SIMA EXAMPLE

FPSO Jumper Model in Sima

Valid from SIMA version 4.6

SIMA Example

FPSO Jumper Model in Sima

Date: November 2023

Prepared by: Digital Solutions at DNV

E-mail support: software.support@dnv.com

E-mail sales: digital@dnv.com

Table of Contents

1 Introduction 1

2 About the Model 2

3 Results 4

1 Introduction

This document introduces an example of modelling of a complex system including a free-standing hybrid riser tower with jumpers and a vessel with bell mouths. as shown in Figure 1-1. The FPSO is modelled as Support Vessel and connected with gas jumper, water jumper, production jumpers and control cables through bell mouths on the side of FPSO.

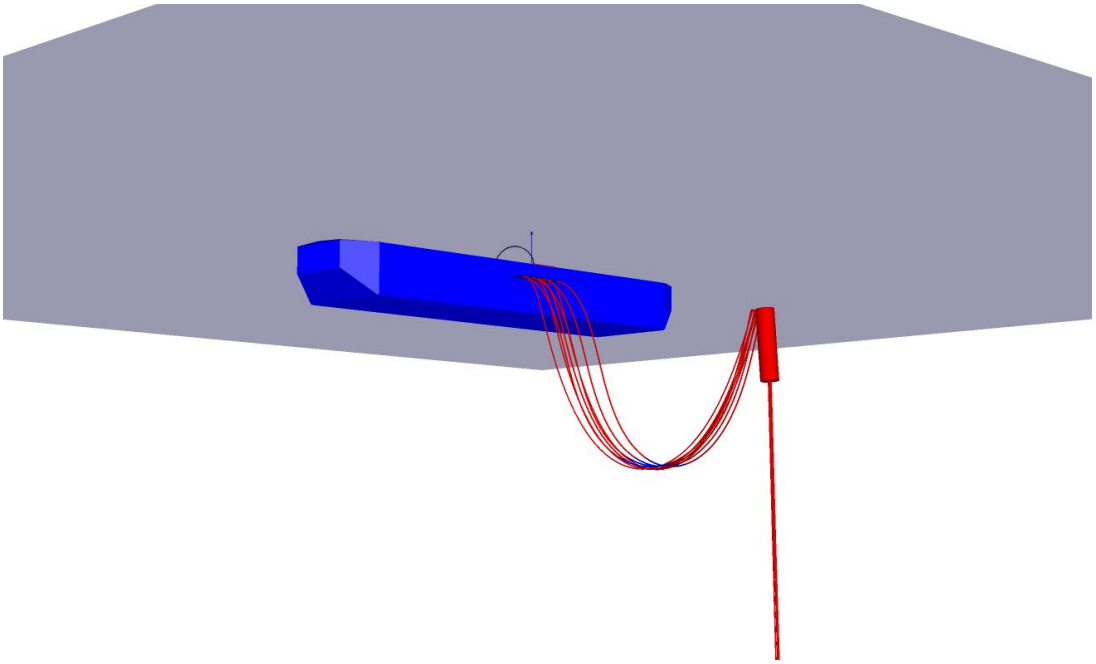

Figure 1-1 PFSO jumper model's 3D view

To open the example model, create a new SIMA workspace and import the "FPSOJumper.stask" file (*File → Import → SIMA → SIMA Task Archive (.stask)*). This will import a Riflex coupled analysis model containing the example.

