



GUIDE FOR CLASSIFICATION AND CERTIFICATION OF MANAGED PRESSURE DRILLING SYSTEMS

SEPTEMBER 2017

**American Bureau of Shipping
Incorporated by Act of Legislature of
the State of New York 1862**

**© 2017 American Bureau of Shipping. All rights reserved.
ABS Plaza
16855 Northchase Drive
Houston, TX 77060 USA**

Foreword

Managed Pressure Drilling (MPD) techniques have proven to be cost-effective, reliable, and safe when drilling difficult onshore wells as well as when drilling from mobile offshore drilling units (MODU) with a surface BOP. MPD is now widely being used as an enabling method in drilling increasingly complex and challenging offshore wells from MODUs with subsea BOPs.

As the leading global provider of offshore classification services, ABS is deeply involved in the safe and reliable use of MPD technology in global shallow-water and floating rig applications through design verification and validation. ABS has worked closely with the drilling industry to develop this Guide that specifies the classification and certification requirements for MPD systems, subsystems and equipment. This Guide is intended to be used in conjunction with the *ABS Guide for the Classification of Drilling Systems (CDS Guide)*, other applicable ABS Rules and Guides, codes and standards as referenced therein, and applicable national regulations.

For ABS classed drilling units that are in compliance with this Guide, the optional **MPD** and **MPD-Ready** class notations are offered. These notations are offered to drilling units that may or may not be classed with any of ABS' **CDS** notations and sub-notations for the associated drilling systems.

ABS also offers certification services for MPD systems, subsystems, equipment and/or components provided that the applicable requirements in this Guide are fulfilled. Certification can be provided for drilling units classed with ABS as well as for non-ABS classed units.

This Guide becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.



GUIDE FOR CLASSIFICATION AND CERTIFICATION OF MANAGED PRESSURE DRILLING SYSTEMS

CONTENTS

SECTION 1	General	1
1	General	1
3	Scope	1
5	Classification and Class Notations	1
5.1	MPD Systems	1
5.3	"MPD-Ready" Systems	1
5.5	Systems Not Built Under Survey	2
7	Certification	2
9	Certification and Classification Process	2
9.1	Certification Process	2
9.3	Classification Process	2
11	Applicable Codes and Standards	4
13	Alternatives	5
13.1	General	5
13.3	Standards or Basis of Design	5
15	New Technologies and Novel Concepts	5
17	Risk Evaluations for Alternative Arrangements and Novel Features	5
19	Design Plans and Data	6
21	Definitions	7
23	Abbreviations	9
	FIGURE 1 ABS Classification/Certification Process	3
SECTION 2	Design of MPD Systems, Subsystems and Equipment	10
1	General	10
3	MPD System General Safety Considerations	10
5	Risk Assessment for MPD System	10
5.1	HAZID	11
5.3	HAZOP	11
5.5	FMEA/FMECA	11
7	Rig Modifications	11
9	System Design	12

11	Back-Pressure Systems, Subsystems and Equipment Design	13
11.1	Low Pressure Riser above the Rotating Control Device (RCD).....	13
11.3	Rotating Control Device (RCD).....	14
11.5	MPD Annular	14
11.7	Riser Flow Spool.....	15
11.9	PRV and Discharges	15
11.11	MPD Manifolds	16
11.13	Debris Catcher/Junk Catcher.....	17
11.15	Piping.....	17
11.17	Flow Lines Including Flexible Lines	18
11.19	Back-Pressure Pump (BPP)	18
11.21	Mud-Gas Separator/Drill Thru Degasser	19
11.23	Non-Return Valve (NRV)	19
11.25	Control Systems	19
11.27	Modifications to the Drilling Riser System.....	20
13	Dual Gradient Systems	20
15	Controlled Mud-Level Systems, Subsystems and Equipment Design	20
15.1	Subsea Pump Module (SPM)	21
15.3	Low Pressure Riser above Subsea Pump Module	21
15.5	Subsea Annular Isolation Device/MPD Annular.....	21
15.7	PRV and Discharge	21
15.9	Flow Manifolds.....	21
15.11	Flow Meter	22
15.13	Piping.....	22
15.15	Mud Return Line (MRL)	22
15.17	CML Control Systems.....	22
15.19	Modifications to the Drilling Riser System.....	23
17	Materials, Welding and Nondestructive Examination for MPD System	23
SECTION 3	Survey of MPD Systems, Subsystems and Equipment.....	24
1	General	24
3	Surveys at Manufacturer and During Assembly	24
5	On-Board Surveys during Installation and Commissioning	24
7	Surveys after Commissioning	25
9	MPD Systems and Equipment not Associated with a Specific Drilling Unit.....	25
TABLE 1	Codes for Design Review and Survey	26
TABLE 2	Codes for Testing.....	29



