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Pipeline Infrastructure - Sour Oil Transmission Pipeline

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Abstract

A sour oil transmission pipeline of length 10.8 Kilometer and of nominal outer diameter 36 Inch has been in service since 2010. The integrity of the pipeline between 01/2010 and 11/2020 was previously analyzed and the integrity management planning was found to be fair (56.76 %).

This report discusses the integrity management program of the pipeline between 2021 and 2026. Based on the revised integrity management program it is projected that the integrity of the pipeline will be slightly better in the next review period (62.16 %).

Introduction

The sour oil transmission pipeline of length 10.8 Kilometer and nominal diameter 36 Inch was in service 10 years (01/2010-11/2020)[1]. The previous integrity management program based on the 5-M methodology (modelling, mitigation, monitoring, maintenance, and management) principles indicated that integrity management program planning was fair (56.76 %).

The integrity management plan of the pipeline was evaluated using the 5-M methodology[2] and readjusted for the period between 2021 and 2026. As indicated by the analysis results described in this paper, the integrity of the pipeline in the projected period will be better (62.16 %) if the selected KPI are properly implemented.

5-M Methodology

The 5-M methodology is extensively descried elsewhere[2]. The 5-M Methodology encompasses "Direct assessment", ILI, and other integrity analysis and has proven to be effective in the risk and corrosion control of infrastructures. The implementation of 5-M Methodology is based on evaluation of status of 50 key performance indicators (KPI). The status of implementation of each KPI is indicated by score and by color code as shown in Table 1.

Table 1: Status of Implementation

Status of implementation	Score	Color Code
Analysis is not done		Grey
Not relevant	0	Blue
Accounted for adequately	1	Green
Accounted for inadequately	2	Yellowish Green
Accounted for inadequately	3	Yellow
Not adequately accounted for	4	Orange
Not adequately accounted for	5	Red

The strategies to reduce risk and control corrosion, as evaluated by the corrosion engineer and reviewed, and approved by integrity manager, are described in the following paragraphs.

Context of Corrosion Control and Risk Mitigation

The results and the rationale for assigning the KPI scores for corrosion control are shown in Table 2.

Table 2: Context of corrosion control

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
1	Segmentation of Infrastructure	5	2	2-Segmentation is quantitative but does not cover all corrosion	40	83,402	In the previous service period (01/2010-11/2020), the segmentation was not done. In the current period (2021-2026), quantitative segmentation will be done where each segment has uniform characteristic, though it will not cover all corrosion.
2	Corrosion Risk	4	3	3-Corrosion risk is medium	10	20,851	The pipeline transports sour oil effluent with some gas, water, and chlorides. Based on iFILM, the internal corrosion risk was high (1.02 mm/yr) for the pipeline, hence a score of 4 was assigned. Both external/internal corrosion risks and cracking were considered in the previous review period. The corrosion risk will be lowered from high in the previous period to medium for the current period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
3	Location of Infrastructure	4	4	4-Consequence of failure is relatively high	10	0	The pipeline is in an industrial area, hence the consequence of failure was considered to be relatively high and a KPI score of 4 was assigned. The situation remains the same for the current review period (2021-2026).
4	Overall Corrosion Risk	4	3	3-Overall risk from corrosion is relatively medium	10	41,702	The overall risk from corrosion will be lowered from high in the previous period to relatively medium for the current period.
5	Remaining life of the Infrastructure	2	2	2-Life is between 5 to 10 years	0	0	The line was originally constructed in 2010. Since the pipeline life is 10 years, a KPI of 2 was assigned. The same conditions were assumed in the current period and hence the value assigned to KPI 5 is 2.

Internal corrosion Model

The results and the rationale for assigning the KPI scores for internal corrosion model are shown in Table 3.

Table 3: Internal Corrosion Model

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
6	Material of Construction - Internal	1	1	1-Material selected solely based on corrosion consideration	0	0	API 5 L X70 Carbon steel was used to construct the pipeline. It seemed to be a correct choice of material. The API 5L X70 CS was compatible with sour service, hence, a KPI score of 1 was assigned. The situation remains the same for the current review period (2021-2026).

