Regulatory Regimes for Preventing Major Accidents in Offshore Operations: Evolution of Approaches in the United States and China

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ABSTRACT

This Article compares the impacts of the Macondo (2010) and Bohai Bay (2011) accidents on the regulatory regimes for the safety of offshore oil and gas operations in the United States and China. Based on an analysis of the main regulatory approaches, the Article examines the regulatory changes before and after the two accidents. It reveals that both the U.S. and China heavily rely on prescriptive command-and-control regulation, while the U.S. started to combine this with performance-based and management-based approaches in its regulatory reforms after the Macondo accident. Given the high risks arising from expanding offshore operations in the two countries, the Article concludes that a combination of prescriptive, performance-based, and management-based approaches is the preferred option for now to shift regulatory regimes for offshore operations in both countries.

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INTRODUCTION

Since the largest American offshore disaster occurred at the Deepwater Horizon drilling platform at the Macondo site in the Gulf of Mexico ("GOM"), the United States government and research groups have initiated various evaluations and analyses of the U.S. regulatory regime for offshore accident prevention. In these processes, participants critiqued the prescriptive approach in a command-and-control ("CAC") legal framework for its emphasis on detailed inspections led by agency personnel.[1] Performance-based and management-based approaches were theoretically considered to be superior in preventing major offshore accidents. The regulatory reforms afterwards in the U.S. moved "beyond 'one-size-fits-all' technology standards to a site-specific approach to managing risks"[2] but still kept in line with prescriptive rules and hard law enforcement. In the post-Macondo era, proper implementation of the new regulatory regime along with continuous and robust improvements to offshore oil and gas regulation could be a challenge for the U.S.

Following the Macondo accident in 2011, two oil leaks occurred in the Penglai 19-3 oil and gas field in Bohai Bay, resulting in a major offshore accident in China. The leaks contaminated a large region of the Bohai Gulf, causing severe environmental, social, and economic impacts, but it did not trigger thorough investigations regarding how and why they occurred. This was mainly attributed to the disarray in the relationship between the regulatory authorities and offshore operators, the excessive reliance on cooperation with foreign enterprises in exploiting offshore petroleum resources,[3] and tolerance of the unreliable safety information reported by operators. Like the Macondo accident, the Bohai Bay accident also received criticism on the insufficiency of a purely prescriptive approach of the offshore health, safety and environmental ("HSE") regulation in China. Accordingly, observing the U.S. regulatory changes for offshore safety would significantly help China in reforming its offshore HSE regulation.

This Article examines the two aforementioned offshore accidents in the U.S. and China, with the aim of exploring why the prevention of offshore accidents failed in these two specific instances and what role regulatory regimes played in

1. Russell W. Mills & Christopher J. Koliba, *The Challenge of Accountability in Complex Regulatory Networks: The Case of the* Deepwater Horizon *Oil Spill*, 9 REG. & GOVERNANCE 77, 77 (2015).

2. Lori S. Bennear, *Offshore Oil and Gas Drilling: A Review of Regulatory Regimes in the United States, United Kingdom and Norway*, 9 REV. OF ENVTL. ECONS. & POL'Y 2, 22 (2015).

3. Yuan Yang, *Preventing Major Offshore Oil Spill Accidents in China: Lessons from the EU Offshore Safety Directive*, CHINA OCEANS L. REV. 125, 152 (2018).

these failures. Tracing the evolution of regulatory approaches for offshore operations, this Article further considers how the U.S. has combined performance-based and management-based approaches in its regulatory regime, and whether a hybrid approach is suitable for China. Part I reviews the Macondo and Bohai Bay accidents and the risks arising from offshore operations in the U.S. and China. Part II introduces three regulatory approaches for offshore oil and gas operations, including their advantages and disadvantages. Parts III and IV respectively analyze regulatory regimes before and after the two accidents, particularly the progress and challenges in reforming offshore HSE regulation in the U.S. and China. Finally, the Article briefly compares the regulatory regimes for offshore operations in the two countries and concludes that the U.S. has introduced performance-based and management-based rules to its prescriptive CAC regime, which provides a reference for China to reform its regulatory regime. A combination of multiple regulatory approaches may maximize the effects of preventing major offshore accidents, but the implementation process in these two countries will face challenges.

