



JIP Phase 3 proposal

1. Objectives
2. Benefits
3. Deliverables
4. Costs
5. Proposed CTRs

FLEXIBLE-RISERS

1

JIP Phase 3 – Objectives

The JIP Phase 3 workscope is intended to continue on from, and extend the work of, the JIP Phases 1 and 2:

- a) To complete the High Pressure tests in Nitrogen gas of actual 6” carcass sections
- b) To carry out High Pressure testing of a number of representative, prefabricated tests sections that had previously been tested at low and medium pressures
- c) To determine the effect of the introduction of a liquid flow into a “singing” riser system
- d) To quantify the effect of various acoustic boundary conditions
- e) To evaluate the use of “tuned absorbers”
- f) To evaluate the effect of larger diameter or longer riser sections
- g) To develop both source and a pressure drop models
- h) To develop a simple tool to predict the onset velocity, pressure pulsation frequency and amplitude, and the pressure drop

2

JIP Phase 3 – Benefits

For operators:

- Access to a fully developed theoretical understanding of the concern, validated by scale and full scale tests
- Opportunity to be involved in the development of generic guidelines on how to overcome the problem, and help define the optimum means of minimising the risk of a vibration induced fatigue failure
- Guidelines for the measurement and assessment of the concern for both topsides and subsea pipework
- Dialogue with the Flexible Riser vendors, and the opportunity to influence the design of their products to your specifications
- An international focus for knowledge sharing

2

JIP Phase 3 – Benefits

For vendors:

- Knowledge sharing with both operators and other vendors;
- Dialogue with operators, leading to better understanding of their requirements in the area of flexible risers
- Guidance on potential long terms modifications to risers

For both operators & vendors:

- Leveraged funding - for a relatively small outlay, members will benefit from a full scale research and testing programme
- Access to all JIP deliverables
- Facilitated technology transfer into participating companies

3

JIP Phase 3 – Deliverables (1 of 2)

The major deliverables are proposed as follows:

- A comprehensive technical report detailing the results of the High Pressure testing measurements in Nitrogen, on three actual 6” riser carcasses, and the effect of flow direction, corrugation profile, flowrate and pressure on the onset velocity, Strouhal Number, and pressure pulsation amplitudes
- A technical report detailing the results of the high Pressure testing measurements in Nitrogen, on up to five (5) prefabricated profiles, chosen to extend the LP and MP measurements previously undertaken as part of Phase 2 of the JIP, i.e. to extend the frequency range. This would include the effect of flow direction, corrugation profile, flowrate and pressure on the onset velocity, Strouhal Number, and pressure pulsation amplitudes
- A technical report detailing the results of LP tests on one prefabricated and one actual carcass test piece with varying upstream and downstream boundary conditions (acoustic reflection effects)

3

JIP Phase 3 – Deliverables (2 of 2)

The major deliverables are proposed as follows (continued):

- A technical report detailing the results of LP and MP tests on existing prefabricated profiles, but with larger pipe diameters and longer test piece lengths
- Based on the results of the Phase 2 and Phase 3 testing, to develop:
 - A Source model tool
 - A Pressure Drop tool (to predict pressure drop down a “singing” riser carcass);
 - An Evaluation tool (an executable program implementing the above tools).
- Should additional field data become available, a summary report comparing the results with previous analysed offshore installations, and the JIP test data.

4

JIP Phase 3 – Proposed Cost

- Total cost of £225k over an 18 month period
 - Based on £75k per existing operator participant
 - £37.5k for regulatory organisations (“half ticket”)
 - £85k for “new” operator participants – also gives access to Phase 1 deliverables
 - Riser Vendor fee to be agreed (contribution “in kind” possible)

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 1	Description: Completion of NEL “improved piping design” tests
Objectives:	To complete the High Pressure testing of actual 6” carcass sections, so that a comprehensive set of measurement and analysis data is available for review against LP/MP measurements undertaken by TNO as part of Phase 1 and 2, and field data. Also to evaluate effect of liquid, and what concentration affects “singing”.
Activities:	HP tests using Nitrogen gas using: <ul style="list-style-type: none"> • NKT (2 directions), 40 and 60 bar • FlexiFrance (1 direction) risers, 40 and 60 bar • with introduction of liquid into “singing” riser For flow velocities between 1.5 and 25 m/s.
Deliverables:	Technical report, including all measurement data, and including full comparison with previous NEL test data.
Budget cost:	£31k
Time scale:	3 months