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
7	Corrosion Allowance	2	2	2-Corrosion allowance is slightly more than mitigated corrosion rate times anticipated life	0	0	The wall thickness of the pipeline was 40 mm. Unmitigated internal corrosion rate established using iFILMS was 1.02 mm/yr and mitigated corrosion rate was 0.09 mm/yr. Assuming that the anticipated life of this pipeline was 60 years, the corrosion allowance was more than the mitigated corrosion rate multiplied by anticipated life. Hence a KPI score of 2 was assigned. The situation remains the same for the current review period (2021-2026).

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
8	Normal Operating Conditions	2	2	2-Operating conditions exceed intermittently, but within 10% of the limits established for short duration (typically less than 1 hour to 1 shift)	0	0	Temperature and pressure were constantly measured through SCADA and the system did not go beyond the normal operating conditions for a long time period. The situation remains the same for the current review period (2021-2026).
9	Upset Conditions in the Upstream Segment	2	2	2-Potential influence of upset conditions upstream is understood and communication plan is established with upstream team to obtain information in case if there is an upset within a shift or within 1 day	0	0	The operating conditions from upstream pipeline could affect this gathering pipeline. It was assumed that the pipeline operating conditions were monitored through SCADA. iFILMS was run for potential upset conditions, and it was assumed that a communication plan had been established with the upstream team to obtain information in case of upset within the next review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
10	Upset Conditions	2	2	2-Potential influence of upset conditions in the sector on downstream operation is understood and communication plan is established with downstream team to provide information in case if there is an upset. Communication is sent within 1 shift or one day.	0	0	Upset conditions in this line would affect the downstream sector. It was assumed that the pipeline operating conditions were monitored continuously through SCADA. iFILMS was run for potential upset conditions, and it was assumed that a communication plan had been established with the downstream team to obtain information in case of upset within the next review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
11	Corrosion Damage Mechanisms	2	2	2-Some prominent corrosion damage mechanisms are considered	0	0	Based on iFILMS, this pipeline could have top of the line corrosion (TLC), microbiologically influenced corrosion (MIC) and under-deposit corrosion (UDC). The situation remains the same for the current review period.
12	Maximum Internal Corrosion Rate	1	1	1-Maximum corrosion rate is based on all corrosion damage mechanisms (CDM)	0	0	Maximum Internal corrosion rate (1.02 mm/yr) was established using iFILMS considering all the corrosion damage mechanisms. There is no change for next review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
14	Installation of Accessories	1	1	1-Corrosion professionals are involved during construction and the accessories for implementing mitigation, monitoring, and maintenance activities are properly installed	0	0	The corrosion professionals were involved in the design, commissioning, and operation stage of the pipeline. Hence the related accessories for mitigation, monitoring and maintenance activities were properly installed. The situation remains the same for the current review period.
15	Commissioning	4	4	4-No documented evidence that the hydrotest is conducted properly and that the infrastructure is commissioned properly	0	0	No documented evidence was available showing that the hydrotest was conducted properly and that the infrastructure was commissioned properly. Same for the current review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
39	Internal Corrosion Rate after Maintenance Activities	1	1	1-Corrosion rate after the maintenance activities is lower than the corrosion rate before maintenance activities	0	0	Since the established unmitigated corrosion rate was very high, maintenance activities such as pigging, batch chemical inhibition, and continuous chemical inhibition were implemented for this pipeline. The corrosion rate after the mitigation activities was calculated to be 0.09 mm/yr. There is no change for next review period.
40	Percentage Difference in Internal Corrosion Rate Before and After Maintenance	0	0	0-KPI not considered as relevant	0	0	No corrosion monitoring data was available for comparison. Same for the current review period.

Internal Corrosion Mitigation

The results and the rationale for assigning the KPI scores for internal corrosion mitigation are shown in Table 4.

Table 4: Internal Corrosion Mitigation

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
16	Internal Corrosion Mitigation	2	2	2-Yes. Based on the analysis performed at the conceptual and design stages	0	0	The estimated internal corrosion rate for this pipeline was 1.02 mm/yr, suggesting that this pipeline had severe internal corrosion issues and mitigation activities were required. Same activities are needed for the current review period.
17	Types of Internal Corrosion Mitigation Strategies	2	2	2-Mitigation strategy is standardized by combination of time-tested and proven techniques and some trial and error method under the operating conditions and is proven to be effective	0	0	The mitigation strategies for this pipeline included pigging, batch inhibition, and continuous chemical inhibition. The calculated corrosion rate was reduced considerably after the mitigation. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
18	Targeted Mitigated Internal Corrosion Rate	2	2	2-Some basis for the selection of maximum corrosion rate	0	0	The targeted mitigated internal corrosion rate was calculated from iFILMS to be 0.09 mm/yr. No change for this review period.
19	Internal Corrosion Mitigation Strategy Effectiveness	3	3	3-Mitigation practices are implemented 90 to 95% of time	0	0	It was assumed that the mitigation strategies were implemented 90% -95% of the time No change for this review period.

