ROTARY DRILLING SERIES

Unit I: The Rig and Its Maintenance
Lesson 1: The Rotary Rig and Its Components
Lesson 2: The Bit
Lesson 3: Drill String and Drill Collars
Lesson 4: Rotary, Kelly, Swivel, Tongs, and Top Drive
Lesson 5: The Blocks and Drilling Line
Lesson 6: The Drawworks and the Compound
Lesson 7: Drilling Fluids, Mud Pumps, and Conditioning Equipment
Lesson 8: Diesel Engines and Electric Power
Lesson 9: The Auxiliaries
Lesson 10: Safety on the Rig

Unit II: Normal Drilling Operations
Lesson 1: Making Hole
Lesson 2: Drilling Fluids
Lesson 3: Drilling a Straight Hole
Lesson 4: Casing and Cementing
Lesson 5: Testing and Completing

Unit III: Nonroutine Operations
Lesson 1: Controlled Directional Drilling
Lesson 2: Open-Hole Fishing
Lesson 3: Blowout Prevention

Unit IV: Man Management and Rig Management

Unit V: Offshore Technology
Lesson 1: Wind, Waves, and Weather
Lesson 2: Spread Mooring Systems
Lesson 3: Buoyancy, Stability, and Trim
Lesson 4: Jacking Systems and Rig Moving Procedures
Lesson 5: Diving and Equipment
Lesson 6: Vessel Inspection and Maintenance
Lesson 7: Helicopter Safety
Lesson 8: Orientation for Offshore Crane Operations
Lesson 9: Life Offshore
Lesson 10: Marine Riser Systems and Subsea Blowout Preventers
Contents

Figures v
Foreword vii
Preface ix
Acknowledgments xi
About the Authors xii
Units of Measurement xiv
Causes of Fishing Jobs 1
  Twistoff 2
  Stuck Pipe 3
    Mechanical Sticking 3
    Differential Sticking 7
  Offshore Sheared Pipe 8
  Junk in the Hole 8
  To summarize 9
Preparing for a Fishing Job 11
  To summarize 14
Fishing Out a Twistoff 15
  Milling the Fish 16
  Rotary Speed and Weight During Milling 19
  Engaging the Fish 21
  To summarize 29
Fishing for Stuck Pipe 31
  Freeing Mechanically Stuck Pipe 31
    Jarring 32
    Finding the Stuck Point 33
    Backing Off 36
    Washing Over 36
    Drilling Out 42
    Cutting Pipe 43
  Freeing Pipe from a Keyseat 45
  Freeing Wall-Stuck Pipe 48
  To summarize 49
Other Fishing Jobs 51
  Recovering Drill Collars 51
  Fishing for Offshore Sheared Pipe 53
  Fishing for Wireline 53
  Fishing for Junk 57
  To summarize 62
The Economics of Fishing  63
To summarize  67
Appendix  69
Glossary  75
Review Questions  83
Index  91
Answers  95
About the Authors

Jerry Fisher has 36 years experience working with fishing and re-entry products, of which the past 12 years have been with Weatherford International, Ltd. Jerry is currently serving as the Global General Manager for Fishing Services, based in Houston, Texas. His past positions include the Middle East/North Africa Regional Fishing and Re-Entry Product Line Manager, based in Dubai, UAE; the Operations Manager, Fishing Re-Entry Product Line, based in Aberdeen, UK; and the Fishing Tool Supervisor overseeing the Fishing & Re-Entry Product Line throughout the United States, North Sea, Continental Europe, and West Africa. Jerry has a vast amount of experience in all types of fishing operations including open-hole, cased-hole, milling, cutting, well abandonment, slot recovery, casing milling, and casing exits.
Arthur Meeks is the Senior Engineering Supervisor at Weatherford International, Ltd. In that role, he oversees the design and construction of prototype tools in response to demands from customers and Weatherford engineers in the field. He is also involved in developing recommended practices for the use of equipment in particular situations.

