent sections of this paper. The Guidance Document made reference to the standard questionnaire used in the Global ILI contract and developed a series of check lists for each stage in the process.

The Guidance Document on first run success was then shared with the Pipeline Operators Forum (POF) in October 2011. Following review by POF members the guidance document was modified and made available through the POF web site for use within the wider industry. The standard questionnaire, check lists and feedback process have been made available as separate documents.

Work is continuing with the ILI Suppliers to improve tool reliability and how the pipeline bore is confirmed as being suitable before an ILI run commences. These have been the focus of detailed audits and discussions however are not addressed in detail in this paper.

KEY STAGES FOR IMPROVING RUN SUCCESS

The topics included in the POF Guidance Document follow the key stages in the development and execution of an ILI Project.

Project Initiation

At the start of each ILI project clear objectives need to be set. This requires dialogue and effective communication between the operator and the supplier. High first run success rates are consistently achieved where there is an early engagement process and alignment of the project objectives.

The early stages of any ILI project require a considerable level of data gathering and transfer. This process can be simplified through the use of a standard questionnaire, as the requirements should be the same for all Suppliers. Based on the NACE Standard RP0102 [3] the BP Global ILI Contract developed additional sections and a common format for use with all of the Suppliers. These have been further developed and have now been included in the POF Guidance note.

Completion of the questionnaire and an early technical review start the process of matching the inspection objectives with the tool attributes and inspection capabilities. The discussion should address the physical limitations of the tool and the performance for the anticipated operating conditions. Understanding the technical limitations is an important parameter that drives the probability and accuracy of detection. To assist with this process a checklist was developed which provides the minimum expectation for topics to be discussed during the initial supplier meeting.

From the information presented the supplier can determine the optimum tool set-up for the given pipeline conditions or provide guidance on how the inspection performance may be improved by changing the operating parameters.

An early site visit and discussion with all of the key stakeholders is recommended. A further checklist was developed which provides the key topics that should be covered during the site visit.

All successful operations require effective management of risks which need to be clearly identified at an early stage in the process. Risk assessments need to address both personal safety and the wider process safety issues associated with ILI runs such as the impact the tool can have on downstream operations; changes to flow conditions and the implications of a stuck or lost tool. A risk assessment check list was developed as part of the guidelines to provide the key points which need to be addressed and a structured approach for evaluating and documenting the findings.

Improving dialogue and involving both parties in the risk discussions improves the overall understanding of the project scope. When this is combined with the use of standard questionnaires and check lists for stakeholder meetings, site visits, and risk assessments there will be greater alignment between the operator and supplier and an increased first run success rate. Copies of the checklists are provided as Annex A.

Cleaning and Preparation

The quality of inspection data is not only dependent on the quality and reliability of the inspection methodology used but also the operational conditions of the pipeline during the inspection. Ineffective cleaning can lead to: incomplete or degraded data; damage to the inspection tool or, in the worst case, a stuck tool.

It is recommended that early proving of the pipeline bore is carried out during the cleaning phase to allow an early assessment of the suitability of the ILI tool to pass through the pipeline.

Although gauge plates (Figure 3) or profile tools are often used for this purpose incorrect interpretation of damage has led to stuck or damaged tools. It should be noted that gauge or multi profile plate tools do not provide an indication of where the pipeline may have a larger bore diameter, which has been the cause of a number of failed runs including stuck tools. For this reason use of a high definition caliper tool is considered to be more effective.

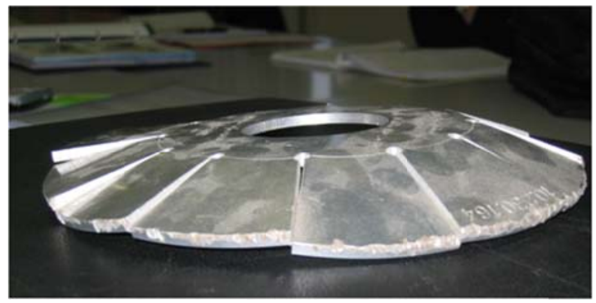

FIGURE 3: EXAMPLE OF GAUGE PLATE

Effective cleaning for ILI is best achieved where the pipeline is pigged and cleaned on a regular basis. The type of cleaning tool used and the amount of material removed should be recorded and tested. The cleaning programme should start well in advance of the planned inspection date.

The level of cleanliness required for successful inspection will generally depend on the technology used. It may also depend on the tool design, including bypass capabilities (to keep materials in suspension) and flushing to keep sensitive parts of the tool free from build-up of deposits (which is important when inspecting wax rich pipelines).