Internal Corrosion Monitoring

The results and the rationale for assigning the KPI scores for internal corrosion monitoring are shown in Table 5.

Table 5: Internal Corrosion Monitoring

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
24	Internal Corrosion Monitoring Techniques	5	3	3-Only one type of monitoring technique that is proven to be effective in monitoring the corrosion damage mechanism occurring in the segment is used	15	31,276	In the previous service period (01/2010-11/2020), no monitoring was performed. For the current period (2021-2026), one type of effective monitoring technique will be used to monitor the corrosion damage.
25	Number of Internal Corrosion Monitoring Probes	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available previously. No change for this review period.
26	Internal Corrosion Rate from Monitoring Techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available previously. No change for this review period.
27	Accuracy of internal corrosion monitoring techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available previously. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
32	Frequency of Corrosion Inspection	0	0	0-KPI not considered as relevant	0	0	No information was available previously. No change for this review period.
33	Difference in Internal Corrosion Rate between Monitoring and Inspection Techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available previously. No change for this review period.

External Corrosion Mitigation

The results and the rationale for assigning the KPI scores for external corrosion mitigation are shown in Table 6.

Table 6: External Corrosion Mitigation

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
20	External Corrosion - Mitigation	1	1	1-No mitigation. Based on the analysis performed and strategies implemented (e.g., use of corrosion-resistant alloys) at the conceptual and design stages	0	0	The pipeline was coated with composite and protected by cathodic protection (CP). No change for this review period.
21	Types of External Mitigation strategies	1	1	1-No mitigation strategy is implemented (as per KPI 16) or mitigation practice implemented is time-tested and proven to control the predominant mechanism of corrosion occurring under the operating conditions of	0	0	The pipeline coating was inspected during installation, and CP was installed since the day of operation. No change for this review period.
22	Targeted Mitigated Corrosion Rate	0	0	0-KPI not considered as relevant	0	0	Mitigated external corrosion targets were not established for this pipeline. No lab testing was done to establish target rates. No change for this review period.
23	External Mitigation Strategy Effectiveness	2	2	2-Mitigation practices are implemented 95 to 99% of time	0	0	The pipeline was protected by CP with the effectiveness of 95-99%. The annual CP survey reports were available. No change for this review period.

External Corrosion Model

The results and the rationale for assigning the KPI scores for external corrosion model are shown in Table 7.

Table 7: External Corrosion Model

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
6	Material of Construction - External	1	1	1-Material selected solely based on corrosion consideration	0	0	The pipeline was externally coated with the corrosion resistant composite. The pipeline was also protected by CP. No change for this review period.
7	Corrosion Allowance	5	5	5-Corrosion allowance is significantly less than mitigated corrosion rate times anticipated life	0	0	The wall thickness of the pipeline was 40 mm. Mitigated external corrosion rate was estimated to be 0.29 mm/yr. Corrosion allowance was significantly less than mitigated corrosion rate times anticipated life of 60 years. No change for this review period.
8	Normal Operating Conditions	2	2	2-Operating conditions exceed intermittently, but within 10% of the limits established for short duration (typically less than 1 hour to 1 shift)	0	0	Temperature and pressure were constantly measured through SCADA. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
9	Upset Conditions in the Upstream Segment	2	2	2-Potential influence of upset conditions upstream is understood and communication plan is established with upstream team to obtain information in case if there is an upset within a shift or within 1 day	0	0	Potential temperature spikes in the upstream sector could damage the coating. It was assumed that the pipeline operating conditions were monitored through SCADA. It was also assumed that a communication plan was established with the upstream team to obtain information in case of upset within the next shift or day. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
10	Upset Conditions	2	2	2-Potential influence of upset conditions in the sector on downstream operation is understood and communication plan is established with downstream team to provide information in case if there is an upset. Communication is sent within 1 shift or one day.	0	0	Potential temperature spikes in the pipeline could damage the coating. It was assumed that the pipeline operating conditions were monitored through SCADA. It was also assumed that a communication plan was established with the downstream team to obtain information in case of upset within the next shift or day. No change for this review period.
11	Corrosion Damage Mechanisms	1	1	1-All corrosion damage mechanisms are considered and most prominent ones determined	0	0	All CDMs were considered using the software. The expected CMDs were axial gauge corrosion, weld-zone corrosion, and abrasion corrosion. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
13	Maximum External Corrosion Rate	1	1	1-Maximum corrosion rate is based on model, laboratory experiment, simulation, or documented similar field experience	0	0	Maximum external corrosion rate (0.29mm/yr) was established using the software. No change for this review period.
14	Installation of Accessories	1	1	1-Corrosion professionals are involved during construction and the accessories for implementing mitigation, monitoring, and maintenance activities are properly installed	0	0	It was assumed that corrosion related accessories were installed properly and corrosion professional were involved. No change for this review period.
15	Commissioning	4	4	4-No documented evidence that the hydrotest is conducted properly and that the infrastructure is commissioned properly	0	0	No documented evidence was available about conducting proper hydrotest and commissioning of the pipeline. No change for this review period.
41	External Corrosion Rate after Maintenance Activities	0	0	0-KPI not considered as relevant	0	0	There was no information available about the external corrosion rate values measured before and after maintenance activity. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
42	Percentage Difference in External Corrosion Rate Before and After Maintenance	0	0	0-KPI not considered as relevant	0	0	The corrosion rate after the maintenance activities was not available.No change for this review period.