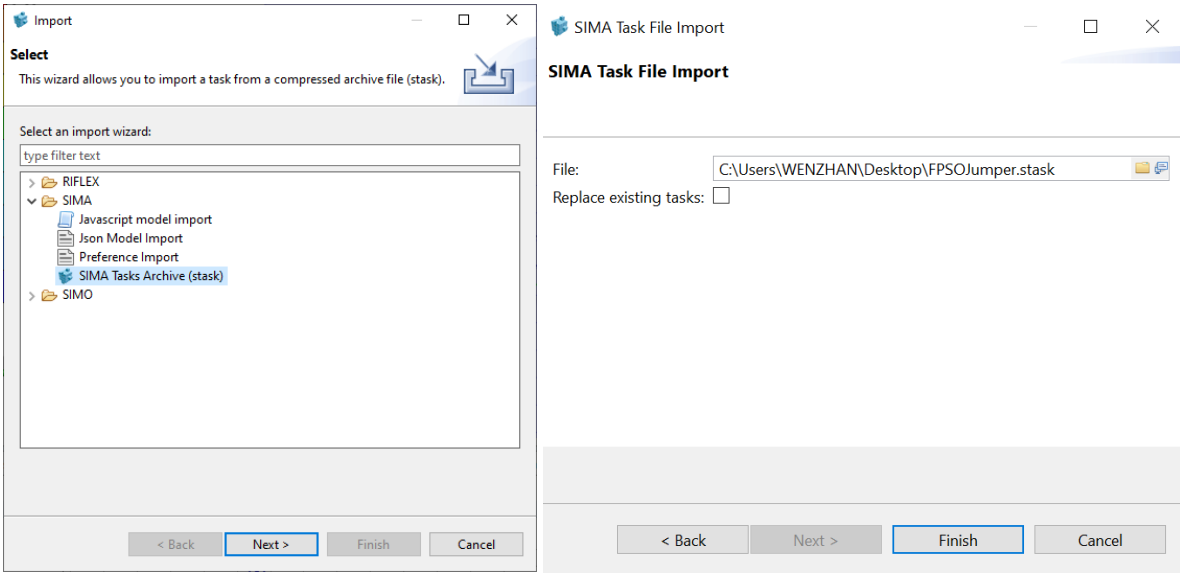

Figure 1-2 Importing the .stask file

2 About the Model

The model consists of several objects: the FPSO (**MPM_UG**), the risers (**production_riser#**), the jumpers (**prod_, gas, water, con**_) free-standing riser tower (**Top_can**) and bell mouths (**Bell**_) for the jumpers. The objects are shown in Figure 2-1 and Figure 2-2.