I. TWO MAJOR ACCIDENTS IN OFFSHORE OPERATIONS

A. MACONDO ACCIDENT

Eight years have passed since the Macondo accident, but discussions have continued due to its devastating impact on the environment. The accident and its blowout caused at least 4.9 million barrels of oil leakage into the Gulf of Mexico,[4] covering at least 75,000 square kilometers and affecting 350–450 kilometers of the U.S. coast.[5] The oil spills further led to incalculable damage to fish, wildlife, vital marshes and estuaries. Besides the environmental damage, the disaster also resulted in safety and health problems. Not only were there eleven deaths, but first responders also became ill from the chemicals and other substances that were used to clean up the oil spills.[6]

Stakeholders were highly concerned with the response to the Macondo accident because there had never been an uncontrolled blowout from a deep-water well before.[7] On the one hand, the overall response successfully achieved goals

4. NAT'L COMM'N ON THE BP DEEPWATER HORIZON OIL SPILL & OFFSHORE DRILLING, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING (2011).

5. Sergei Vinogradov, *The Impact of the Deepwater Horizon: The Evolving International Legal Regime for Offshore Accidental Pollution Prevention, Preparedness, and Response*, 44 OCEAN DEV. & INT'L L. 335, 335 (2013).

6. Charies K. Ebinger, *6 Years from the BP Deepwater Horizon Oil Spill: What We've Learned, and What We Shouldn't Misunderstand*, BROOKINGS: PLANETPOLICY (Apr. 20, 2016), https://www.brookings.edu/blog/planetpolicy/2016/04/20/6-years-from-the-bp-deepwater-horizon-oil-spill-what-weve-learned-and-what-we-shouldnt-misunderstand/.

7. John R. Harrald, *Chapter 8: The System Is Tested: Response to the BP Deepwater Horizon Oil Spill*, *in* EMERGENCY MANAGEMENT: THE AMERICAN EXPERIENCE 1900-2010 213, 215 (Claire B. Rubin ed., 2d ed. 2012).

such as stopping the spill, controlling pollution, and establishing a $20 billion oil spill claim fund.[8] On the other hand, the recovery outcomes were less impressive than the activity output in terms of actual response performance measures.[9] The main problems exposed in the response system were conflicts in federal regimes and insufficiency in the states' coordination.[10] For a robust, well-coordinated, whole-of-government response,[11] scholars suggested establishing "a strongly led and adequately resourced national response" while also considering "the needs and prerogatives of states and local governments."[12]

The Macondo disaster triggered a series of investigations initiated by BP, the government, and research groups. In particular, President Obama created the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, which together with the Chief Counsel's team, comprehensively examined the Macondo well design and operation system,[13] providing insights to the root cause of this extreme accident. The Chief Counsel's report revealed that a number of "separate risk factors, oversights and outright mistakes" led to the prevention failure of the accident.[14] The cement that BP and Halliburton used in the well did not correctly seal it.[15] This finding was attributable to management errors from the companies involved in the accident.[16] Specifically, BP did not recognize risks created by last-minute changes to well design, and it misinterpreted the results when a test showed that leaks were occurring.[17] The Commission also examined in depth the U.S. regulatory regime for preventing major offshore accidents. The Commission found the regime inadequate to address the risks of offshore operations and of little relevance to engineering and management problems.[18] Accordingly, this Article will focus on the regulatory failure of the Macondo accident and the reforms in the post-Macondo era.

B. BOHAI BAY ACCIDENT

Another typical case occurred in China's largest offshore oil and gas field, Penglai 19-3, in the Bohai Gulf. The disaster, known as the Bohai Bay accident, included two instances of oil spills, causing "a tremendous toll on the ecological

8. *See id*. at 232.

9. *Id*. at 232.

10. Thomas A. Birkland & Sarah E. DeYoung, *Emergency Response, Doctrinal Confusion, and Federalism in the* Deepwater Horizon *Oil Spill*, 41 J. FEDERALISM 471, 475–77 (2011).

11. THAD W. ALLEN, NATIONAL INCIDENT COMMAND, U.S. COAST GUARD, NATIONAL INCIDENT COMMANDER'S REPORT: MC252 DEEPWATER HORIZON (2010).