SECTION 1 General

1 General

The general requirements for conditions of Classification and Certification are contained in the *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*. Additional requirements specific to managed pressure drilling (MPD) systems are contained in this Guide.

This Guide is intended to be used in conjunction with the *ABS Guide for the Classification of Drilling Systems (CDS Guide)*. The requirements contained herein and the referenced requirements from the *CDS Guide* are both to be met for classification and certification of MPD systems.

For ABS classed drilling units that are in compliance with this Guide, the optional **MPD** and **MPD-Ready** class notations are offered. These notations are offered to drilling units that may or may not be classed with any of ABS' **CDS** notations and sub-notations for the associated drilling systems.

ABS also offers certification services for MPD systems, subsystems, equipment and/or components provided that the applicable requirements in this Guide are fulfilled. Certification can be provided for drilling units classed with ABS as well as for non-ABS classed units.

3 Scope

The focus of this Guide is on MPD systems utilizing a Rotating Control Device (RCD) and a surface choke system to create surface back-pressure, and those that maintain a Controlled Mud Level (CML). Section 3, Table 1, lists the MPD systems, subsystems and equipment that may be classed/certified using this Guide. For subsystems and equipment of MPD systems not listed, the client is to contact the appropriate ABS technical office for guidance on the approval process.

5 Classification and Class Notations

Two optional class notations related to MPD systems (**MPD** and **MPD-Ready**) are available for ABS classed drilling units provided the classification requirements in Sections 2 and 3, as applicable, are complied with.

5.1 MPD Systems

Where classification of an installed MPD systems is requested by the Owner/Operator, the MPD system may be classed and distinguished in the *ABS Record* by the notation **✕ MPD**, where approved by the Committee for service under the specified design environmental conditions.

5.3 “MPD-Ready” Systems

The notation **✕ MPD-Ready** is available where MPD operations are anticipated however operationally-essential MPD equipment is not physically present. “MPD-Ready” means that a rig, usually a floating MODU, is pre-fitted with provisions (e.g., general piping and tie-in points pre-installed) to deploy a MPD system. When an MPD system is installed on a “MPD-Ready” rig, the Record may be distinguished accordingly from “MPD-Ready” to “MPD”, where classification of this system is requested by the Owner/Operator and thereafter approved by the Committee.

5.5 Systems Not Built Under Survey

The symbol “✕” (Maltese-Cross) signifies that the system was reviewed, built, installed and commissioned to the satisfaction of ABS. MPD systems, sub-systems, or equipment that have not been built under ABS survey, but which are submitted for Classification, will be subjected to special consideration. Where found satisfactory and thereafter approved by the Committee, they may be classed and distinguished in the Record by the notation described above, but the symbol “✕” signifying survey during construction will be omitted.

7 Certification

Upon request of the Owner/Operator or Designer/Manufacturer, and where permitted by the recognized Authority, ABS will issue Certificates for MPD systems, subsystems, equipment and/or components provided that the requirements in this Guide are fulfilled. Where authorized by a government agency and upon request of the Owner/Operator, ABS will survey and certify a classed MPD system or one intended to be classed for compliance with particular regulations of that government on their behalf.

Certification can be provided for drilling units classed with ABS as well as for non-ABS classed units. All the requirements in this Guide are applicable to certification except those in Subsection 3/7, “Survey after Commissioning”.

