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Well Control Kill Methods during the Drilling Operations (Module I and II)

1.0 Course Faculty Information

Name: Prof. Dr. M. Enamul Hossain
NSRIC Chair Professor in Sustainable Energy
NSRIC Inc., Toronto, Ontario, Canada

2.0 Course Information

Course Codes	ENG-P-C00315 and ENG-P-C00323
Class Days	Follow posting in NSRIC LMS system
Class Time	Follow posting in NSRIC LMS system
Course Credit Hours	2 + 2
Class Location	NSRIC online platform
prerequisites and/or co-requisites	n/a
Level /A, E, H, I, K12, M, P, S, T, U, V, W	P

Note: The below classification of courses is related to any areas of knowledge:
A: Advanced level academic level courses; **C**: Canadian immigration and training courses; **E**: Executive courses; **H**: Higher-level courses (i.e., graduate courses); **I**: Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12**: Foundational, and lower-level courses; **M**: Mid-level courses (i.e., undergraduate courses); **P**: Professional courses; **S**: Short/seminar courses; **T**: Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W**: Workshop courses.

3.0 Professor Information

Name	Prof. Dr. M. Enamul Hossain
Title	NSRIC Chair Professor in Sustainable Energy
Contact Information	enamulh@nsric.ca; dr.mehossain@gmail.com
Office Location	NSRIC online platform
Office Hours	10: 30 am – 11:30 am EST (Monday) by email appointment

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4.0 Target Audiences

- University graduates, early career engineers and professional engineers.
- Diploma and vocational training student.
- University undergraduate level student.
- Any student who is interested in drilling engineering.
- Students who have completed Basics of Drilling Engineering I (Modules 1 – 4) and Drilling Engineering II offered by Prof. M. Enamul Hossain.

5.0 Course Modules Descriptions

Module I

The objective of any well kill technique is to restore safety to primary well control. The driller's method and the wait and weight (W&W) method are the most commonly used well control kill methods. This course explores both in detail. In addition, other kill methods are discussed, such as volumetric, lubricate and bleed, concurrent, bullheading, reverse circulation, and low chock pressure methods.

The course begins with an overview of all the methods and covers step-by-step procedures with specific workout examples of an application of the kill methods. A complete discussion on the driller's method and wait & weight (W&W) method. The oilfield well control kill worksheets are also introduced. The course is designed to control kicks through both kill methods. It covers the fundamental issues for beginners interested in learning how to apply, select, and procedures of kill methods, including all calculations related to completing the entire process. The course presents the engineering terminologies so the reader can understand the formulas, mathematical models, correlations etc., with minimum effort. The module concludes by discussing calculations involving shut-in drill pipe pressure, shut-in casing pressure and explaining maximum shoe pressure. This module will make the students interested in enrolling in the course.

This course is a foundation, resource guide and an excellent source for petroleum engineering students, drilling professionals, executives and drilling engineers who want to learn concepts, design, and all oilfield practicing kill methods through enough practice of the theories and examples. Module I is designed for individuals and students who have a basic understanding of drilling engineering. The course contains a total of 12 lectures, and each lecture comprises 25 to 40 PowerPoint presentation slides and pdf documents. Students are strongly advised to complete the course title "Basics of Drilling Engineering I and Drilling Engineering II" by Prof. M. Enamul Hossain at NSRIC Platform to understand this course content.

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Keywords: Well control, types of kill methods, formation fluid, influx, kill mud, kick analysis, kill mud calculations, driller's method, wait and weight (W&W) method, true vertical depth, shut-in pressure, shut-in casing pressure, maximum shoe pressure, annular capacity, tubing capacity, warning signals, formation and pore pressure.

Module II

The objective of any well kill technique is to restore safety to primary well control. The driller's method and the wait and weight (W&W) method are the most commonly used well control kill methods. This course explores both in detail. In addition, other kill methods are discussed, such as volumetric, lubricate and bleed, concurrent, bullheading, reverse circulation, forward circulation and low chock pressure methods.