12. Harrald, *supra* note 7, at 233.

13. Executive Order 13,543, 75 Fed. Reg. 29397 (May 21, 2010).

14. NAT'L COMM'N ON THE BP DEEPWATER HORIZON OIL SPILL & OFFSHORE DRILLING, MACONDO: THE GULF OIL DISASTER, CHIEF COUNSEL'S REPORT x (2011).

15. BP, *DEEPWATER HORIZON* ACCIDENT INVESTIGATION REPORT 141 (2010).

16. NAT'L COMM'N ON THE BP DEEPWATER HORIZON OIL SPILL & OFFSHORE DRILLING, *supra* note 14.

17. *Id*.

18. *Id*.

environment of the surrounding waters and local economy."[19] As estimated by the Chinese Research Academy of Environmental Sciences ("CRAES"), at least 50,000 tons (equal to about 0.34 million barrels)[20] of oil was released into the Bohai Bay,[21] polluting at least 6,200 square kilometers of water.[22] This pollution seems less severe than that of the Macondo oil spills. However, the Bohai Bay has a smaller area (78,000 km^2) than the Gulf of Mexico (1.6 million km^2), and at 85 meters deep, the Bohai Bay is much shallower than the Gulf of Mexico, which averages 1,000 meters. In comparing the damage per unit volume, the former spill could be more serious.[23]

Such a severe accident did not receive sufficient response in light of these oil spills. On June 4, 2011, the operator ConocoPhillips China Inc. ("COPC") detected and then controlled an oil leak near Platform B of Penglai 19-3 oilfield. Following the first leak, another leak was found around Platform C on June 17, which received significant attention from the State Oceanic Administration ("SOA") of China.[24] One month later, the SOA decided to close Platforms B and C, commanding the COPC to thoroughly search for the risk points and to seal the source of the leaks. After the COPC failed to stop the leaks, the SOA ordered a halt of the production at the Penglai 19-3 field on September 2.[25] It took almost three months to figure out the reason for the oil spill and to finally suspend drilling and operation activities. Because of a disordered response system, the involved parties acted passively and failed to effectively cooperate clean-up efforts.[26] The operator COPC and its co-venture, China National Offshore Oil Corporation ("CNOOC"), only compensated RMB 1.35 billion ($197.13 million USD)[27] for the loss of fisheries and RMB 1.683 billion ($245.76 million USD)[28]

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19. Liying Zhang & Jia Liu, *The Accountability of the Offshore Drilling Platform's Oil Pollution Damages in the COPC Incident: In Comparison with the United States Gulf of Mexico Spill Incident*, CHINA OCEANS L. REV. 151, 165 (2011).

20. *See Oil Converter and Calculator*, E TOOLS AGE, http://www.etoolsage.com/converter/Oil_converter.asp (last visited Feb. 4, 2019).

21. 专家称康菲溢油污染强度大于墨西哥湾溢油 [Experts Say the ConocoPhillips Oil Pollution is Greater than Oil Spill in Gulf of Mexico], INST. L., CHINESE ACAD. SOC. SCI., INST. INT'L L., http://www.iolaw.org.cn/showNews.asp?id=28436 (last visited Feb. 4, 2019).

22. 蓬莱19-3油田溢油事故联合调查组关于事故调查处理报告, CHINA NEWS (June 21, 2012) [hereinafter Investigation Report of Penglai 19-3 Oil Spill Accident by Joint Investigation Team], http://www.chinanews.com/gn/2012/06-21/3980404.shtml.

23. Heo Jae-Yong, *The Bohai Bay Oil Spill and China Environmental Risks*, POSCO RES. INST. (POSRI) CHINDIA QUARTERLY, Winter 2012, at 95, 96.

24. Investigation Report of Penglai 19-3 Oil Spill Accident by Joint Investigation Team, *supra* note 22.

25. *Id.*

26. Jun Ma, *Transparency Test in the Bohai Sea*, CHINA DIALOGUE (Jul. 20 2011), https://www.chinadialogue.net/article/show/single/en/4418-Transparency-test-in-the-Bohai-Sea.

27. *Currency Converter*, OANDA CORP., https://www.oanda.com/currency/converter/ (last visited Feb. 4, 2019).