9 Certification and Classification Process

Section 1, Figure 1 shows the typical process for ABS Certification of MPD systems, subsystems, equipment and components and the way forward to Classification of MPD systems. Section 3, Table 1 identifies the typical MPD systems, subsystems and equipment that are part of the ABS Classification/Certification process. For MPD systems, subsystems, equipment and/or components not listed, the designer/manufacturer is to contact the appropriate ABS Technical office for guidance on the approval process.

For the **MPD-Ready** notation, the scope is only for the pre-fitted provisions on the rig, therefore, the process of “ABS Survey at Vendor’s Plant” in Section 1, Figure 1 may not apply.

Detailed ABS Classification and Certification process for drilling systems, subsystem, equipment, and/or components is contained in Section 4 of the *CDS Guide*. A brief summary of the process is provided below.

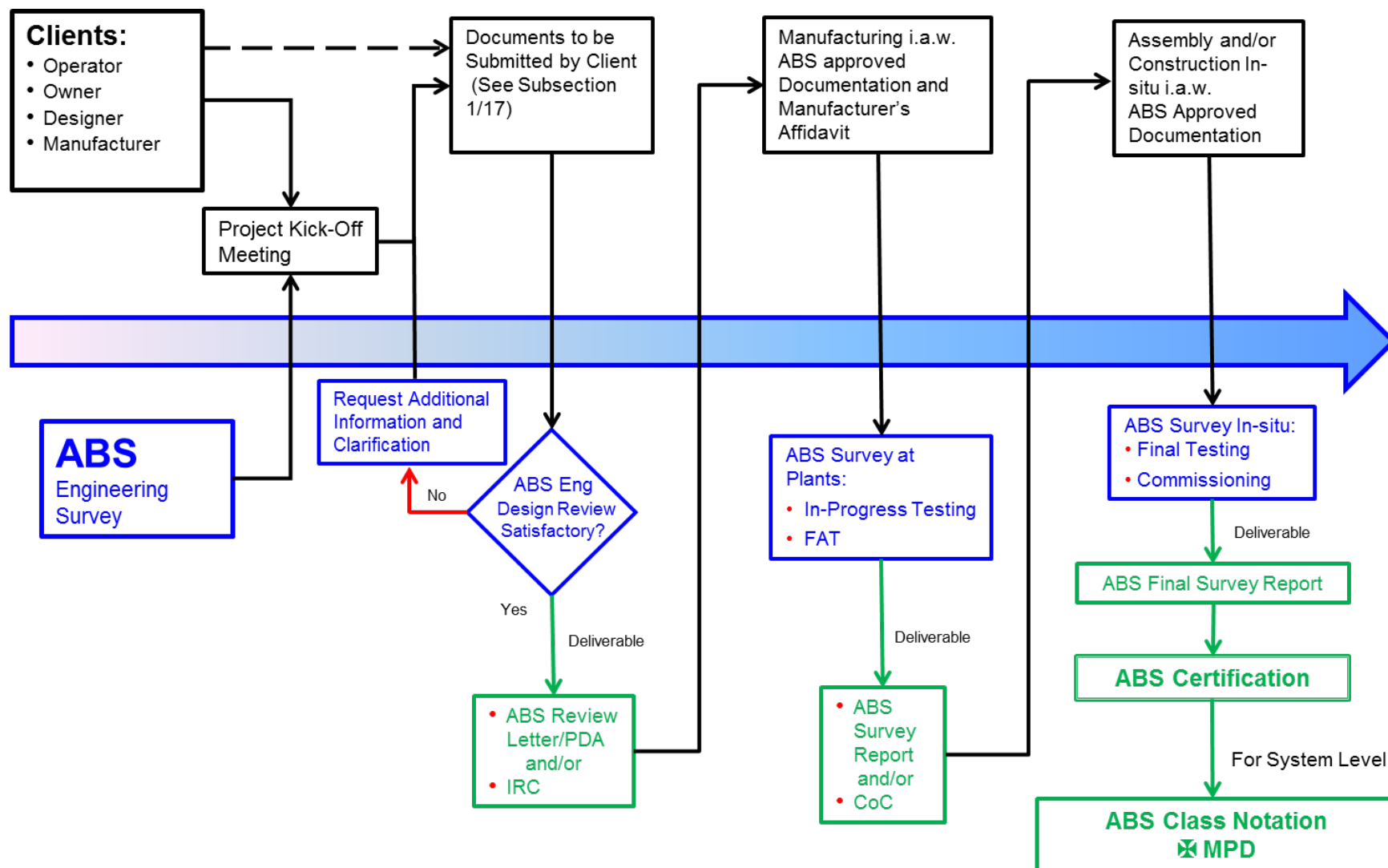
9.1 Certification Process

- i) Related MPD systems, subsystems, equipment and component drawings, calculations and documentation are required to be submitted to ABS by entities as listed in Subsection 1/19 to substantiate that the design of the systems, subsystems, equipment and/or components are in compliance with this Guide, and applicable codes or standards, as listed in this Guide.
- ii) Upon satisfactory completion of ABS review of design documents, ABS Engineers will issue an ABS review letter and/or an Independent Review Certificate (IRC), as specified in Section 3, Table 1. This letter or IRC, in conjunction with ABS-approved documentation, will be used and referenced during surveys.
- iii) Upon satisfactory completion of survey, ABS Surveyors will issue appropriate survey reports and/or a Certificate of Conformity (CoC).

9.3 Classification Process

In addition to items i) through iii) above, and upon satisfactory completion of all of the required engineering design review and survey processes (inspection, testing, installation and commissioning), ABS may issue a Classification Certificate to the drilling unit, including the Class notation as listed in Subsection 1/5.

FIGURE 1
ABS Classification/Certification Process



Note: For “MPD-ready” Notation, “ABS Survey at Vendor’s Plant” may not apply.

11 Applicable Codes and Standards