A review of cleaning options should not just be limited to the use of mechanical cleaning pigs as the use of cleaning fluids in conjunction with regular cleaning pigs can provide a more efficient programme resulting in a relatively low number of runs [2]. A checklist has been developed which identifies key points to be considered when developing the cleaning programme.

During the cleaning programme the pipeline should be continuously assessed to monitor the cleaning programme effectiveness and to confirm when the pipeline is ready for inspection.

Analysis of failure data (Figure 2), shows that a significant number of failed runs are attributable to not adequately cleaning the pipeline before inspection.

Three common assessment methods are currently used to assess the condition of a pipeline before inspection. These include; visual assessment; use of pipeline data-loggers and advanced caliper tools. Unfortunately, these techniques can, at best, only provide a crude assessment of the pipeline readiness.

Failure data shows that a significant proportion of stuck and severely damaged tools are due to inadequate assessment of the pipeline bore. Although gauge plates are often used their limitations to detect larger bore diameters in fittings and components are often not understood, which has led to stuck tools. Similarly there have been occasions where an over-optimistic interpretation of gauge plate damage has also lead to stuck or severely damaged tools. These can be avoided through the increased use of caliper tool runs and more effective gauging procedures.

With a drive towards higher first run success rates it is anticipated that the next stage will include development and use of simple assessment tools based on the inspection technology to be deployed. The tools fitted with a limited number of sensor heads will give an indication as to whether data can be obtained from all of the pipeline. They can also be used as a measure of how cleaning is progressing.

The final decision on whether the pipeline is ready for inspection should be made jointly by the operator and ILI supplier.

Operations

The operational objectives are to run an ILI tool that is configured and run within defined limits to acquire usable data without incident. To achieve this, effective coordination and communication are needed between the Operator and ILI supplier.

The prelaunch phase normally covers mobilisation,, tool preparation and final checks prior to launch. During this phase general issues and documentation is reviewed to confirm that all procedures are in place; the pipeline is ready and the tool has been properly prepared and is set up to meet the inspection requirements.

Whilst early proving of the pipeline bore is recommended the final step should be verification that the line is both clean and there are no bore restrictions due to a change in valve position. This should normally be done in the presence of both the operator and the ILI supplier. An example of a failure to assess the cleanliness of a pipeline is illustrated in Figure 4.

FIGURE 4: FAILURE TO CLEAN PIPELINE ADEQUATELY

Many of the failures observed across the industry have occurred due to a failure to follow recognised steps or procedures. Typical failures reported across the industry during the operating phase include:

- Failure to assess the pipeline bore
- Tool set up errors
- Changes to valve position after the final proving run
- Changes to pipeline operating conditions resulting in change of cleanliness (e.g. sand from a flow line)
- Launch procedure errors
- Flow conditions out of range for inspection

To provide data for subsequent inspections the condition of the ILI tool should be recorded before launch and on receipt of the tool. Following cleaning the tool should be inspected to verify it is undamaged and that all components have been received.

The supplier's ILI team is generally responsible for downloading the data at site to begin the analysis process. Specific checks include the tool operating parameters and the completeness of data recovery. This may include support and review by the ILI supplier's analysis team. Documents that help support this part of the process include field data check forms and a final run acceptance report.

Analysis and field verification

An ILI project is not complete until the reported features have been verified in the field and it is confirmed that the tool has performed in accordance with the agreed specification. Examples of requirements include NACE [4], API 1163 [5] and the Pipeline Operators Forum Specification [6]. The field procedures to achieve this are important as inappropriate field inspection processes can invalidate an otherwise valid report.

Field verification of reported features helps confirm the condition of the line for the operator to take appropriate action. It also helps to support validation of other lines where dig verification is not possible.

As part of the process for collating and assessing ILI data required with API 1163 it is essential to record the method of field verification. The accuracy of the selected field inspection technique should be understood and assessed to ensure that it is appropriate to provide the level of verification required.

To achieve a reliable data set it is important that field data is collected using recognised standards and protocols. It is also important to verify that the field personnel have the right skills and competencies to gather the data with the required accuracy. Problems can arise if reported features have been sized incorrectly in the field. This has an impact on both the verification of the inspection report and determination of the tool performance.