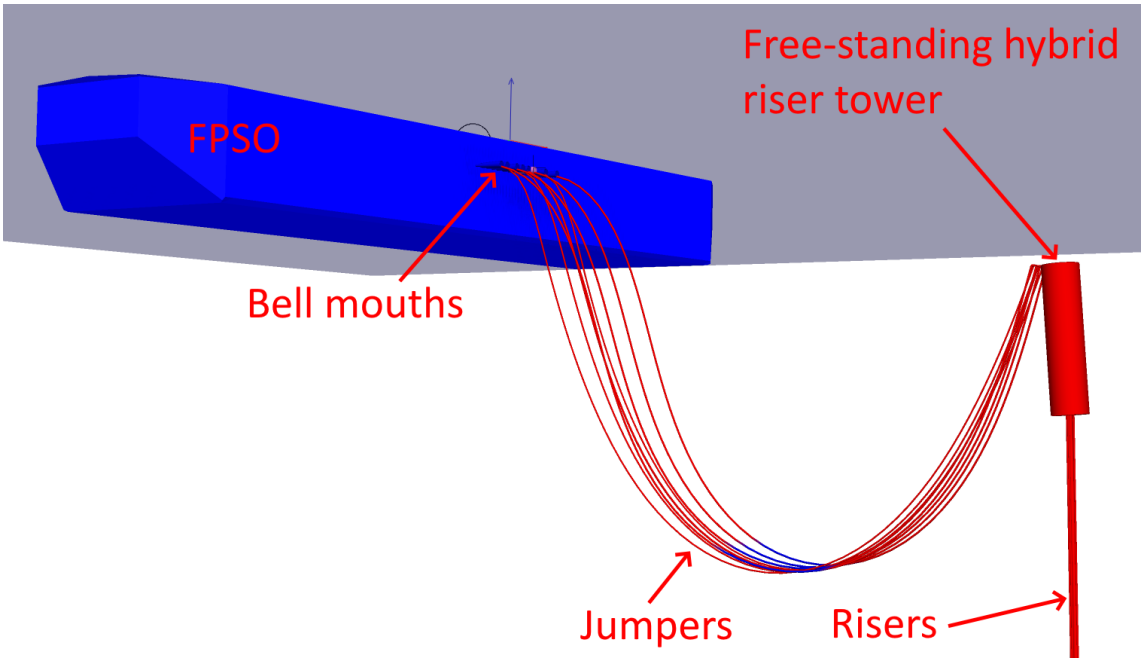

Figure 2-1 The main objects in the model

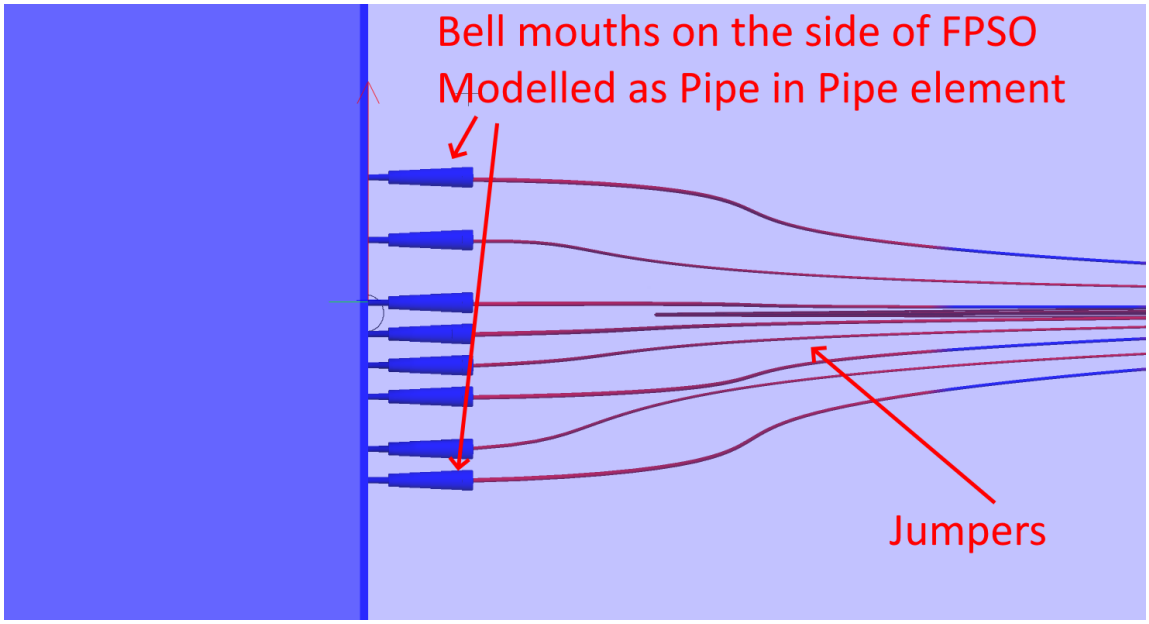

Figure 2-2 Details of the bell mouth

The FPSO is modelled by using Support Vessel in Sima. The movement of the vessel is based on the first order motion transfer function (motion RAO). The water depth is 1330 m. Jonswap wave spectrum is used with Hs = 11.5 m and Tp = 13.0 s. No wind and swell wave being implemented. Depth dependent current with 0.63 m/s surface velocity is applied as environmental loads.

Line ends connections are used to model rigid connections between the jumpers and the production risers to the top can of the tower. On the FPSO side, jumpers are connected through bell mouths. The bell mouths are modelled by using pipe in pipe element in Sima, as shown in Figure 2-3. You can find more detailed information about modelling pipe in pipe from here: https://sima.sintef.no/doc/4.6.0/riflex/sima/context/PipeInPipeContact.html. On the free-standing jumper tower side, jumpers are connected with flexible joints, you can find more detailed information here: https://sima.sintef.no/doc/4.6.0/riflex/sima/context/FlexJointConnectorType.html.

