Protecting flexible risers

MAPS-FR: a unique input into integrity management
MAPS-FR is the industry’s first and only tool to assess the integrity of the key structural elements of flexible pipe

What are the challenges?
Unbonded flexible risers are comprised of an inner flexible metal liner surrounded by a polymer pressure barrier that is then overlaid with helically wound steel armor layers, all within an outer polymer protective shield. This structure is far too complex for conventional inspection technologies to be effective. This difficulty is compounded by the confined area where the riser faces the most significant integrity risks. This area between the splash zone and termination, often including bend stiffener and I-tube structures, is particularly congested and allows no access for other inspection or monitoring equipment. Subsea locations requiring divers or ROV access are also a challenge.

How does MAPS-FR work?
MAPS-FR adopts a unique approach to overcome these challenges by employing our patented MAPS® technology, a non-destructive, non-contacting technique for the measurement of stress in steel materials. From this information, the integrity of the steel armour wire layers—the primary load bearing component—may be assessed. MAPS-FR can therefore detect cavity degradation at its onset.

What makes MAPS-FR unique?
• A key benefit is the concept of ‘reach’, the ability to sense the effect of a wire break up to ±15 meters from the actual damage site, unlike conventional inspection technologies which require the exact location of the defect to be known and to be positioned over the area. This is of particular advantage in assessing integrity in and near the splash zone and up to the top termination where there may not be access to the pipe
• Can be flexibly deployed topside, or subsea by a diver, or by using an ROV down to 1 km
• Validation of MAPS® technology application to flexible pipe, through being part of our Flexible Pipe Qualification program
• Works on flexible risers from any manufacturer
• Ability to provide information wire-by-wire and layer-by-layer (two or four layers), bringing integrity assessment of flexible pipes to a new level
• Attaches easily to the riser’s external surface with no penetration or compromise to the outer layer or overall integrity

What benefits can MAPS-FR offer?
• Investigating design life extensions
• Provision of integrity assurance of key elements in the flexible pipe design
• Management of end-of-life scenarios
• Confirmation of fitness for service of damaged pipes and demonstration of performance of repaired regions
• Provision of data to allow continued operation in response to changing service conditions

Flexible risers are critical equipment in floating production operations, and they are subject to the most demanding of operational conditions involving extreme dynamic loading and arduous chemical environments. Yet, their structural integrity is extremely difficult to assess during operation.

MAPS-FR is the industry’s first and only tool to assess the integrity of the key structural elements of the flexible pipe: the steel armour wires. Available as an inspection service or an installed monitor, it can be applied topsides or subsea, to inspection service or an installed monitor, the steel armour wires. Available as an structural elements of the flexible pipe: a tool to assess the integrity of the key structural elements of flexible pipes.

Non-invasive Non-disruptive

Inspection configuration: easily deployed in extremely confined spaces; remote-controlled mobile sensor orbits the riser body for complete data capture.

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Practical in-field examples of MAPS-FR deployment for managing flexible riser integrity

Investigating extension of design life—we receive many requests to support continued operation and life extension for both inspection and monitoring services.

Changing reservoir conditions over time are a key concern. A souring of produced fluids with increasing H₂S levels, particularly if the original service was based on sweet service, can place integrity at risk. MAPS-FR provides solid information for equipment replacement planning and can help enable existing risers to remain in service.

Prolonged operating difficulties, such as outer sheath breaches, for example due to faulty annulus vent systems, can lead to riser damage—the extent of which is rarely obvious since the affected region may not be amendable to routine inspection. One significant concern would be exposed armour wires at and around the splash zone where installed CP systems are ineffective. MAPS-FR enables operators to continue with confidence. If riser replacement is needed, it allows intervention actions to be managed or deferred at the convenience of the operator.

Damage often requires installation of repair clamps, rendering impacted areas invisible to visual inspection or conventional techniques. Due to its unique ‘reach’ ability, MAPS-FR is able to ascertain the integrity under the clamp, quickly providing information needed to keep production flowing.

Operational upset conditions such as extreme loading outside the design envelope or changing field conditions often require inspection or installation of monitoring equipment. MAPS-FR’s ability for fast and flexible deployment makes it the ideal solution in such critical circumstances.

Monitoring configuration: the fixed sensor array surrounds the riser body for continuous stress measurement of all internal armor wires.

MAPS-FR inspection service
For individual inspections, the measurement equipment is attached to the pipe in a software-controlled scanner system with mobile sensor elements that capture the information from all of the armor wires. The collected data is ready for transmission and interpretation. An offshore campaign can take less than a day of onboard time for each flexible pipe inspected.

MAPS-FR monitoring system
Multiple fixed sensors are distributed around the pipe to provide continuous, full-range data sensing of all internal armor wires. The MAPS-FR software system is flexible, and data management can be configured to meet the operator’s needs. The equipment can be integrated within a new build or retro-fitted onto an existing riser—including fast and easy installation during operation. An essential feature is that MAPS® technology is not reliant on the detection of a transient response. The effect of wire degradation leaves a lasting impression on the stress distribution.

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