This Guide is intended for use in conjunction with codes and standards listed in this subsection, as well as those standards referred by related Sections/Subsections of *CDS Guide*.

ABS	Guide for the Classification of Drilling Systems (CDS Guide)
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Safety Systems for Offshore Production Platforms'
API RP 14E	Recommended Practice for Design and Installation of Offshore Products Platform Piping Systems
API RP 16Q	Recommended Practice for Design, Selection, Operation and Maintenance of Marine Drilling Riser Systems
API RP 17B	Recommended Practice for Flexible Pipe
API RP 92C	Controlled Mud Level Managed Pressure Drilling Operations
API RP 92M	Managed Pressure Drilling Operations with Surface Back-pressure
API RP 92P	Managed Pressure Drilling Operations – Pressurized Mud Cap Drilling with a Subsea Blowout Preventer
API RP 92S	Managed Pressure Drilling Operations – Surface Back-pressure with a Subsea Blowout Preventer
API Spec 16A	Specification for Drill-Through Equipment
API Spec 16C	Specification for Choke and Kill Equipment
API Spec 16D	Specification for Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment
API Spec 16F	Specification for Marine Drilling Riser
API Spec 16RCD	Specification for Drill-Through Equipment – Rotating Control Devices
API Spec 17K	Specification for Bonded Flexible Pipe
API Spec 6A	Specification for Wellhead and Christmas Tree Equipment
API Spec 7K	Specification for Drilling and Well Servicing Equipment
API Spec 7NRV	Specification for Drill String Non-return Valves
API STD 53	Standard for Blowout Prevention Equipment Systems
API TR 6AF1	Technical Report on Temperature Derating on API Flanges under Combination of Loading
API TR 6AF2	Technical Report on Capabilities of API Integral Flanges Under Combination of Loading – Phase II
IADC	Well Classification System for Underbalanced Operations and Managed Pressure Drilling
ISO 15156/NACE MR0175	Petroleum and Natural Gas Industries—Materials for use in H ₂ S-Containing Environments in Oil and Gas Production

13 Alternatives

13.1 General

ABS is ready to consider alternative arrangements and designs which can be shown through either satisfactory service experience or a systematic analysis based on sound engineering principles, to meet the overall safety, serviceability, and design standards of the Rules and Guides.