External Corrosion Monitoring

The results and the rationale for assigning the KPI scores for external corrosion monitoring are shown in Table 8.

Table 8: External Corrosion Monitoring

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
28	External Corrosion Monitoring Techniques	5	3	3-Only one type of monitoring technique that is proven to be effective in monitoring the corrosion type occurring in the segment is used	15	31,276	In the previous service period (01/2010-11/2020), no monitoring was performed. For the current period (2022-2026), one type of effective monitoring technique will be used to monitor the corrosion damage.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
29	Number of External Corrosion Probes	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available. No change for this review period.
30	External Corrosion Rate from Monitoring Techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available. No change for this review period.
31	Accuracy of External corrosion monitoring techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available. No change for this review period.
32	Frequency of Corrosion Inspection	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available. No change for this review period.
34	Difference in External Corrosion Rate between Monitoring and Inspection Techniques	0	0	0-KPI not considered as relevant	0	0	No monitoring techniques were available. No change for this review period.
35	Measurement Data	1	1	1-All measurement data required for deciding corrosion conditions of the segment are available in a readily usable format	0	0	It was assumed that all the data required for determining the corrosion condition of the segment were readily available. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
36	Validity and Utilisation of Measured Data	3	3	3-The measured data is utilised without any validation process and the measured data is properly integrated to establish the corrosion rate	0	0	No validation process of measured data was carried out. No change for this review period.

Maintenance

The results and the rationale for assigning the KPI scores for maintenance are shown in Table 9.

Table 9: Maintenance

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
37	Procedures for Establishing Maintenance Schedule	1	1	1-Preventive type established based on experience, when the risk moves from low to ALARP stage, and scheduled on time	0	0	Internal corrosion maintenance activities were preventive based on risk reduction. No change for this review period.
38	Maintenance Activities	1	1	1-The work is carried out as per planned maintenance activities with all teams delivering their services as per schedule	0	0	CP was maintained in the pipeline ad CP surveys were conducted as required. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
43	Workforce – Capacity, Skills, Education, and Training	1	1	1-The number of workers is enough to carry out the work and all personnel involved have proper education and formal training to carry out the task	0	0	It was assumed that there was enough workforce trained according to the IMP plan. No change for this review period.
44	Workforce – Experience, Knowledge, and Quality	1	1	1-All personnel involved have at least five years of experience and knowledge in similar work	0	0	It was assumed that all personnel involved had at least 5 years of experience and were formally trained. No change for this review period.
45	Data to Database	2	2	2-Data from different activities, measurements are manually and systematically transferred to the database with some human intervention and coordination	0	0	It was assumed that the data from various activities were manually and systematically transferred to the database. No change for this review period.
46	Data from Database	2	2	2-Data is properly verified, stored, and passed on to appropriate persons but not necessarily in the format he or she requires	0	0	It was assumed that the data from various activities were manually and systematically transferred to the database. No change for this review period.