Arthur has over thirty years of experience in oilfield services, with a focus on the engineering of drilling, fishing, and remedial tools. His previous employers include Smith International, Inc. and Houston Engineers, Inc. Arthur has worked in most of the petroleum-producing areas of the United States, and has traveled to the Middle East, Far East, and Europe to direct the training of specialist workers in the use of new tools and to monitor the performance of equipment in field operations.

Arthur holds a B.S. in Manufacturing Systems-Engineering Technology from the University of Houston and is a member of the SPE and ASM.
Throughout the world, two systems of measurement dominate: the English system and the metric system. Today, the United States is one of only a few countries that employ the English system.

The English system uses the pound as the unit of weight, the foot as the unit of length, and the gallon as the unit of capacity. In the English system, for example, 1 foot equals 12 inches, 1 yard equals 36 inches, and 1 mile equals 5,280 feet or 1,760 yards.

The metric system uses the gram as the unit of weight, the metre as the unit of length, and the litre as the unit of capacity. In the metric system, 1 metre equals 10 decimetres, 100 centimetres, or 1,000 millimetres. A kilometre equals 1,000 metres. The metric system, unlike the English system, uses a base of 10; thus, it is easy to convert from one unit to another. To convert from one unit to another in the English system, you must memorize or look up the values.

In the late 1970s, the Eleventh General Conference on Weights and Measures described and adopted the Système International (SI) d’Unités. Conference participants based the SI system on the metric system and designed it as an international standard of measurement.

The Rotary Drilling Series gives both English and SI units. And because the SI system employs the British spelling of many of the terms, the book follows those spelling rules as well. The unit of length, for example, is metre, not meter. (Note, however, that the unit of weight is gram, not gramme.)

To aid U.S. readers in making and understanding the conversion system, we include the table on the next page.
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Causes of Fishing Jobs

In this chapter:

- Types of large and small fish
- Common causes of fishing jobs
- Mechanical sticking, differential sticking, and sheared drill string
- Elements that can comprise junk in the hole

Fishing can be divided into two broad categories: open-hole and cased-hole. A major difference between the two is timing: open-hole fishing is done as the well is being drilled, whereas cased-hole fishing is performed during production or well workover. Fishing techniques and types of equipment used also vary between the two. This book describes the basic techniques and tools used in open-hole fishing—that is, retrieving fish from a hole that is being drilled but is not yet cased.

Just as there are many types of fish, there are many ways that equipment can become lost or stuck in the hole. Each fishing job is unique; the tools and techniques needed to fish a string of stuck pipe from one well may not work at another well or under other conditions at the same well.

The largest type of fish is a segment of the drill string that has become stuck, has broken off, or has been purposely disconnected. Comparatively small fish, known as *junk*, can also result from drill string failure. Slivers of metal may come loose when the drill string parts. Metal fragments also are produced during the process of *milling* a larger fish to aid in its recovery. And junk from uphole may stick the drill string by jamming between the drill pipe or collars and the hole wall.
Preparing for a Fishing Job

In this chapter:

• Questions an operator asks to prepare for a fishing job
• How to determine depth of broken drill string
• Necessary hole and fish conditions

When it becomes necessary to fish drilling equipment out of an uncased hole, the experienced operator finds out as much as possible about the situation before taking action. The first step is usually to ask for the most recent well survey, a map of the borehole that shows where the bit deviated from vertical during drilling.

The operator will then attempt to answer a number of questions, including the following:

• What is to be fished out of the hole?
• Is the fish stuck, or is it resting freely?
• If stuck, what is causing it to stick?
• What is the condition of the hole?
• What is the size and condition of the fish?

Is it possible to screw into the threads on the fish? If not, could fishing tools be run outside the fish, or must they be run inside it?

• Could other tools be run through the fishing assembly that is to be used?
• Are there at least two ways to disengage from the fish if it cannot be freed?
In this chapter:

- The variety of mills used to dress the top of fish
- Scenarios for mill tool usage
- Importance of speed and weight in milling
- Procedure for engaging the fish

If part of the drill string has broken off in an open hole and is not stuck, the fishing job consists mainly of locating and engaging the top of the fish with an appropriate fishing tool.