A run failure may be associated with the feature being incorrectly reported. Data quality can be affected by poor pipeline preparation but missed data or incorrectly sized features may also indicate problems either with the tool configuration, set up or the algorithms used for analysis

Involvement of the ILI suppliers during the planning and execution of field verification is recommended. Further guidance on the field inspection processes can be found in the POF Guidance document ILI Field Verification Procedure [7].

Tool Reliability

Use of the technical run success definition is a key performance measure to drive improvements in tool reliability.

A significant proportion of failed runs are attributable to tool failures. From analysis of data held by ILI suppliers these can account for up to fifty percent of all failed runs. Discussions with each supplier identified a number of common factors:

- Use of new tools or components
- Pipeline environment
- Tool preparation and set up

The introduction of new tools will remain a feature of the ILI sector. Driven by competition between suppliers and requests from operators to inspect ever more challenging pipelines, their introduction poses a dilemma for both suppliers and operators as this can introduce a level of uncertainty. Whilst reliability should be a fundamental consideration during tool design, suppliers who have programmes which extensively test tools before their introduction generally have lower failure rates.

However rigorous the testing programme may be; there will inevitably be times during the life of the tool where new components are introduced and used. This should never be done without consultation between the supplier and operator and the risks should be discussed and included in the risk assessment.

The reliability and life expectancy of critical components on the tools should be assessed and this should drive the suppliers' preventative maintenance programmes.

Even when tools have been tested and their design proven over a period of time, new applications will be found to challenge and test the tool. It is important therefore that each supplier maintains records of the lines inspected and clearly understands the conditions for which the tools have been designed.

Failures have occurred where the tools have operated in an environment at the limit of operational experience. Examples include operations in dry environments and higher pressures. Failures may also occur due to fatigue or corrosion of components. Each failure should be recorded and used to establish an envelope of suitable operating conditions.

As with new tools or components, wherever the use of the tool is proposed in an environment that is at the edge or beyond current proven operating conditions this should be clearly identified by the supplier and discussed with the operator in the risk assessment.

A significant number of failures have been caused by inappropriate tool preparation. These can be avoided through the use of simple check lists as discussed in Section 3. Failures at this stage usually manifest themselves through loss of data through loose connections. More significant failures have occurred where non-standard component parts have been used.

Tool design and modifications play a part in the failure statistics. Failures have occurred simply due to the change of orientation of an on/off switch. Whenever new tools are introduced their design should consider field operatives and consistency of operation with earlier models.

Training and knowledge of field technicians is crucial if failures are to be avoided. This should not only include the use of check lists but also a good understanding of the tool operating history. Industry failures reported in this category include lack of knowledge of battery histories resulting in partial data collection and a flat battery.

Whilst it may be possible to resolve some electronic failures on site, such as those caused by a loose cable or connection, most other problems associated with the tool "firmware or software" result in a loss of data and will usually require the tool to be returned to base for modification.

Much of the current tool failure analysis is based on operational failures. Information collected during tool refurbishment and preparation can also provide useful data on component performance.

As the industry increasingly looks at more challenging pipelines offshore and in deeper water the industry will need to look to techniques used in other industries if the reliability rates are to improve significantly.

Lessons learnt and feedback

Performing an ILI run on a pipeline can be a straight-forward exercise when the operating conditions and tool characteristics are correctly matched. To achieve this, detailed information about the line design and operating conditions need to be transferred between the operator and supplier. Unfortunately, this information is not always available from the operator.

It is important that data from the inspection process and lessons learned are maintained to facilitate future inspections. Information from a particular line may also be of value for other pipelines operating with similar conditions. Records should, where possible, include photographs.

Typical pipeline and operating data that should be retained following an inspection project is outlined in Annex B. Most of the information should be held by the operator but data will also be held by the ILI supplier. Where inspection was not successful records should be retained of the failure investigation and any steps taken to rectify the problems.

To ensure that lessons learned are systematically gathered a formalised feedback process was developed as part of the BP Global Contract. This has been developed further and has been included in the POF Guidance document. It is available as a separate document "ILI Data Feedback Form" [8] on the POF website (www.pipelineoperators.org).

SUMMARY

Understanding the impacts and causes of failed ILI runs are key steps in the process of improving first run success rates. This has increased significance where the operating costs associated with failure increase, as may be found with subsea operations.

A discussion on first run success should be included as part of the risk assessment performed at the early stage of the project as this may result in changes to the inspection programme support requirements or the need for a standby inspection tool. It may also lead to the manufacture of additional tools or critical components to support inspection programmes.

Successful ILI requires good communication between all parties from the initiation of an ILI project to field execution, analysis and field verification.