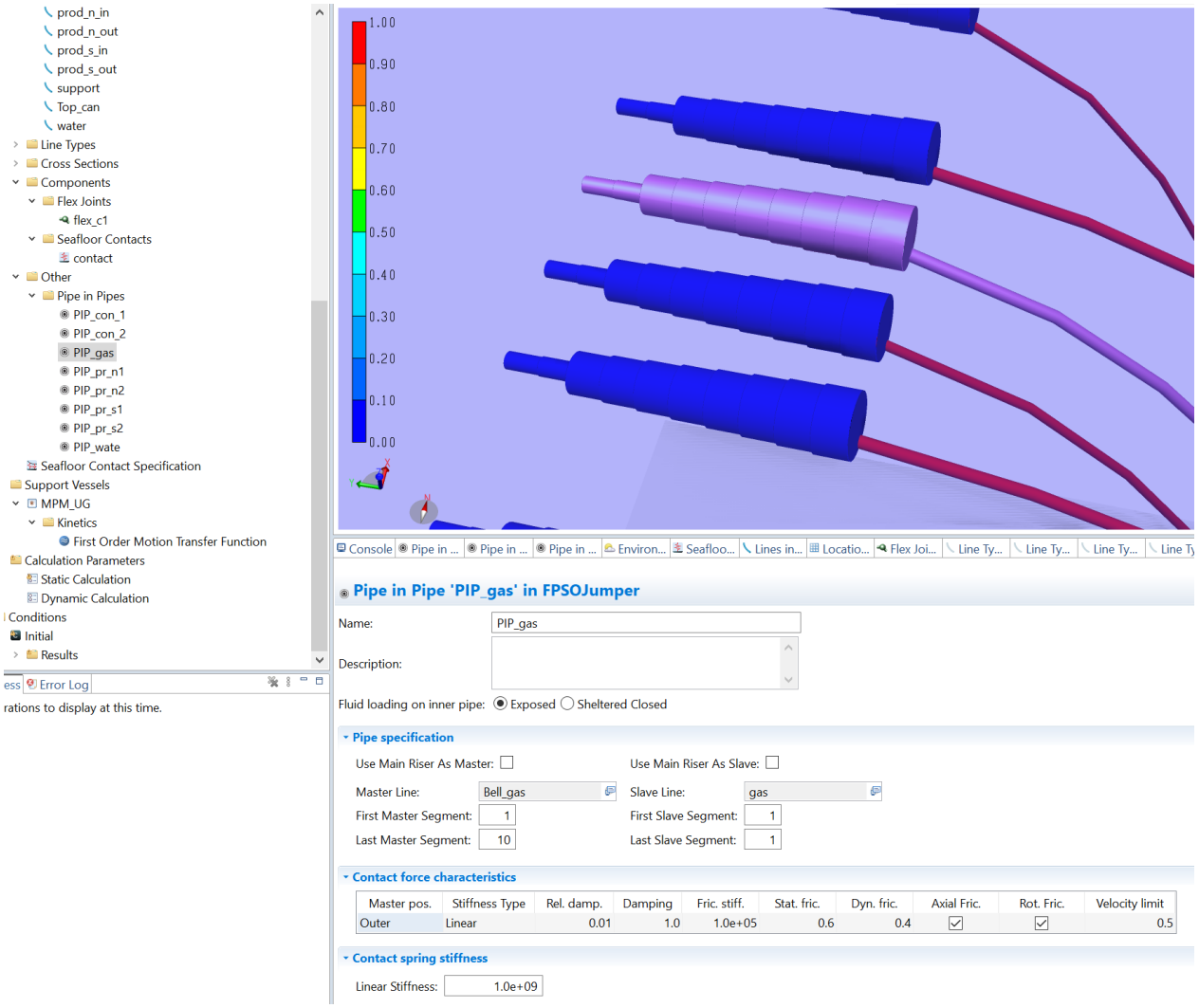

Figure 2-3 Pipe in pipe elements and settings

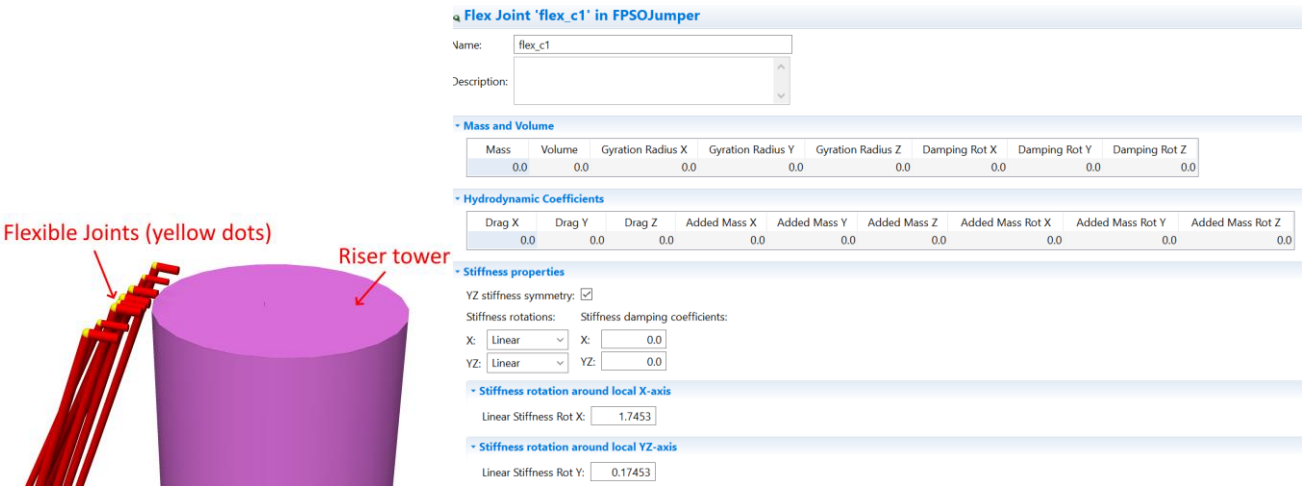

Figure 2-4 Flexible joint settings

3 Results

To run the simulation, run the dynamic analysis in the Initial condition. The simulation length has been set to 100 s with 0.005 s time step just for demonstrate purpose, in your own analysis, you may set longer simulation length. Some results are already set to be stored in the model. For example, production jumper end displacement, free-standing hybrid riser tower ends displacement, force response of jumpers, bell mouths, risers, free-standing hybrid riser tower and the 3D visualization of dynamic analysis etc.