28. *Id.*

for marine ecological restoration,[29] a total much less than the penalties of $20 billion BP had to pay in the U.S.[30]

Overall, the Bohai Bay accident did not trigger as many investigations as the Macondo accident did. Investigators did not comprehensively and promptly publicize relevant data and information, such as the exact amount of the oil spills and the degree of pollution to the marine environment.[31] Like the Macondo accident, the Bohai Bay accident also exposed problems in technique, risk management, and regulatory regime for offshore operations. According to an investigation by the SOA, the COPC adopted general water injection instead of stratified water injection to exploit oil,[32] which produced unanticipated high pressure, further causing a crack in an existing geological fault and then in a well kick.[33] In technique, the COPC did not sufficiently identify risks of operations or take measures to reduce those risks.[34] As for accountability, both the government and the public blamed the COPC for its inappropriate operations, but ignored the fact that CNOOC held a 51% share at the time of the Penglai oil field, and it also bore responsibility for the safety of offshore operations.[35] This could have resulted from the ambiguous responsibilities in Chinese offshore oil and gas regulation. Therefore, how the regulatory failure contributed to the Bohai Bay accident is another critical question this Article addresses.

C. RISKS OF OFFSHORE OPERATIONS

Risk is commonly defined as "a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence."[36] Risk in offshore operations is often associated with the values of health, safety, and environment ("HSE"). Offshore operations mainly bring risk to personnel, assets, production capacity, and the environment. Among the various dimensions of the risk of offshore operations, safety and environmental factors

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29. Yu Jin, *Environmental Public Interest Litigation for Bohai Bay Oil Spill (*"康菲溢油"重大事故环境公益诉讼首立案), PEOPLE.CN (July 26, 2015, 6:19 AM), http://politics.people.com.cn/n/2015/0726/c70731-27360825.html.

30. Jana Kasperkevic, *BP oil spill: judge grants final approval for $20bn settlement*, GUARDIAN, Apr. 4, 2016, https://www.theguardian.com/environment/2016/apr/04/bp-oil-spill-judge-grants-final-approval-20-billion-dollar-settlement.

31. Jun Man, *supra* note 26.

32. Joint Investigation Team of Penglai 19-3 Oil Spill Accident Announced the Investigation Result of the Accident, CHINESE GOV. NETWORK (Sep. 6, 2011), http://www.gov.cn/gzdt/2011-09/06/content_1941319.htm.

33. *Penglai 19-3 Oilfield, Bohai Bay*, OFFSHORE TECH. (Dec. 21, 2018), https://www.offshore-technology.com/projects/penglai-19-3-oilfield-bohai-bay/.

34. Investigation Report of Penglai 19-3 Oil Spill Accident by Joint Investigation Team, *supra* note 22.

35. Qing Wu, 中海油渤海湾漏油追踪：51%的责任如何兑现 [CNOOC Bohai Bay Oil Spill Tracking: How to Cash the 51% of the Responsibility?], SINA.CN (Aug. 29, 2018, 04:34 AM), https://finance.sina.cn/2015-08-29/detail-ifxhkaeq8843783.d.html?from=wap.

36. ISO GUIDE 73 ch. 1.1 (2009), https://www.iso.org/obp/ui/#iso:std:iso:guide:73:en.

are the most significant threat to the sustainable development. For example, oil releases caused by a blowout are normally uncontrolled and difficult to clean up in the long term.[37] Such risk causes offshore oil and gas industries to regularly assess critical elements on safety and environment throughout their operations.[38] This is understood as risk assessment, which in practice is implemented as a risk acceptance criterion and is a key component of the risk management process.[39]

Risk management "covers all coordinated activities designed to direct and control an organization with regard to risk," whereas the risk management process is "the systematic application of management policies, procedures and practices to the tasks of establishing the context, assessing, treating, monitoring, reviewing and communicating risks."[40] Managing risk does not mean that relevant activities and measures are undoubtedly worthwhile, but that they appear to be cost-effective.[41] For offshore industry, risk assessment and management impose more costs and obligations on operators, but they may better mitigate the risks of offshore operations and prevent major offshore accidents. Normally, risk assessment and management for offshore operations are based on data, modeling, and analysis.[42] The data and information can provide necessary evidence and produce knowledge for decision-makers for their further review and judgment.[43]

Regulating risks of offshore operations is also based on information-gathering.[44] The Macondo and Bohai Bay cases have revealed that operators, contractors, and environmental agencies in the U.S. and China failed to fully identify and mitigate the risks of offshore operations because of the fragmented and incomplete information on the offshore safety of the two countries. In the U.S., responsible agencies—the Minerals Management Service ("MMS") and the Coast Guard ("CG")—could not systematically collect and evaluate relevant information for two reasons: (1) the regulatory disarray and negligence in dealing with the data reported by operators, and (2) excessive delegation of responsibilities to the American Petroleum Institute ("API"), causing difficulties in following up

37. Sergei Vinogradov, *supra* note 5.

38. Haley Connor, *Managing Environmental Risk in the Oil and Gas Industry*, 15–18 (2015) (unpublished B.A. thesis, Claremont McKenna College), *available at* http://scholarship.claremont.edu/cmc_theses/1121.