In many cases the operator will find that the top of the broken-off pipe is badly split and twisted. Most fishing techniques require a section of straight, undamaged pipe to make a firm catch. The damaged metal must be removed to give the fish a more acceptable shape.
Fishing for Stuck Pipe

As mentioned earlier, there are two main ways that pipe can become stuck in the hole: mechanical sticking by solid materials and differential sticking by fluid pressure. Keyseating is a particular type of mechanical sticking that happens when the pipe becomes stuck during a trip. Although differential sticking is the most common reason for stuck pipe, fishing techniques are somewhat limited for recovering differentially stuck, or wall-stuck, pipe. Emphasis is therefore placed on preventing wall sticking from the start.

After a fish has been caught in the overshot, the usual procedure is to circulate out the settled cuttings without rotation. If circulation cannot be fully established and the fish cannot be pulled, the fish is almost certainly stuck mechanically in the hole.
Other Fishing Jobs

In this chapter:

• The process of recovering drill collars
• Considerations for fishing pipe sheared on an offshore rig
• Steps for fishing for stuck wireline and wireline tools
• Tools and methods for junk removal

When a drill collar separates, the break usually occurs at a connection: the pin breaks off in the box, or the box breaks off and comes out with the top part of the string. The remaining collars can usually be fished out with a standard overshot and jar assembly. However, if the diameter of the drill collar is very close to that of the wellbore, as in a packed-hole assembly, an overshot may not have enough clearance to go over the collars. The outside diameter of the fish must be milled over to create a fishing neck that a standard-size overshot can engage.

As a last resort a taper tap can be used to screw into the inside diameter of the drill collar (fig. 50). The taper tap is nonreleasing, so it is used only when an overshot cannot be run. The tap is lowered into the collar bore and slowly rotated to cut its own threads as it engages the fish. Some taps have open tips, allowing limited circulation for cleaning off the top of the fish; others have small side jets that move the point of the taper tap about to help locate the top of the fish.

Figure 50. Taper tap
The Economics of Fishing

In this chapter:

- How to calculate the number of days a fishing job should be allowed to continue
- The role of specialized fishing service companies
- The significance and limitations of fishing insurance

Some fishing jobs can go on for months before the fish is retrieved. After a certain period, however, the cost of fishing operations and lost drilling time become prohibitive. Generally, once these costs reach above half the cost of sidetracking and redrilling, fishing should be abandoned. In some cases the operator will opt to sidetrack immediately, without even attempting a fishing operation.

One way to calculate the number of days that should be allowed for fishing uses the following equation:

$$D = \frac{V + Cs}{R + Cd}$$

where

- $D$ = number of days to be allowed for fishing;
- $V$ = replacement value of fish;
- $Cs$ = estimated cost of sidetracking;
- $R$ = daily cost of fishing tool rental and services; and
- $Cd$ = daily rig operating cost.
Index

anchor washpipe spears, 41, 46, 48

backing off, 36
basket grapples, 22, 23
blowout preventers, subsea, 8, 53
blowout sticking, 4
boot baskets, 55, 57, 58, 61
boot subs, 61
bottomhole assembly (BHA), 21
Bowen-Lebus spear, 41
bowl, 22
bumper subs, 45, 46

cable-guide assembly, 54
cable-guide fishing method, 55
center prong rope spear, 53–54
chemical cutters, 44
core-type junk baskets, 59
crooked pipe, 6
cutting pipe, 43–44

depth of fish, 13
depth of drill string, 12–13
differential sticking, 7, 48
differential sticking vs. mechanical sticking, 3, 12, 31
ditch magnet, 19
dressing of fish, 13, 16, 23, 38, 44, 53
drill collars
   in bottom hole assembly (BHA), 21
   recovery of, 51–52
   in washover string, 36
drillout tool, 42
drill string washout, 5
economics of fishing, 63–67
engagement of the fish, 21–28
extension sub, 25
external catch tools, 18
filter cake, 7
finger shoes, 57
finger-type junk baskets, 57
fish
   conditions of, 13
   engagement of, 21–28
fishing insurance, 67
fishing jar accelerator, 21, 32
fishing jobs, causes of
   about, 1
   offshore sheared pipe, 8
   stuck pipe, 3–8
   summary, 9
   twistoff, 2
fishing jobs, economics of, 63–67
fishing jobs, other
drill collars, recovery of, 51–52
junk, fishing for, 57–61
offshore sheared pipe, 53
summary, 62
wireline fishing, 53–56
fishing jobs, preparation for
depth of string, 12–13
OPEN-HOLE FISHING