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 2	Description: Additional NEL High Pressure tests using manufactured-to-suit corrugated pipe sections.
Objectives:	To extend the previous NEL high pressure testing to include representative (but not actual carcass) sections, e.g. similar to previous TNO LP/MP tests, so that the effect of 10 metres long corrugation profiles can be more fully evaluated at high pressures. Also to evaluate the effect of introduction of liquid, and what concentration affects “singing”.
Activities:	HP tests using Nitrogen gas using up to five, 10 metre long, representative (to be agreed) prefabricated profiles, for at least 2 pressures (40 and 60 bar), and for a range of flow velocities (minimum of 1.5 to 25 m/s).
Deliverables:	Technical report, including all measurement data, and comparison with LP and MP test data.
Budget cost:	£46k
Time scale:	4 months

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 3	Description: Influence of boundary conditions
Objectives:	Using experimental measurements and subsequent analysis, the effect of the test section end conditions on the onset and characteristics of “singing” carcass/test specimens will be evaluated, to help determine the influence of topsides/subsea pipework acoustic characteristics. Also to evaluate the effect of the introduction of tuned absorbers and how they might be used to affect the concern.
Activities:	Using representative test sections (minimum of 1 fabricated + 1 actual carcass section) both the upstream and downstream boundary condition will be varied (orifices, volumes, side branches). The standard parameters (frequency, amplitude) will be measured to obtain the influence of the boundary reflection coefficients. The base measurements will be done for a range of low pressures. Some high pressure validation tests may also be performed. In this series of experiments the tests can include the introduction of controlled liquid volumes into a “singing” system.
Deliverables:	Technical report, including all measurement data. Input data for developing an evaluation tool. Engineering guidelines for evaluating the influence of boundary conditions, (pipework at either end of a flexible riser).
Budget cost:	£21k
Time scale:	4 months

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 4	Description: Scaling effects/rules
Objectives:	From LP and MP tests, the effect of corrugation volume appears to be significant and hence it is proposed to evaluate this factor, through measurements of longer test section lengths, and large diameters.
Activities:	In almost all the experiments (at 2") the effect of the corrugation volume is seen. To validate this behavior it is proposed to extend the measurements to larger scales. The frequencies, amplitudes and onset velocities will be measured for different tubes sizes with (near) identical corrugations. The experiments will be done with tube sizes of 2", 3" and 4" at different lengths. The base idea is to use long lengths of readily available corrugated tubes
Deliverables:	Technical report, including all measurement data. Scaling rule
Budget cost:	£24k
Time scale:	3 months

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 5	Description: Prediction tool development
Objectives:	To produce a series of prediction tools which can be used in combination to determine the gas riser operating envelop with the minimum risk of flow induced pulsation.
Activities:	To develop: <ol style="list-style-type: none"> 1. A Source model: combining the results of the LP/MP and damping experiments it should be possible to develop a “source model” for a range of different test geometries. Used with an acoustic analysis of the measurement systems, the model should then be able to be used to predict the pulsation frequency, amplitudes and the onset velocities. 2. a Pressure drop model: through detailed analysis of previously recorded pressure drop data, develop pressure drop models for all the test geometries, so that a generic pressure drop model can then be used for corrugated tubes. 3. An evaluation tool (executable): A software tool will be developed for submission to the JIP participants, which with carcass geometry and process conditions as input data, will calculate the static pressure drop, and the frequency and maximum amplitude of the pressured pulsations as output data, (As noted in our previous meeting, we will have to discuss and agree the Intellectual rights associated with this item).
Deliverables:	Tools as described above
Budget cost:	£53k
Time scale:	3 months

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 6	Description: Field data analysis
Objectives:	Should additional on-site data become available, then detailed analysis would be undertaken (subject to information supplied) to identify onset velocity, Strouhal Number, etc.
Activities:	Review and analyse field data, including detailed process conditions.
Deliverables:	Technical report detailing results and conclusions, and comparison with previous field data.
Budget cost:	£5k per system.
Time scale:	1 month per system.

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 7	Description:
Objectives:	JIP management services.
Activities:	<ul style="list-style-type: none"> •Facilitation of Phase 3 launch meeting & subsequent minutes •Identification of potential additional participants •Secretariat role acting as a single point of contact and coordination •Responsible for progress reports etc •Workshop / meeting organisation and facilitation •Updating and maintenance of the JIP website •Management of project documentation •Responsible for project publicity
Deliverables:	As above.
Budget cost:	£35k, (or 16%)
Time scale:	Duration of project.

5

JIP Phase 3 – Proposed CTRs

Activity (CTR) Sheet	
Activity no.: 8	Description: BV Technical management fee
Objectives:	Technical management fee
Activities:	<ul style="list-style-type: none">• Hosting project contracts• Overall responsibility for technical aspects of projects• Setting up project• Control and review of project deliverables• Assimilation of final deliverables for delivery to project sponsors.
Deliverables:	As above.
Budget cost:	£10k, (or 5%)
Time scale:	Duration of project.