Improvements in ILI first run success will be driven, in part, through improved feedback and investigation of failed runs. This requires changes to reporting processes, which will improve over time. Without feedback and a willingness to improve processes, it will not be possible to fully realise the potential value anticipated with improved first run success rates.

Building on the operational data gathered from earlier inspection runs and the pipeline questionnaire, use of the best practices in the POF guidance document will help improve first run success rates. It cannot be used however, as a substitute for open discussion in the preparation for each inspection project. Use of the check lists, improved communication between operators and suppliers and effective gauging procedures will continue to drive a reduction in failed runs. Development of tools to assess the effectiveness of cleaning is required.

As run success rates improve tool reliability will become increasingly important. Greater use of predictive analysis; testing and use of leading performance indicators will help drive improvements in tool reliability. This is already used in other industries and the transfer of processes and techniques should be relatively simple.

As the industry starts to address more challenging pipelines in deeper and more hostile environments first run success rates need to improve. The POF Guidance Document provides a basis for sharing best practice across the industry and is the start of a longer process to improve the delivery of the ILI services.

Achieving ILI first run success requires both the operator and ILI supplier to work together. Whilst each has a key part to play effective communication from an early stage is essential.

ACKNOWLEDGEMENT

Since the first workshop, held in 2010, BP has worked closely with their ILI Suppliers to understand first run success rates and how to improve them. BP would like to thank their ILI Global Contract Suppliers (ROSEN Swiss; PII Pipeline Systems; Baker Hughes and NDT Systems and Services) for the significant part they have each played in the development of the guidelines,

The authors would like to thank BP for allowing the guidance document to be shared with the industry and for permitting the development of this paper.

The authors would also like to thank the members of POF for their contribution in reviewing the Guidance Document; providing comments and validation of the process and practices and their willingness to develop an industry guidance note.

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[5] API Standard 1163 In Line Inspection Systems Qualification Standard 2005

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[7] Pipeline Operators Forum Guidance on First Run Success available on www.pipelineoperators.org

[8] Pipeline Operators Forum : ILI Data Feedback Form available on www.pipelineoperators.org

ANNEX A :

ILI CHECK LISTS

A1: **Project Initiation: Project approval**

- Pipeline risk assessment completed
- Objectives / reason for inspection documented
- Critical features and sizes documented
- Pipeline questionnaire completed
- Data from operational cleaning and pigging runs collated and assessed.
- Tool selection basis completed (may need preliminary input from suppliers)
- Decision support package completed and approvals in place
- Project Team in place; roles and responsibilities agreed

- Pipeline ready for inspection. If not, agreed plan in place to prepare line.
- Supplier(s) contacted
- Work order issued
- Operator's world-wide ILI coordinator to be notified (if applicable)
- Any other point(s)

A2: Project Initiation: Initial supplier meeting

- Confirmation of Scope & Expectations
- Safety & training requirements
  - Process safety overview
  - Safety reviews
  - Site inductions and training
  - Control of work and permitting
- Communications
  - Key personnel and points of contact
  - Correspondence
  - Stakeholders
- Schedule
  - Tentative programme , time of year and climatic conditions
  - Key milestones
  - Tool availability / non-availability
- Review pipeline questionnaire
- Facilities / Services
  - Required by supplier
  - Provided by operator
- Transport logistics
- 3rd party support requirements
- Site visit
- Pipeline preparation
  - Review programme
  - Gauge plate/ profile tool acceptance criteria agreed
- Previous pigging / inspection
- Any other point(s)

A3: Project initiation: Risk assessment

- Review processes
  - HAZID / HAZOP
  - Site assessments
  - Tool box discussions
- Organisation
  - Roles and responsibilities
  - Decision process
  - Control of work and permitting
  - Organisational competency
  - 3rd party interface management
- Process safety
  - Operating conditions for pigging
  - Pipeline contents / cleanliness
  - Hazardous areas confirmed
  - ATEX requirements
  - Impact on upstream and downstream
  - Condition of pig traps and facilities
  - Temporary facilities
  - SIMOPS
- Pig selection
  - Pig suitability
- Operating procedures
  - Documented procedures
  - Communications
  - Pig trap operation, isolation and purging
  - Launch
  - Running pigs & tracking
  - Receive
  - Downloading data
- Handling materials
  - Use of chemicals
  - Handling and disposal of waste
  - Cleaning pigs and equipment after use
- Logistics
  - Transport
  - Access to sites
  - Handling pigs and equipment
- Other
  - Schedule / Inspection Windows / Delays
  - Weather conditions
- Lessons Learnt