The Movement of free-standing riser tower on global Y direction is shown in Figure 3-1. You can also find the axial force of the free-standing riser tower as shown in Figure 3-2. Apart from these, you can also check the contact force at the bell mouth, for example, the contact force on gas jumper bell mouth as shown in Figure 3-3.

You can find the results in Figure 3-1 from 'Dynamic/Top_can/segment_1/node_1 and node_2'.

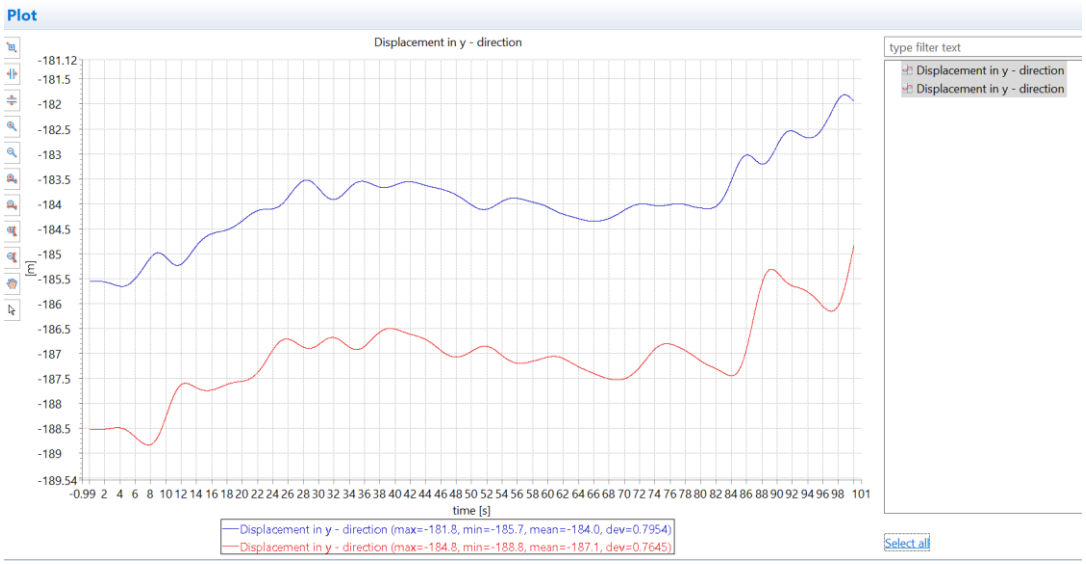

Figure 3-1 Movement of free-standing riser tower on global Y direction

You can fine the results in Figure 3-2 from ‘Dynamic/support /segment_1/element1.’