39. JAN ERIK VINNEM ET.AL., RISK ASSESSMENTS FOR OFFSHORE INSTALLATIONS IN THE OPERATIONAL PHASE 1–2 (2003), *available at* https://www.forskningsradet.no/csstorage/vedlegg/153536_nr6.pdf.

40. TERJE AVEN & JAN ERIK VINNEM, RISK MANAGEMENT: WITH APPLICATIONS FROM THE OFFSHORE PETROLEUM INDUSTRY 1–2 (1st ed. 2007).

41. KYLA WETHLI, WORLD BANK GROUP, BENEFIT-COST ANALYSIS FOR RISK MANAGEMENT: SUMMARY OF SELECTED EXAMPLES 6 (2014), *available at* http://siteresources.worldbank.org/EXTNWDR2013/Resources/8258024-1352909193861/8936935-1356011448215/8986901-1380568255405/WDR15_bp_BenefitCost_Analysis_for_Risk_Management_Wethli.pdf.

42. Terje Aven, *Risk Assessment and Risk Management: Review of Recent Advances on Their Foundation*, 253 EUR. J. OF OPERATIONAL RES. 1, 1 (2015).

43. *Id*. at 2.

44. CHRISTOPHER HOOD, HENRY ROTHSTEIN & ROBERT BALDWIN, THE GOVERNMENT OF RISK: UNDERSTANDING RISK REGULATION REGIMES 24 (1st ed. 2001).

with the industrial performance.[45] For China, the competent authority, SOA, and the operators COPC and CNOOC also failed to collect or transparently publicize information in time.[46] Both the U.S. and China lacked comprehensive national compilations of data and studies before the accidents occurred. The unfortunate reality is that some data and its relevant system are spread far and wide across offshore businesses, but they are inaccessible to the majority.[47] This demonstrates how data is the foundation of decision-making and risk management of offshore oil and gas activities.[48]

Geographically, both deep water and shallow water contain risks to offshore operations, which can lead to catastrophic consequences.[49] Although the Macondo and Bohai Bay accidents occurred near the heart of the oil and gas service industry along the coast of the U.S. and China, they raised serious concern about what would happen if the accidents occurred in remote regions. Since 2017, we can see that the Trump Administration issued a series of new plans to reopen all U.S. coastal water for offshore drilling activities.[50] This would threaten the environment of the coastal states. Particularly in Alaska's northwest shelf, exploiting petroleum resources is extremely risky. Once there is a major oil spill accident in this area, it is difficult to ecologically recover because of the vulnerability of the environmental system.[51] Offshore operations in China also are growing and moving to further and deeper coastal areas. With exploitation activities expanding massively in the East China Sea and the South China Sea, the risk of major accidents increases, bringing environmental, safety, and security challenges to the entire Asian Pacific region.[52] Some scholars opine that offshore disasters in the Asia Pacific are inevitable.[53] This requires China and the surrounding states to establish rigorous and cooperative regulatory regimes to prevent major offshore accidents and to limit their consequences. In addition, risks in offshore operations also come from new technologies. To exploit oil and

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45. Michael Baram, *The U.S. Regulatory Regime for Preventing Major Accidents in Offshore Operations, in* RISK GOVERNANCE OF OFFSHORE OIL AND GAS OPERATIONS 161 (Preben Hempel Lindøe et al. eds., 2014).

46. Jun Ma, *supra* note 26.

47. Mike Neill, *The Future of Offshore Risk Management*, OFFSHORE (May 4, 2016), http://www.offshore-mag.com/articles/print/volume-76/issue-5/departments/beyond-the-horizon/the-future-of-offshore-risk-management.html.

