ABSTRACT

The present article accounts for the recent RBI implementation for a complex pipeline network in the Far East with facilities and components varying from new to 30 years old.

The purpose of the project was to develop a risk assessment in order to implement an integrity inspection program over a three year period for a network with minimal information available for construction, process and inspection history. A qualitative approach, based on T-REX® Pipelines software, was deemed appropriate in order to carry the risk assessment without detailed technical data. The RBI work was carried out by a slim work team who did an initial risk assessment using the available data and thus developed an inspection plan focused on the high-priority components.

Inspection would then generate precious technical data for updating the risk assessment. The risk reassessment would then be used to update the inspection plans and fine tune the priorities of the maintenance works.

INTRODUCTION

The SGS Group is the largest verification, testing and certification organisation in the world. Founded in 1878, the SGS Group brand is recognised as a global benchmark for the highest standards of expertise, quality and integrity. Industrial Services, as one of the largest business lines within the SGS group, offers a combination of specialised solutions and traditional services focussed on the complete asset life cycle of our clients. During all stages, from design through procurement, construction and commissioning into operation, SGS provides a comprehensive package of integrated services. Due to our global experience, we can verify a project against all existing standards and ensure that all safety, reliability and quality requirements are met.

As an SGS Technology Partner Tischuk International (TIL) has been one of the world leaders in Risk-Based Inspection (RBI) since 1988. Either directly or through its global network of technology transfer partners, TIL has implemented risk based inspection programs in more than a hundred oil and gas, refining, petrochemical facilities and pipeline networks around the world, always using its own Tischuk RBI technology.

The Tischuk RBI methodology for pipelines includes an operational criticality assessment and has been particularly successful in cases where very little or poor data is available. This paper describes the recent RBI implementation for a complex pipeline network in the Far East, with facilities and components varying from new to 30 years old. With very little meaningful information about the as-built and current condition of the system, the initial problem faced by the client in trying to build a picture of the condition of the asset was, “where to begin?”

FACILITIES DESCRIPTION

The pipeline network was extensive and relatively complex and included the following features:

- 32 trunk lines sized 16 through 30 inch diameter from manifold stations to process facilities.
- 21 oil, gas and NGL export pipelines from 16 inch to 42 inch diameter.
- Over 1000 six and eight inch diameter submarine production flow-lines.
- 34 manifold stations.
- 5 process facilities for oil and gas separation.
The facilities ranged in age from new to 30 years old. Very little data was available about the flow-lines. Minimal construction data was available. Limited process data was available and minimal inspection data was available. More data was available for the trunk lines and export lines.

PROJECT OBJECTIVES AND CONSTRAINTS

The primary purpose of the project was to develop a criticality assessment and implement an integrity inspection program, to be implemented over a three year period. The client recognized that it had an insufficient understanding of the condition of the network and there was consequently a high business risk associated with the infrastructure.

The pipeline network was relatively complex with facilities and components varying from new to 30 years old. Very little inspection and maintenance had been carried out and what had been done had generally been done on a reactive basis, with little or no cohesive strategy or long term forward planning. Results of inspection had not been well documented and it was accepted that lessons had not been learned. Information on construction and process and inspection histories was sketchy at best and in some case, missing altogether.

METHODOLOGY

A qualitative methodology was adopted, using Tischuk's T-REx Pipelines software. In view of the lack of available pipeline data it was agreed with the client that a qualitative rather than a quantitative analysis was the only feasible option to carry out the risk assessment. The work was carried out by a slim team including some client personnel. The team did an initial criticality assessment using the available data and then developed an inspection plan focused initially on the high risk/high priority components. Once the inspection was carried out, this generated hard technical data and the criticality assessment was updated with these results. This updated risk assessment will be used to update the inspection plans and fine tune the priorities of the maintenance works. The process is one of continuous improvement, as follows:

- On-site implementation of initial inspection planned over three year time-scale.
- Do initial RBI Assessment using available data.
- Use initial results to develop online inspection requirements & priorities.
- After each inspection cycle update assessment.
- Update the inspection plan from the updated assessment.

Of the software itself, the following key features give the Tischuk T-REx P RBI software strong advantage in tackling the kind of situation described:

- Uses qualitative assessment - minimal requirement for detailed technical data.
- Includes TaskMaster module to automatically generate inspection plans.
- Easily updated with inspection results.
- Includes audit trail to track updates.

System Architecture - The T-REx modules are RBI tools aimed at specific types of equipment. They are designed for owner/operator personnel to carry out and apply the risk assessment. All data is supplied and entered by user personnel, not by consultants. An audit trail is an integral part of the system and includes name and date of assessment, creator, authoriser and modifier including the changes made to the original assessment. The T-REx modules have integrated TaskMaster technology that allows the user to easily develop an inspection work program based on the Risk Assessment.

Customization - T-REx P, while simple to use, allows for a high degree of user customization. It is delivered set up for a 3x3 risk (criticality) matrix. The user can change this to a 4x4, 5x5 or any other matrix. For this project, a 3x3 matrix was selected. T-REx includes four failure consequences criteria and twelve standard failure modes (damage mechanisms) for pipeline segments. The user may edit these definitions and may also define one additional failure mode.

Consequences criteria - T-REx P uses four consequences of failure criteria. Each is evaluated by user personnel using a drop down pick list. The pick list can be edited by supervisory level user personnel.
Probability of failure - T-REx P is initially configured with six corrosion and erosion failure modes and six cracking or damage failure modes. T-REx P has the facility to add one more user defined failure mode. Each failure mode is evaluated by user personnel using a drop down pick list that can be changed by supervisory level users.

Criticality matrix - The Operational Criticality Rating is an overall summary figure based on the Consequences rating and the probability rating. T-REx P is initially set up with this 3x3 matrix, however it may be configured by users for other matrices.

Taskmaster - After completing the criticality risk assessment TaskMaster technology which is built into the software allows the user to develop consistent, focused inspection programs. Taskmaster allows the user to maintain a list of standard inspection activities and frequencies. TaskMaster then enables users to build logic conditions that automatically associate an inspection task and frequency with a specific pipeline segment. The user then has the final option to accept or modify the inspection task list for each segment.

TECHNOLOGY TRANSFER

For this project, the client opted to take full ownership of the RBI program and to purchase the software. The client therefore opted for Tischuk’s Technology Transfer approach, with Tischuk transferring its technology, skills and experience to client personnel. Tischuk therefore supplied a senior RBI Level III Facilitator to train and guide the client personnel during the initial stages of implementation. The Facilitator gradually withdraws his support as client personnel gain confidence.

The team consisted of the following personnel:
- Tischuk Facilitator
- Client Team Leader
- Client RBI Engineer
- Client Technical assistant

As required, client:
- Process Engineer

• Operations Supervisor

RESULTS

The following example shows the results for one flow-line. This was typical of most sections of the network and shows the identification and distribution of high risk/high priority areas.

The criticality assessment identified all the High, Medium and Low risk sections and components within the pipeline network, allowing immediate action to be taken and focusing initially on the high risk items.

CONCLUSIONS

T-REx Pipelines qualitative process is ideally suited for
- limited data
- unknown condition
- poor knowledge of operational/inspection history
- complex pipeline system various ages

First pass results gave initial inspection plan.

Inspection results can be used to update risk assessment and develop a long-term inspection plan. A fast, positive start can be made in which the high priority items are readily identified.

The feedback of inspection results is part of a continuous improvement process.