DRAFT AMS 5.04.05 PIPEWORK VIBRATION RECOMMENDED PRACTICE

Asset Management System Achieving Sustainable Business Outcomes

Royal Dutch Shell

Asset Management System

Non-Mandatory

Restricted

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Contents

1 Purpose and Scope

This Recommended Practice (RP) provides the requirements for assessing vibration induced fatigue of process pipework.

This RP is structured in four levels and is consistent with the Energy Institute Guidelines (EI Guidelines) for the avoidance of vibration induced fatigue in process pipework:

- Level 1: In-field vibration screening
- Level 2: S-RBI assessment
- Level 3: Detailed screening assessment according to the EI Guidelines using the Best Practice Guide that caters for Shell designs
- Level 4: Detailed assessment

2 Pipework vibration induced fatigue assessment procedure

The following procedure is a four level procedure for assessing in service vibration of pipework:

- Level 1: In-field vibration screening
- Level 2: S-RBI assessment
- Level 3: Detailed screening
- Level 4: Detailed assessment

2.1 Level 1: In-field vibration screening

2.1.1 Visual assessment

A visual assessment should be performed following the guidelines in the Energy Institute (EI) Technical Module T5 and T6. Specifically, the piping should be looked at for:

- High Vibration/Noise
- Fretting Damage
- Pipe Geometry (Routing, Wall Thickness, etc.)
- SBC Geometry
- Pipe Supports
- Bracing of SBC
- Vibration Control Measures (Pulsation Dampeners, Snubbers, etc.)
- Vibration Transmission (e.g. from Machinery, or shared supports)

2.1.2 Initial evaluation

For issues identified by EI Technical Module T5 and T6, the following should be conducted

- follow corrective actions in Modules T5 and T6 in the first instance, or
- more detailed corrective actions as per Modules 10, 11 or 12 should be undertaken, or
- vibration measurement should be undertaken as per section 2.1.1

One of the primary causes of vibration is when supports can become out of adjustment, either from maintenance activities or damage. Spring hangers can become bottomed or topped out requiring adjustment. Any malfunctioning supports should be rectified and reassessed.

Rotating equipment can also induce vibration in the piping system. Bearings may become worn and impart vibration at harmonics that can lead to piping issues. The rotating equipment engineer should address these issues and reassess.

2.1.3 Pipework vibration measurement

The vibration measurements should be conducted according to Module T7 at the worst case process conditions or conditions giving the potential vibration issues.

The process conditions (fluid contents, fluid density, fluid velocity, pressure, and temperature) should be recorded before any measurement.

The vibration monitoring locations should be selected according to Module T7 with locations and axis of measurement recorded. Typically, vibration concerns on pipework are small bore connections with large weights (valves) on SBC, or long unsupported lengths, or small diameters.

If the frequencies from the vibration measurement are greater than 300 Hz then specialist monitoring techniques as per Module T8 should be conducted.

2.1.4 Pipework vibration evaluation

The vibration velocity and frequency should be assessed according to Figure 1. The vibration velocity in Figure 1 is in mm/s root mean square and monitoring equipment should be set appropriately.

The following are the recommended susceptibility to failure and recommended actions

EI Guidelines Assessment Category	Susceptibility to failure	Recommended action
Acceptable	Low	Record in integrity management database
Concern	Medium	- Implement applicable corrective actions (2.1.2) - Consider NDE of relevant welds to ensure fatigue cracks have not initiated - Re-evaluate according to Level 2
Problem (Immediate action required)	High	- Implement applicable corrective actions (2.1.2) - Perform NDE of relevant weld to ensure fatigue cracks have not initiated - Re-evaluate according to Level 2
Seek specialist advice		- Specialist monitoring techniques as per Module T8 - Re-evaluate according to Level 2

2.2 Level 2: S-RBI vibration screening

The S-RBI vibration screening module (SR.16.10669) should be used if the vibration screening falls in the Level 1 concern (StF=Medium) or problem (StF=High) categories or the process conditions at the time of measurement are not worst case or typical of normal operation.

The assessment can be conducted using the software tool Pipework LOF.

If the assessment results in a risk assessment that is not ALARP, then the vibration should be mitigated in line with the EI Guidelines or a Level 3 assessment should be conducted.

2.3 Level 3: Detailed screening

Where the assessment from Level 2 results in a risk assessment that is not ALARP, the assessment should be conducted according to the EI Guidelines in concert with the Best Practice Guideline on vibration induced fatigue (GS.09.54405)

The assessment can be conducted using the software tool Pipework LOF.

If the assessment results in a risk assessment that is not ALARP, then the vibration should be mitigated in line with the Energy Institute Guidelines or a Level 4 assessment should be conducted.

2.4 Level 4: Detailed assessment

Where the assessment from Level 3 results in a risk assessment that is not ALARP, detailed assessment by vibration specialists according to EI Guidelines Module T8 and T9 should be conducted.