Module II begins with a discussion of the volumetric method and covers step-by-step procedures with specific workout examples of an application of the kill methods. A complete discussion on the volumetric method, lubricate and bleed method, concurrent method, bullheading method, reverse and forward circulation methods, and low chock pressure method. The oilfield well control kill worksheets are also introduced. The module is designed to control kicks through different kill methods and covers the understanding of the common problems and complications during well kill operations. It covers the fundamental issues for beginners interested in learning how to apply, select, and procedures of kill methods, including all calculations related to completing the entire process. The course presents the engineering terminologies so the reader can understand the formulas, mathematical models, correlations etc., with minimum effort. The module concludes by discussing calculations involving shut-in drill pipe pressure, shut-in casing pressure and explaining maximum shoe pressure. This will make the students interested in enrolling in the course.

This course is a foundation, resource guide and an excellent source for petroleum engineering students, drilling professionals, executives and drilling engineers who want to learn concepts, design, and all oilfield practicing kill methods through enough practice of the theories and examples. The course is designed for individuals and students with a basic understanding of drilling engineering. The course contains a total of 10 lectures, and each lecture comprises 25 to 40 PowerPoint presentation slides and pdf documents. Students are strongly advised to complete the course title "Basics of Drilling Engineering I and Drilling Engineering II" by Prof. M. Enamul Hossain at NSRIC Platform to understand this course content.

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Keywords: Well control, types of kill methods, formation fluid, influx, kill mud, kick analysis, kill mud calculations, bullhead method, volumetric method, lubricate and bleed method, concurrent method, forward circulation method, reverse circulation method, low chock pressure method, true vertical depth, shut-in pressure, shut-in casing pressure, maximum shoe pressure, annular capacity, tubing capacity, warning signals, formation and pore pressure.

6.0 Course Learning Outcomes

Students who complete this course can achieve the following course learning outcomes (CLOs):

CLO1: Become familiar with the warning signals, reasons for kicks and sequence of kicks.

CLO2: Become familiar with an overview of well-control kill methods.

CLO3: Ability to analyze the well-control kick methods through different criteria.

CLO4: Select and apply the procedures of the driller's method with theories, mathematical formulas, and calculations.

CLO5: Select and apply the procedures of the wait and weight (W&W) method with theories, mathematical formulas, and calculations.

CLO6: Decide on and execute the procedures for the volumetric method with theories, mathematical formulas, and calculations.

CLO7: Choose and implement the technique of the lubricate and bleed method using theories, mathematical formulas, and calculations.

CLO8: Select and apply the procedures of the concurrent method with theories, mathematical formulas, and calculations.

CLO9: Choose and implement the methods of the bullhead method using theories, mathematical formulas, and calculations.

CLO10: Select and apply the procedures of the reverse circulation method with theories, mathematical formulas, and calculations.

CLO11: Use theories, mathematical formulas, and calculations to select and implement the low chock pressure method procedures.

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CLO12: Ability to calculate the kill mud, design the appropriate mud weight for controlling the well, and apply the appropriate kill methods.

CLO13: Analyze the kill methods through workout examples and apply the practical knowledge in real-life scenarios.

CLO14: Ability to demonstrate a clear understanding of the different well kill methodologies and scenarios in which they are chosen.

CLO15: Familiarization with A complete discussion on the volumetric method, lubricate and bleed method, concurrent method, bullhead method, reverse and forward circulation methods, and low chock pressure method.

CLO16: Understand the common problems and complications during well kill operation.

7.0 How the course supports the attainment of the student outcomes

Student Learning Outcomes (1-6)						
1	2	3	4	5	6	7
Moderate	Moderate	Moderate	Low	Moderate	Moderate	Excellent

8.0 Course Materials

Online course materials

- Online presentation documents in pdf form.
- Audio/visual recording of lectures (Optional).
- Online tutorial and meeting with students upon request.
- Workout examples for hands-on experience.
- Assignments and MCQs in the form of evaluation at the NSRIC online MLS system
- Reading materials, if any, in pdf form

Textbook and resources (If any)

1) **Hossain, M.E.** (2016). Fundamentals of Drilling Engineering: MCQs and Workout Examples for Beginners and Engineers. ISBN: 978-1-119083-56-6, John Wiley & Sons, Inc. Hoboken, New Jersey, and Scrivener Publishing LLC, Salem, Massachusetts, USA, pp. 854.
2) **Hossain, M.E.** and Al-Majed, A.A. (2015). Fundamentals of Sustainable Drilling Engineering. ISBN 978-0-470878-17-0, John Wiley & Sons, Inc. Hoboken, New Jersey, and Scrivener Publishing LLC, Salem, Massachusetts, USA, pp. 786.