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
48	External Communication Strategies	2	2	2-External communication strategy and communication person(s) with many entities is established, communication with others is only on adhoc basis	0	0	The external communication strategy was established. No change for this review period.
47	Internal Communication Strategies	2	2	2-Internal communication strategy between many entities is established, and communication with others is only on adhoc basis	0	0	The internal communication strategy was established. No change for this review period.

Management

The results and the rationale for assigning the KPI scores for management are shown in Table 10.

Table 10: Management

KPI	KPI Name	Score (2010-2020)	Score (2021-2026)	Rationale for KPI Score	% cost	Cost of implementing the KPI, US ($) (2021-2026)	Notes
49	Review for Continued Improvement	1	1	1-The corrosion control activities, i.e., all 50 activities discussed, are reviewed annually and lessons learned are implemented to improve the corrosion control practice	0	0	It was assumed that annual evaluations of all corrosion control activities and scheduled internal audits were conducted by the EH&S Department. No change for this review period.
50	Failure Frequency	1	1	1-Zero failure or incidence due to corrosion during the review period for the segment	0	0	No failures were assumed in this segment. No change for this review period.

Overall Corrosion and Corrosion Control Status

Figure 1 and Figure 2 present the status of corrosion and risk of oil transmission from 2010 to 2020 and from 2021 to 2026 respectively. Among the fifty-nine (59) KPI, seventeen (17) KPI will be adequately implemented, twenty-five (25) KPI will be fairly implemented, and fourteen (14) KPI will not be considered as relevant. It is expected that three (3) KPI will not be implemented, as we will not be able to adjust the corrosion allowance or the infrastructure at this service stage of oil transmission.

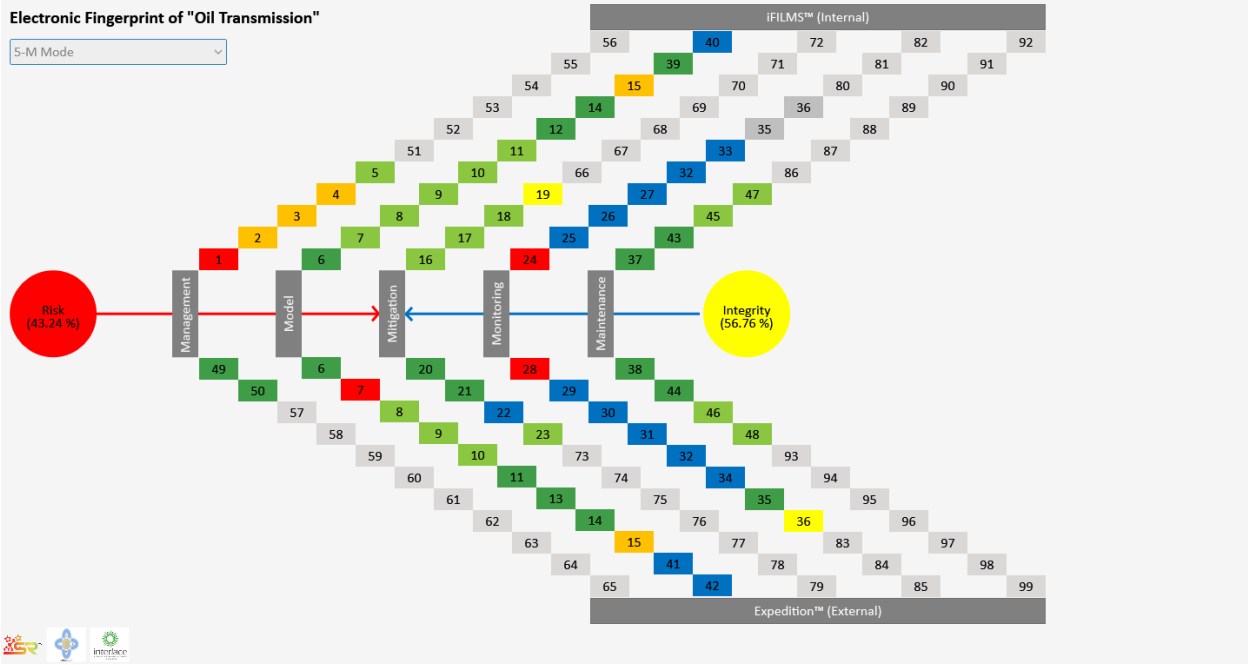

Figure 1: Corrosion Control Status of the Sour Oil Transmission Pipeline (2010-2020)