13.3 Standards or Basis of Design

- i) Designs complying with other national or international standards not listed in Subsection 1/11 will be subject to special considerations, on a case-by-case basis. When alternate design codes and standards are proposed, justifications may be achieved through equivalency, gap analysis, or appropriate risk analysis to demonstrate that the proposed alternate design codes and standards will provide a safety level which is acceptable to ABS.
- ii) Designs based on manufacturer's standards may also be accepted. In such cases, complete details of the manufacturer's standards and engineering justifications are to be submitted for review. The manufacturer will be required to demonstrate by way of testing or analysis that their design criteria employed results in a level of safety consistent with that of the recognized standard or code of practice. ABS will consider the application of risk evaluations for alternatives or novel features for the basis of design in accordance with the procedures specified in Subsection 1/15.

15 New Technologies and Novel Concepts

MPD systems, subsystems, equipment and/or components which contain novel design features to which the provisions of this Guide are not directly applicable may be classed/certified when approved by ABS. This will be on the basis that this Guide, insofar as applicable, has been complied with and that special consideration has been given to these aspects based on the best information available at that time. Justifications for the new or novel features can be accomplished by applying Subsection 1/17.

17 Risk Evaluations for Alternative Arrangements and Novel Features

- i) Risk evaluations for the justification of alternative arrangements or novel features may be applicable either to the MPD system as a whole, or to individual subsystems, equipment and/or components.
- ii) ABS will consider the application of risk evaluations for alternative arrangements and novel features in the design of the MPD system, subsystems, equipment and/or components, verification surveys during construction, and surveys for maintenance of Class.
- iii) When applied, risk assessment techniques are to demonstrate that alternative arrangements and/or novel features provide acceptable levels of safety in line with current offshore and marine industry practice.
- iv) Portions of the MPD system or any of its subsystems, equipment and/or components not explicitly included in the risk evaluation submitted to ABS are to comply with any applicable part of the ABS Rules and Guides.
- v) If any proposed alternative arrangement or novel feature affects any applicable requirements of flag or coastal State, it is the responsibility of the Owner/Operator to discuss with the applicable authorities the acceptance of alternatives based on risk evaluations.

The *ABS Guidance Notes on Review and Approval of Novel Concepts*, *ABS Guidance Notes on Qualifying New Technologies*, and *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities* provide guidance to ABS clients on the preparation of a risk evaluation to demonstrate equivalency or acceptability for a proposed MPD system design.

19 Design Plans and Data

Typical plans and data that are required to be submitted are listed below.

- i) The general arrangement of the MPD system, equipment plans, including all relevant risk assessment reports are to be provided in accordance with 2/7.1 of the *CDS Guide* for the MPD system showing its proposed arrangement and integration with the elements of a specific rig's existing drilling system.
- ii) Revised documentation that outlines modifications to the existing drilling system/equipment to accommodate MPD (piping modification, structural modifications, fire and gas detection, hazardous area plan, etc.).
- iii) Emergency and shutdown philosophy
- iv) MPD operational procedures (to be used as reference for reviewing the risk assessment reports)
- v) Piping and instrumentation diagrams (P&IDs) and/or process flow diagrams (PFDs) including valve numbering and representation of all MPD-related equipment (including PRVs) and flow paths for each MPD scenario being planned, or considered possible.
- vi) MPD equipment pressure relief protection providing rating/capacity and sizing calculations in accordance with 2/1.5 of the *CDS Guide*. Take into consideration possible variable PRV practices during scheduled operations when the MASP varies.
- vii) Riser management system changes required by the MPD system including but not limited to changes caused by different drilling fluid density within the riser, changed hoop stresses arising from MPD practices, changes in the riser tensioning requirements, additional weight and external dimensions of the MPD riser joint, current and wave forces added by subsea pumps (and umbilicals) for some MPD methods, and other MPD-created loads on the drilling riser system.
- viii) Details for any prime movers such as motors.
- ix) Design documentation for mechanical load-bearing components, as per 2/7.13 of the *CDS Guide*.
- x) Design details for all electrical systems and equipment, as per 2/7.17 of the *CDS Guide*.
- xi) Design details for all control system, as per 2/7.19 of the *CDS Guide*.
- xii) Design details for all MPD manifolds, pressure vessels, and tanks, as per 2/7.21 of the *CDS Guide*.
- xiii) Design details for rigid piping, valves, and fittings, as per 2/7.23 of the *CDS Guide*.
- xiv) Design details for flexible lines refer to 2/7.25 of the *CDS Guide*. Documentation (such as material specification, test procedures and test results) verifying material compatibility of flexible line linings with all anticipated well fluid types is to be submitted.
- xv) Prototype test data, as required by the applicable design code.
- xvi) Manufacturing specifications, as per 2/7.27 of the *CDS Guide*.
- xvii) Manufacturer's Affidavit of Compliance (MAC), as per 4/3.1.2 of the *CDS Guide*.
- xviii) List of handling and running equipment for all MPD systems. Each item included on this list will include documentation that demonstrates a "fit-for-purpose" design. Also, each listed item will include details describing the load test that was performed for that particular item.
- xix) NACE H₂S rating and compliance
- xx) Deck load and stability compliance
- xxi) Diagrams for electrical power and instrumentation wiring routing and tie-ins
- xxii) The design calculations for the MGS system(s), including both upstream and downstream piping diameters, run lengths, and the numbers of turns, verifying that the piping is capable of delivering returns throughout all operations and variations in flow rate at acceptably low pressures.