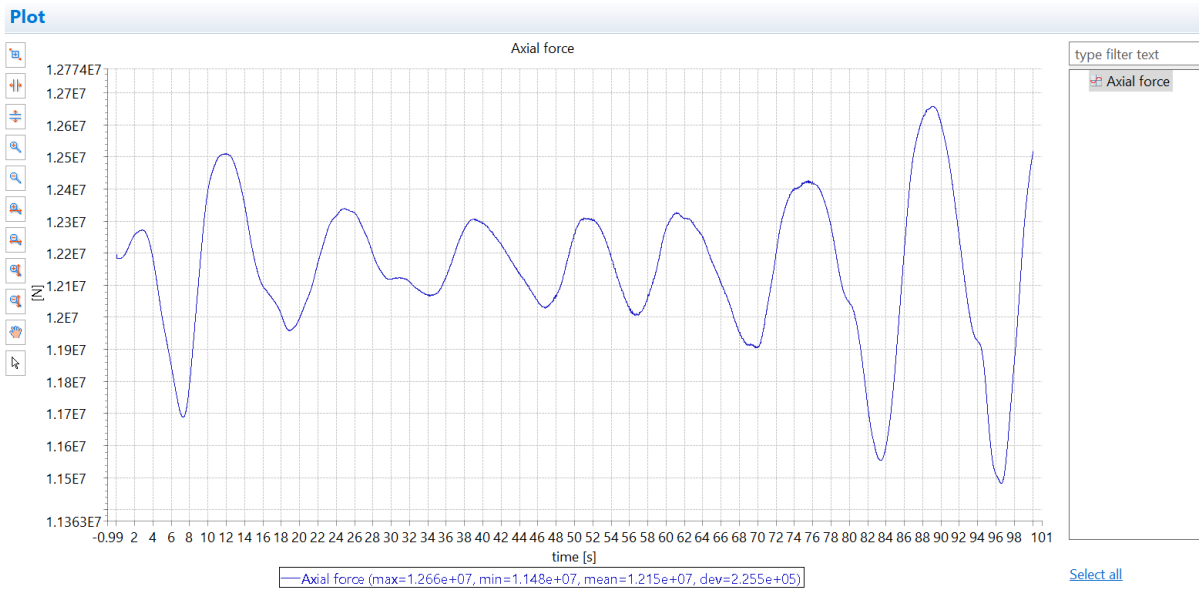

Figure 3-2 Axial force of free-standing riser tower

You can fine the results in Figure 3-3 from ‘Dynamic/Bell_gas/segment_1’.

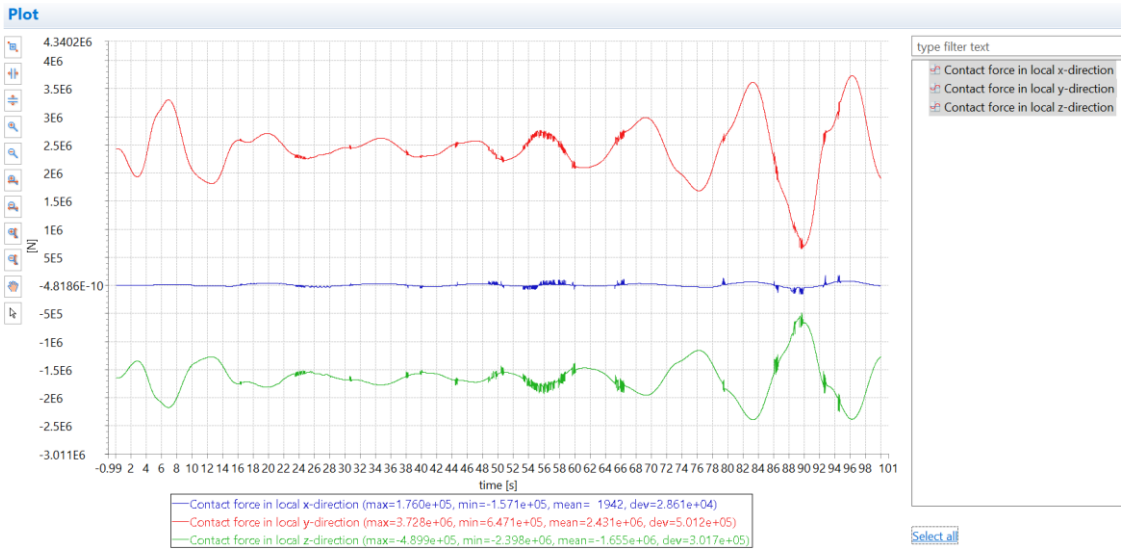

Figure 3-3 Gas jumper bell mouth contact forces in local coordinate system

About DNV

We are the independent expert in risk management and quality assurance. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.

Digital Solutions

DNV is a world-leading provider of digital solutions and software applications with focus on the energy, maritime and healthcare markets. Our solutions are used worldwide to manage risk and performance for wind turbines, electric grids, pipelines, processing plants, offshore structures, ships, and more. Supported by our domain knowledge and Veracity assurance platform, we enable companies to digitize and manage business critical activities in a sustainable, cost-efficient, safe and secure way.