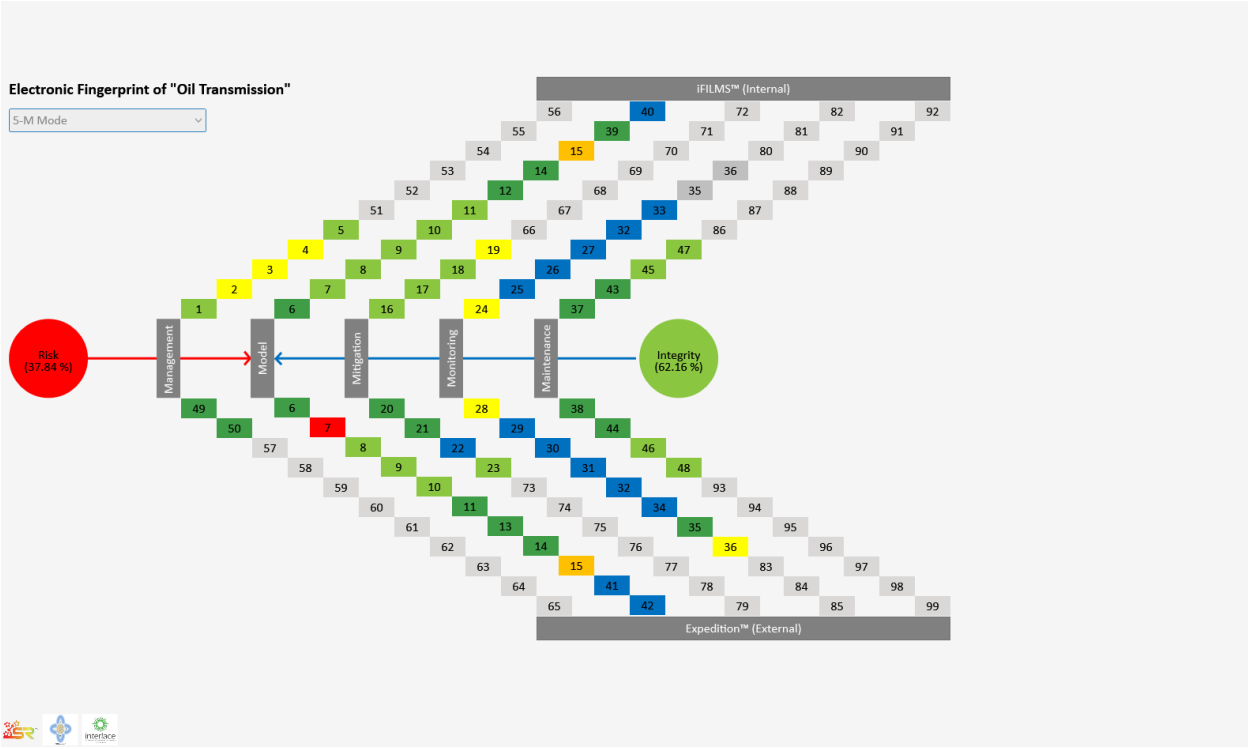

Figure 2: Corrosion Control Status of the Sour Oil Transmission Pipeline (2021-2026)

Cost to Control Corrosion (2021 and 2026)

Engineer requested cost: US ($) 208,505
Expenditure committed: US ($) 208,505
Uncommitted funds available: US ($) 0

The budget for each KPI is well calculated such that, if the budget is reduced, the currently planned KPI will be fully implemented. If the budget is reduced by 20%, some KPIs will be adjusted to lower the overall cost as follows:

- If the budget is reduced by 20%, the score of KPI 1 will be adjusted from 2 to 3, and the scores of KPI 24 and KPI 28 will be adjusted from 3 to 4.
- Consequently, the integrity of the pipeline will decrease from 62.16 % to 60.54%, and the risk will increase from 37.84 % to 39.46% if the budget is reduced by 20%.

Summary

A sour oil transmission pipeline of length 10.8 Kilometer and of nominal outer diameter 36 Inch has been in service since 2010. The integrity of the pipeline between 01/2010 and 11/2020 was previously analyzed and the integrity management planning was found to be fair (56.76 %).

This report discusses the integrity management program of the pipeline between 2021 and 2026. Based on the revised integrity management program it is projected that the integrity of the pipeline will be slightly better in the next review period (62.16 %).

References

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