- xxiii) Calculations demonstrating that the flare or vent piping of MGS system provided is of sufficient diameter for total flow capacity, maximum flow rate, back-pressure generated, and fluid velocity (for erosion tendencies).
- xxiv) Basis of design for RCD bearing assembly running tools.
- xxv) Additionally, for CML-MPD:
 - a) Summary statement describing any additional electrical power supplies required for all components of CML-MPD equipment is to be included in the submittals.
 - b) Design specifications for subsea pump module in accordance with 2/15.1 of this Guide are to be submitted.
 - c) Details of back flushing the mud return line (MRL) including the frequency of flushing is to be submitted.
 - c) If a rig pump is to be used for back flushing of MRL, a flow diagram showing the alignment of piping, flexible lines, and valves is to be submitted.

21 Definitions

The following definitions are provided to clarify the use of certain terms used in this Guide:

Barrier. Envelope of one or several well barrier elements preventing fluids from flowing unintentionally from the formation into the wellbore, into another formation or to the environment.

Circulation System. The complete flow path that the drilling fluid travels from the mud pits to the mud pump intake, down the drill pipe, exiting through the jets of the drill bit, and back up the annular spaces until it returns to the surface for processing and return to the mud pits.

Closed Circulation System. A drilling fluid system flow path which is not open to the atmosphere.

Continuous Circulation Method (CCM). An MPD technique used to maintain flow down the drill pipe while making a connection, thereby maintaining equivalent circulating density (ECD) and thus keeping a constant pressure profile in well annulus to prevent an influx of formation fluids or potential hole collapse due to instability.

Controlled Mud Level (CML). A variant of Dual Gradient Drilling (DGD) used only on floating rigs by placing a special pump in/on the drilling riser to vary the level of fluid in the drilling riser. The fluid level is adjusted up or down to control bottom-hole pressure and to compensate for variations in equivalent circulating density due to frictional pressure losses.

Dual Gradient Drilling (DGD). A drilling process that creates multiple pressure gradients to manage the annular pressure profile.

Equivalent Circulating Density (ECD). The effective density of the circulating fluid in the wellbore resulting from the sum of the pressure imposed by the static fluid column, friction pressure and surface back-pressure.

Floating Mud Cap Drilling (FMCD). A drilling technique used to drill without returns while sacrificial fluid is continuously pumped down drill string and the annulus to avoid all possibility of formation fluid migrating to the surface. Open-hole formation is taking all injected (sacrificial) fluid and drilled cuttings without surface pressure assistance.

Friction Management Method or Annular Friction Management. Systems allowing for continued circulation during drill pipe connections, thereby maintaining constant bottom hole pressure. This technique is also referred to as the CCM method in some publications.

Managed Pressure Drilling (MPD). An adaptive drilling process used to precisely control the annular pressure profile throughout the wellbore. The objectives are to ascertain the down-hole pressure environmental limits and to manage the annular hydraulic pressure profile accordingly.

Mass Flow Meter. A measuring device that is capable of working with flow streams to measure the mass rate of flow and the density of the fluid stream (e.g., Coriolis Meter).