Mitigating Oil & Gas Casing Failures

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A single joint of defective casing can cost a company millions. Fortunately, there are steps a company can take to mitigate this risk and maximize the chance for full compensation if the casing fails.
A company can protect itself by implementing procedures for purchasing, record keeping, and the inspection of casing.

Purchasing Procedures.

A company may place an order by email or over the phone with a supplier, who then typically sends the company an invoice containing one-sided "standard terms." The seller's terms often attempt to rely on provisions in the Uniform Commercial Code (UCC), the governing law in most states that permits a seller to disclaim warranties and limit the buyer's remedies. Companies should avoid accepting one-sided terms by rejecting quotations and invoices that contain such provisions or, alternatively, responding with a purchase order that expressly rejects limits on warranties or damages and conditions purchase on acceptance of the company's terms.

In addition to one-sided seller terms, the seller may also dispute what casing qualities constitute a defect. To avoid such disputes, the astute company should consider requiring the seller to:

- Represent that all casing complies with recognized standards, in particular those provided by the American Petroleum Institute ("API"), as well as any other special performance criteria specified by the company.
- Provide mill certificates from the casing's manufacturer, which typically include a variety of specific representations including chemical composition and inspection results.
- Provide the results of any third-party inspections and testing of the casing. The third party inspector may be liable to the company if casing defects are not detected during the third party's inspections.

Independent Testing.

Although under no duty to do so, a company should consider hiring its own inspection company to test the casing before use in a well. Various inspection techniques are available to detect casing defects, including ultrasound, wet and dry magnetic particle, hydro-static pressure, visual, camera, dye penetrant, thread gauging, and hardness testing. Compared to the costs of a failed well, the costs associated with these tests are often relatively low.

Hydro-static pressure testing can identify sealing issues or other anomalies. Performing this test prior to running the casing downhole becomes a true financial saver if it prevents a failure or leak in a cemented region of the hole where the casing cannot be replaced or patched.

Maintain Records.

Consistent with any record retention policy, the company should keep records of its purchase of casing and associated evidence. This should include a paper and electronic file containing all correspondence and other documents related to the sale, delivery, installation, and use of the casing.

What to do if a casing failure occurs

The company's actions following a casing failure can be crucial to the company's ability to recover damages. After a casing failure, an company should consider taking the following actions:

Notify interested parties

The company should promptly inform its insurer and the casing's seller, manufacturer, and any company that inspected the casing. All notifications are best put in writing and the company should demand that any assurances or requests made by other parties be put in writing as well.

Attempt to retrieve the failed casing

The failed casing itself can be a crucial piece of evidence if any litigation is necessary to vindicate the company's rights. However, retrieving failed casing can be a difficult and expensive process. Bringing in an independent expert to assist with fishing operations adds an additional layer of protection to avoid subsequent criticisms about the operational choices. If retrieval operations prove fruitless, the company will be faced with the choice of when to stop "throwing good money after bad" and abandon all or part of the hole, whether or not all of the casing has been retrieved. If part of the casing string is abandoned, the potentially responsible parties may argue that evidence was "spoliated." To rebut such an argument, the company should consider making reasonable attempts to retrieve the failed pieces of casing and keeping the other interested parties on notice of the attempts as well as any plans to abandon the hole or the casing.

Hydrostatic pressure testing of oil country tubular goods (OCTG)

Wet magnetic particle inspection (WMPI) looking for cracks and other manufacturing defects

Manufacturing defect in seamless pipe

Agreed post-failure analysis.

If some or all of the failed casing is successfully removed from the well, the company and interested parties should consider using an independent laboratory to determine possible causes of the failure. The laboratory should develop a testing protocol that is acceptable to all parties. Casing tests falls into two general categories: non-destructive examination (NDE) and destructive examination. Common NDE techniques for new, used, and failed casing include:

- Ultra-sonic testing to determine wall thickness and defects such as cracks in the body of the casing.
- Special End Area (SEA) examinations including wet or dry Magnetic Particle Inspection (MPI or "mag particle") to detect cracks and other defects near the end of the casing or coupling. "Quench" cracks formed during casing manufacturing may be detectable by this method.
- Hydrostatic pressure testing to determine if there are deficiencies in the pipe, the coupling, or the threaded seal between the coupling and pipe.
- Thread gauging to determine if the casing's thread machining is defective.

In contrast to NDE, destructive examination methods are mainly employed after the casing has failed and the cause of the failure is at issue. Destructive examination techniques include:

- Tensile testing to determine the yield stress (the stress at which the steel becomes plastically deformed) and the ultimate stress (the stress at which the steel breaks in two).
- Charpy impact testing to determine the impact toughness of the steel.
- Chemical analysis to determine the elemental composition of the casing's steel.
- Metallurgical examinations to determine the microstructure of the steel, which can reveal the heat treatment and casing grade and quality.
- Fractography examination of any fracture or crack surfaces to aid in determining the cause of failure.

Preserve Evidence.

To avoid evidence disputes, the company should keep a chain of custody record for all casing retrieved from the well. In addition to a log of the casing retrieved, its location, and the person having custody at various times, retrieved casing should be stored so that it will not be lost, damaged, or intermingled with other casing. Photographs or video of any identifiable markings on the casing can be taken as the casing is removed from the well to aid in later identification and can be persuasive if there are challenges to the chain of custody. Markings can deteriorate during prolonged storage. To help prevent this problem, the casing can be stored, where practical, in an indoor or covered facility, which may also help preserve the condition of the evidence.

Legal demands.

If the casing failure was the result of defects in the casing, the company should consider making a demand on the seller, manufacturer, and any inspector that tested the casing for all damages sustained from the failure. If unsatisfied with the response, the company should consider filing a lawsuit against the responsible parties. Because the time period in which the company may bring a lawsuit varies by state and the applicable law, the company should promptly consult with counsel following a casing failure.

While a well failure caused by defective casing might be beyond an company's control, an company can use relatively inexpensive protocols to minimize that risk. In addition, the company's investment in savvy purchasing methods and post-failure evidence preservation could be the key to reimbursement.