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9.0 Academic Integrity

Students are encouraged to have a look at the NSRIC's statement of academic integrity at NSRIC website. It is noted that by signing this syllabus, you will acknowledge that you have understood that any detected plagiarism should be reported.

10. Assessment for Grade

This course is a professional course not an academic course (i.e., K12, and university level courses). Therefore, there will not be any assessment based on individual and team performance as shown in Table 1. However, the course contains four quizzes and assignments to make the assessment. Students will receive a "***Certificate of completion***" after successful completion of the course.

Table 1: NSRIC grading system.

Type of Assessment	Grade %
Participation/Engagement/Performance	10%
Assignments	60%
Quizzes	30%
Research Project	0%
Midterm Exam I	0%
Midterm Exam II	0%
Final Exam	0%
Total	**100%**

Important Note:

i) The below classified courses (i.e., academic courses) will only be evaluated based on the grade system shown in Table 2. A grade and certificate will be issued for the student(s) and participant(s).
A: Advanced level academic level courses; **H**: Higher-level courses (i.e., graduate courses); **I**: Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12**: Foundational, and lower-level courses; **M**: Mid-level courses (i.e., undergraduate courses).

ii) The below-classified courses will **not** be evaluated based on the grading system shown in Table 2. A certificate will be issued for the student(s) and participant(s).

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E: Executive courses; **P**: Professional courses; **S**: Short/seminar courses; **T**: Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W**: Workshop courses.

Participation/Engagement/Performance

Your participation in every aspect of the course is important for the learning process. Your engagement in every discussion in the course, and due delivery of all practices will be fruitful. These efforts from your side will reflect your performance in the course delivery and your commitments. This performance is the reflection of your dream grade!!

At the end of the term, below Table 2 will be used for translating your marks into a "Latter Grade" based on the NSRIC grading policy.

Table 2: NSRIC grading system.

Marks	Letter Grade	Points	Description
≥ 93	A+	4.00	Outstanding
≥ 90	A	3.75	
≥ 87	A-	3.50	Excellent
≥ 84	B+	3.25	Very good
≥ 81	B	3.0	
≥ 78	B-	2.75	Moderately Good
≥ 75	C+	2.50	Good
≥ 72	C	2.25	
≥ 69	C-	2.0	Moderately Good
≥ 66	D+	1.75	Pass
≥ 63	D	1.50	
≥ 60	D-	1.25	Poor Pass
< 60	F	0	Failing

11.0 Advice and additional requirements

I advise you to:

- Please contact me if you need any help.
- Students are expected to attend all scheduled online lecture classes.
- Students are expected to study from the course materials and/or textbooks which will help to easily read and understand.
- Students are encouraged to write their own notes during lectures/presentations

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(pdf PowerPoint presentations, and additional materials if any).

- Students are encouraged to attend online platform classes on time because late-attendee disrupts the flow of the class for both the instructor and the other students.

Additional information (During Online Course offering Period)

- The PowerPoint course materials and video lectures will be available on the NSRIC Platform.
- There will be scheduled discussion/tutorial sessions based on the request at the class scheduled time. All students must attend this session (Need the student's email request).
- There will be an office hour for students on Monday from 10:30 am – 11:30 am EST (Toronto, Canada time). Students need to send an email request so that a Zoom meeting can be arranged. In addition, any time students can set up an online appointment (i.e., phone, zoom, and/or other mode of communication) based on the availability of the course instructor. However, students should request an email to set up this type of meeting.

12.0 Course Topics

- A basic understanding of well control and monitoring during drilling operations.
- An overview of well-control kill methods.
- Detailed discussion on the Driller's method with workout examples.
- Detailed discussion on the wait and weight (W&W) method with workout examples.
- Detailed discussion on the volumetric well control method with workout examples.
- Detailed discussion on the lubricate and bleed method with workout examples.
- Detailed discussion on the concurrent method with workout examples.
- Detailed discussion on the bullhead method with workout examples.
- Detailed discussion on the circulation methods (reverse and forward).
- Detailed discussion on the low chock pressure method.
- Kill mud calculations for controlling the well.
- Selection and design of kill mud to control the well.
- The oilfield well control kill worksheets.
- The common problems and complications during well kill operation.