48. *Id.*

49. Michael Faure, Liu Jing & Wang Hui, *Multilayered Approach to Cover Damage Caused by Offshore Facilities*, 33 VA. ENVTL L. J. 356, 368 (2015).

50. Editorial, *Mr. Zinke's Risky Venture into Deep Water*, N.Y. TIMES, Jan. 8, 2018, https://www.nytimes.com/2018/01/08/opinion/zinke-offshore-oil-drilling.html.

51. Dan Joling, *Alaska May Open Up Again for Oil Leasing, But Risks Linger*, ASSOCIATED PRESS, Jan. 5, 2018, https://www.apnews.com/b5090015ba2d49cc9e0212d3e6a2e05e.

52. LEE CORDNER, OFFSHORE OIL AND GAS SAFETY AND SECURITY IN ASIA PACIFIC: THE NEED FOR REGIONAL APPROACHES TO MANAGING RISK 1 (S. Rajaratnam School of International Studies, Monograph No. 26 2013).

53. *Id.* at 2.

gas in deeper waters, offshore companies make efforts to advance their technologies. While technologies of automation and remote inspection do improve the efficiency of operations, they may also increase risks of offshore disasters for which neither industry nor government is adequately prepared.[54]

II. CURRENT REGULATORY APPROACHES FOR OFFSHORE OPERATIONS

Risk assessment and management for offshore operations are based on different regulatory regimes—that is, the set of rules and standards that govern the risk in a specific regulatory context.[55] Different regimes involve different regulatory approaches, which mainly include four types: prescriptive, performance-based, management-based, or self-regulatory. The prescriptive approach is heavily applied to CAC regulation, which imposes legally binding rules and sanctions on operators, particularly reflected in mandatory inspections of offshore operations.[56] Performance-based and management-based approaches usually work together to balance legal standards, industrial standards, and the best practices of offshore operations.[57] Self-regulation allows flexibility and freedom to offshore operators so that they can create and enforce rules and standards by themselves.[58] In a regulatory regime, one approach may be dominant or cooperate with another. To trace and compare regulatory changes in the U.S. and China associated with the major accidents, it is important to understand the four main regulatory approaches, though the effectiveness of each needs to be demonstrated by empirical evidence.

A. PRESCRIPTIVE APPROACH

Prescriptive means that a regulated entity must act according to the regulatory standards set by regulators.[59] The prescriptive approach usually transfers industrial technology standards and best practices into enforceable rules for offshore operators, which can guarantee that offshore operations maintain a certain level

54. *See* Ole Andreas Engen, *Emergent Risk and New Technologies, in* RISK GOVERNANCE OF OFFSHORE OIL AND GAS OPERATIONS 340, 355 (Preben Hempel Lindøe et al. eds., 2014).

55. *See* Ortwin Renn, *A Generic Model for Risk Governance: Concept and Application to technological Installations, in* Risk Governance of Offshore Oil and Gas Operations 9, 26 (Preben Hempel Lindøe et al. eds., 2014).

56. *See* Nancy Leveson, *The Use of Safety Cases in Certification and Regulation*, U.S. CHEM. SAFETY BD., http://www.csb.gov/assets/1/7/Leveson_Paper.pdf (last visited Dec. 23, 2018).

57. Preben Hempel Lindøe, *Risk Regulation and Resilience in Offshore Oil and Gas Operation, in* LAW AND THE MANAGEMENT OF DISASTERS: THE CHALLENGE OF RESILIENCE 119 (Alexia Herwig and Marta Simoncini eds., Routledge 2016).

58. Cary Coglianese and Evan Mendelson, *Meta-Regulation and Self-Regulation, in* OXFORD HANDBOOK OF REGULATION (Robert Baldwin et al. eds., 2010).

59. Peter Bjerager, *Performance-Based Safety Regulation*, NAT'L ACAD. SCI. (2016) (on file with Georgetown Environmental Law Review).

of safety.[60] This means operators are merely expected to demonstrate compliance without taking more active measures to minimize risks in offshore operations.[61] The advantage of prescriptive rules for operators is that they do not take unlimited liability for an accident when they have fulfilled their obligations.[62] Insurers and courts are more willing to accept the claims of loss from operators under prescriptive rules, which can reduce their financial risks.[63]

Traditionally, the prescriptive approach of CAC regulation governed risks in offshore operations,[64] which then gradually received criticism. Seeking to establish unified standards for the entire industry, prescriptive rules rarely take into account the unique features of each offshore operation or track each critical safety and environmental element.[65] The prescriptive approach is also weak in keeping pace with rapid changes in technology, modes of operations, and risk reduction.[66] In the face of emerging technologies and innovative modes, regulators correspondingly have an increased responsibility to modify relevant rules that inevitably become obsolete.