A4: Project initiation: Site visit

- Safety induction & site over view
- Organisation responsibilities
- Hazardous areas confirmed
- ATEX requirements confirmed
  - Gas group
  - Temperature rating
- Control of Work
- Transport arrangements
- Access and pig handling
- Pig trap dimensions
- Operating procedures
- Review progress with pipeline preparation
- Tool & equipment cleaning facilities and associated procedures
- Workshop facilities (base & worksites)
- Any other points

A5: Operations: Preparation and Cleaning

- Cleaning plan and procedures
  - Target level of cleaning agreed with supplier
  - Cleaning procedure agreed
  - Key decision points established
  - Roles and responsibilities agreed
  - Operating procedures agreed and in place
  - Communications in place and tested
  - MOC procedure for cleaning process in place
- Pig selection
  - ATEX certification reviewed and accepted
  - Pigs inspected before use
  - Gauge / profile tool acceptance established
- Use of chemicals, gels or nitrogen
  - Temporary facilities in place
  - MDS sheets in place
  - Water sources agreed
  - Disposal process agreed
- Pig Traps
  - Modifications in place
  - Trap connections in place
  - Temporary tanks and vessels in place
- Operating conditions
  - Max pig speed agreed
  - Pressure differentials measured
  - Max line pressure controlled
- Pig tracking
  - Pressure and flow measurement
  - Tracking crews
  - Transmitters on pigs
- Contingency plans in place
  - Stuck or lost tool
  - Loss of communications
- Product and debris handling procedures in place
  - Sampling, testing and disposal
  - NORMS or mercury
  - Disposal of pigs
- Pigging records: procedure in place
- Review of cleaning progress with ILI Supplier
- Gauge and calliper results reviewed with Supplier.

A6: **Operations: Mobilisation of ILI tool**

- Cleaning programme running to plan
- Pipe bore confirmed by calliper or gauge pig and results reviewed with supplier
- ILI supplier confirmed cleaning programme
- Pre project documentation completed and agreed
- Safety reviews completed
- Site transport, access, handling and workshops agreed
- Operations procedures agreed
- ILI mobilisation notification to supplier
- Any other points

A7: Operations: ILI tool run – Pre launch

- ILI Tool preparation
- ATEX compliance certification verified
- Final cleaning run confirmed as acceptable by both Operator and supplier
- Operating procedures confirmed
- Communications confirmed
- Local site logistics and permits in place
- Emergency response systems in place
- Pipeline operating conditions confirmed
- Tool tracking in place
- Profile Tool run completed and received in an acceptable condition confirmed by both operator and supplier
- Valve positions confirmed
- Final ILI tool checks
- ILI tool launched
- Any other point(s)

A8: Operations: ILI tool run and receipt

- Communications maintained between operator and supplier
- Tool progress tracked
- Tool received and checked for damage
- Tool cleaned and checked free of contamination
- Data downloaded
- Data transferred to supplier's analysis department for quality check
- Data quality checked and run conditions confirmed as acceptable
- Completion Report issued and accepted by Operator
- Tool and ILI crew demobilise
- Any other ;point(s)

A9: Data Analysis and Reporting

- Reporting requirements confirmed
- Initial report issued on significant features
- Preliminary Report issued (if required)
- Final report issued
- Presentation of findings (if required)
- Field verification
- Post run analysis of field investigations
- Any other point(s)

A10: Performance Feedback

- Feedback form completed for successful run
- Performance reviewed with supplier
- Procedural improvements captured
- Preparation and ILI run documentation captured
- Lessons learnt prepared and shared
- first run success failures investigated
- Analysis of failed runs updated
- Follow up discussions with supplier

ANNEX B

RECOMMENDED RECORDS TO BE KEPT

B1: Project preparation

- Pipeline operating history
- Pipeline questionnaire and any updates
- Previous inspection data including calliper runs

B2: Pipeline cleaning and preparation

- Records of the cleaning programme; quantities and debris analysis
- Cleaning tool details (disc type, cup type etc.) and specifications
- Subsequent cleaning and pigging runs
- Results of gauge plate inspections

B3: Pipeline inspection

- Procedures and special operating requirements
- Operating records including pressure traces
- Line conditions and valve arrangements
- Comments on the effectiveness of the cleaning programme

B4: Dig Verifications

- ILI inspection reports
- Feature verifications
- Actions taken