If the assessment results in a risk assessment that is not ALARP, then the vibration should be mitigated in line with the Energy Institute Guidelines or Shell DEP's.

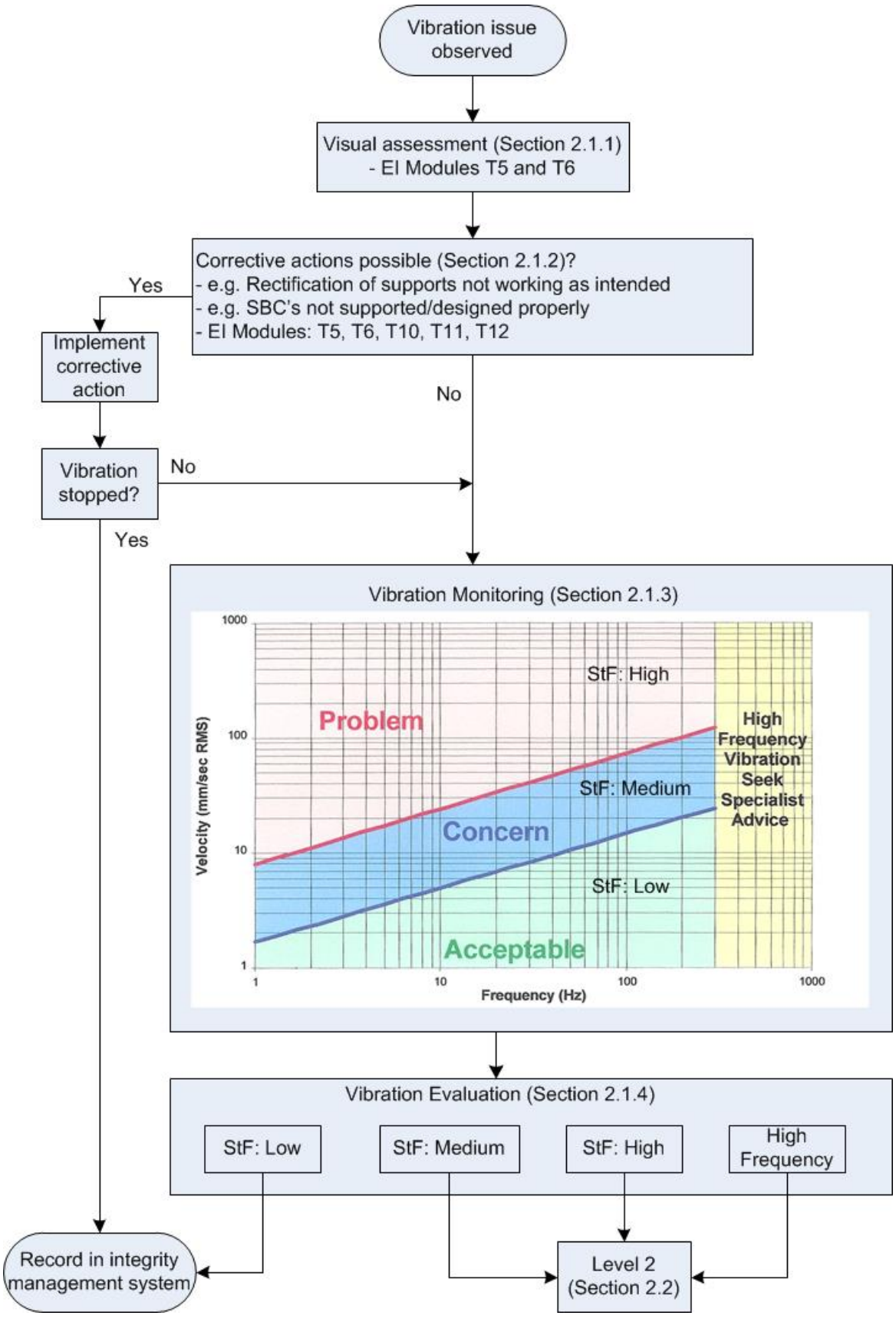

Figure 1: Level 1 Vibration issue evaluation

3 Definitions and abbreviations

Term	Definition
EI	Energy Institute
Pipework LOF	Shell Pipework vibration assessment software
RP	Recommended Practice
SBC	Small Bore Connection
StF	Susceptibility to Failure
S-RBI	Shell Risk Based Inspection

Term	Definition

4 REFERENCES

SHELL STANDARDS

PIPING – GENERAL REQUIREMENTS	DEP 31.38.01.11-Gen
PIPING CLASSES – BASIS OF DESIGN	DEP 31.38.01.10-Gen.

BRITISH STANDARDS

Energy Institute Guidelines for avoidance of vibration induced fatigue in process pipework

OTHER GUIDELINES

Vibration Fatigue Degradation Module	SR.16.10669
Background to S-RBI Vibration Degradation Module and Best Practice Guidelines for	GS.09.54405