diagnosis, 12
impression block use, 14
operator questions, 11
fishing magnets, 60, 61
fishing string
  elements of, 21
  milling of, 19
free-point indicator, 33–34, 35

grapples, 22, 23
guide, 22
guide sleeve, 16

hole conditions, 5, 13
hydraulic fishing jars, 32
hydrostatic junk baskets, 60

impression block, 14
internal catch tools, 18

jar accelerators, 32
jar intensifiers, 32
jarring, 32–33, 36, 40, 46, 48, 49
jarring assembly, 52
jet cutters, 44
jet-powered junk baskets, 59
J-type safety joints, 38, 40
junk, 1, 57–61
junk baskets
  core-type, 59
  finger-type, 57
  hydrostatic, 60
jet-powered, 59
poor boy, 57
reverse circulation, 59
junk boots, 57
junk in the hole, 6, 8
junk subs, 57
keyseating, 5, 31, 45
keyseat reamers, 45
keyseats
  cable-guide fishing method and, 55
  freeing pipe from, 45–47
  nature of, 44
kickoff, 64
kick-sub, 26
knuckle joints, 24, 26, 27–28

lost-in-hole insurance, 67
lubricated bumper subs, 21

mechanically stuck pipe
  backing off, 36
  cutting pipe, 43–44
  determination of, 31
  drilling out, 42
  jarring, 32–33
  keyseat, freeing pipe from, 45–47
  stuck point identification, 33–35
  summary, 49
  wall-stuck pipe, 48
  washing over, 36–41
mechanical sticking, 3–6
mechanical sticking vs. differential sticking, 3, 12, 31
milling, rotary speed and weight during, 19–20
milling of fish, 1, 16–18
mills, 16, 18
mud, properties of, 48
mud cake, 7
offshore sheared pipe, 8, 53
oil spotting, 7, 48
open-hole vs. closed hole fishing, 1
outside cutters, 43
overshot assembly, 53
CAUSES OF FISHING JOBS

INDEX

overshots
- with basket grapple, 17, 23
- in bottom hole assembly (BHA), 21
- circulating and release, 22
- engagement of, 24–25
- preparation for, 16
- with spiral grapple, 23
- tool caught in, 56

packed hole assembly, 51
pilot mills, 18
poor boy junk baskets, 57
prong grab, 54
pup joints, 42

redrilling, 63
reverse circulation junk baskets, 59
rotary shoes, 38
rotary speed and weight during milling, 19–20

safety joints, 52
screw-in subs, 41
service companies, 66
sidetracking
- cost of, 63, 64
- in hard formation, 65
- in soft formation, 64
skirt, 16
skirted milling assembly, 16
sloughing holes, 3
snake, 56
spearhead overshot, 55
spearhead rope socket, 56
spears
- anchor washpipe, 41, 46, 48
- Bowen-Lebus, 41
- center prong rope, 53–54

pilot mills and, 18
spiral grapples, 22
spotting
- oil spotting, 7, 48
- spotted chemicals/fluids, 48
string shot, 34
string shot assembly, 34
stuck pipe
- differential sticking, 7
- fishing for, 31–49
- mechanical sticking, 3–6
- stuck point identification, 33–35
subsea blowout preventers, 8, 53
tapered holes, 6
taper tap, 51–52
tategate, 42
top sub, 22
twistoff, fishing for
- about, 15
- engagement of the fish, 21–28
- milling of fish, 16–18
- rotary speed and weight during milling, 19–20
- summary, 29
twistoff, signs of, 2, 12

undergauge holes, 4

wall hooks, 26, 28
wall sticking, 7
wall-stuck pipe, 31, 48
washed-out hole, 25
washing over, 36–41
washover operation, 39
washover pipe, 36, 38, 41, 47
washover string, 36, 37
wireline fishing, 53–56
wireline tools, 53