Requirements/Instructions

Students are advised to register for all drilling engineering modules courses to become a master in the subject area.

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13. Bundled Courses Program Description

The objective of any well kill technique is to restore safety to primary well control. The driller's method, volumetric method and the wait and weight (W&W) method are the most commonly used well control kill methods. These bundled courses program explores these three kill methods in detail. In addition, other kill methods are discussed, such as lubricate and bleed, concurrent, bullheading, forward circulation, reverse circulation, and low chock pressure methods.

The bundled courses program begins with an overview of all the methods and covers step-by-step procedures with specific workout examples of an application of all kill methods. A complete discussion is presented on the driller's method, volumetric method, wait and weight (W&W) method, lubricate and bleed method, concurrent method, bullheading method, forward circulation method, reverse circulation method, and low chock pressure method. The oilfield well control kill worksheets are also introduced. The program is designed to control kicks through these methods. The bundled courses covers also the understanding of the common problems and complications during well kill operations. It covers the fundamental issues for beginners interested in learning how to apply, select, and procedures of kill methods, including all calculations related to completing the entire process. The course presents the engineering terminologies so the reader can understand the formulas, mathematical models, correlations etc., with minimum effort. The module concludes by discussing calculations involving shut-in drill pipe pressure, shut-in casing pressure and explaining maximum shoe pressure. This module will make the students interested in enrolling in the course.

This program is a foundation, resource guide and an excellent source for petroleum engineering students, drilling professionals, executives and drilling engineers who want to learn concepts, design, and all oilfield practicing kill methods through enough practice of the theories and examples. The modules are designed for individuals and students with a basic understanding of drilling engineering. The course contains a total of 22 lectures, and each lecture comprises 20 to 40 PowerPoint presentation slides and pdf documents that covers the targeted topics in each lecture. Students are strongly advised to complete the course title “Basics of Drilling Engineering I and Drilling Engineering II” by Prof. M. Enamul Hossain at NSRIC Platform to understand this course content.

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14.0 Course Contents and Schedule

No.	Module	Topics	Remarks
Module I			
01	Overview	Lecture 1-An overview of kick control and monitoring	
02	Kill methods	Lecture 2-Types of kill methods I	
03	Kill methods	Lecture 3 -Types of kill methods II	
04	Driller's method	Lecture 4-Driller's method I	Quiz 1
05	Driller's method	Lecture 5-Driller's method II	
06	Driller's method	Lecture 6-Workout example on Driller's method	Assessment 1
07	IADC kill worksheet	Lecture 7-IADC Driller's method well control kill worksheet	
08	W&W method	Lecture 8-Wait and weight (W&W) method	
09	W&W method	Lecture 9-Workout example on wait and weight method	
10	IADC kill worksheet	Lecture 10-IADC W&W method well control kill worksheet	Quiz 2
11	Comparison	Lecture 11-Comparison of Driller's and W&W method	Assessment 2
12	Project	Lecture 12-A project on designing well control kill method	
Module II			
13	Volumetric method	Lecture 13-Volumetric method	
14	Volumetric method	Lecture 14-Workout example volumetric method	
15	Lubricate and bleed	Lecture 15-Lubricate and bleed method	Quiz 3
16	Lubricate and bleed	Lecture 16-Workout example on lubricate and bleed method	
17	Concurrent method	Lecture 17-Concurrent method	Assessment 3
18	Bullheading method	Lecture 18-Bullheading method	
19	Bullheading method	Lecture 19-workout examples on bullheading method	
20	Bullheading method	Lecture 20-IADC bullheading method Kill worksheet	Quiz 4
21	Circulation method	Lecture 21-Circulation and low choke pressure methods	
22	Problem & complication	Lecture 22- Problems and complications during well kill operation	Assessment 4

Prepared by Prof. M. Enamul Hossain, NSRIC Chair Professor in Sustainable Energy, Dept. of Petroleum Engineering, OE Division, NSRIC Inc., Toronto, ON, Canada.

Subtitle

A comprehensive guide with workout examples on the design, selection, and procedures of well control kill methods to stop and control the influx of formation fluids in the well in order to prevent blowouts in oil and gas operations.