B. PERFORMANCE- AND MANAGEMENT-BASED APPROACHES

A performance-based approach focuses on safety goals rather than prescriptive inspections, which allows operators to choose technical solutions to achieve the stated level of performance.[67] Compared with the prescriptive approach, this approach is flexible and provides the possibility for offshore companies to seek cost-effective means to attain the desired outcomes. Performance standards can accommodate technological changes and new hazards' emergence while prescriptive standards generally cannot.[68] Operators accordingly take more responsibilities in achieving higher levels of safety and environmental care. However, the interpretation of performance level in offshore HSE regulation could be complex and challenging. Regulatory standards can be imprecise, especially when they are

60. *See* Shubharthi Barua et al., *Comparison of Prescriptive and Performance-based Regulatory Regimes in the U.S.A and the U.K.*, 44 J. LOSS PREVENTION PROCESS INDUS. 764, 765–66, 769 (2016).

61. *See* I.B. Dahle et al., *Major Accidents and Their Consequences for Risk Regulation, in* ADVANCES IN SAFETY, RELIABILITY & RISK MANAGEMENT 33, 37–38 (Christophe Berenguer et al. eds., 2011).

62. Michael Baram, *supra* note 45, at 173.

63. *Id.*

64. AVEN & VINNEM, *supra* note 40, at 1.

65. Michael Baram, *supra* note 45, at 172.

66. ALEX GOROD & LEONIE HALLO, THE ROLE OF COMMAND-AND CONTROL MANAGEMENT AND GOVERNANCE IN SYSTEMS ENGINEERING (2017).

67. *See* MARC G. LASSAGNE ET. AL., PRESCRIPTIVE AND RISK-BASED APPROACHES TO REGULATION: THE CASE OF FPSOS IN DEEPWATER GULF OF MEXICO (2001), *available at* https://www.researchgate.net/publication/254517624_Prescriptive_and_Risk-Based_Approaches_to_Regulation_The_Case_of_FPSOs_inDeepwater_Gulf_of_Mexico.

68. CARY COGLIANESE ET AL., PERFORMANCE-BASED REGULATION: PROSPECTS AND LIMITATIONS IN HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION 4 (2002), *available at* https://sites.hks.harvard.edu/m-rcbg/Events/Papers/RPPREPORT3.pdf.

loosely specified.[69] This further requires regulators to make judgments on the enforcement and oversight of offshore industry and to be extremely competent. In terms of preventing rare and catastrophic offshore accidents, performance may also have implementation issues because it cannot be directly measured whether the performance corresponds to an expected level; instead, it must be predicted.[70]

Based on procedures rather than performance outcomes of regulatory activities, the management-based approach offers another way for operators to analyze, plan, and report offshore operations.[71] The management-based approach is usually applied together with performance-based approach in offshore oil and gas regulation. The former is process oriented, requiring operators to prepare the documents on major hazards, safety, and environmental management systems, emergency response plans, and verification schemes. The latter is responsible for proposing specific goals, such as the reduction of the risk of major hazards to an acceptable level, and the establishment of minimum requirements for preventing major offshore accidents. A typical example is the 2013 EU Offshore Safety Directive, which combines the performance-based and management-based approaches, showing that the two approaches can complement prescriptive rules that rely solely on liability or command-and-control regulation. However, this does not mean they are superior to the prescriptive and other regulatory approaches.[72]

C. SELF-REGULATION APPROACH

A self-regulation approach promotes offshore operators to follow industry-consensus standards and guidance and to focus on internal safety control of offshore industry.[73] This can facilitate offshore industry keeping up to date on technologies and best practices, and it also creates a symmetrical relationship between regulators, the regulated industry, and other involved parties.[74] To achieve better industrial standards, everyone involved may individually and collectively make contributions to ensuring compliance.[75] From an economic perspective, self-regulation is more flexible than public regulation. The self-regulation approach may save the costs of complying with new regulations and would integrate well with a competitive environment under an appropriated institutional infrastructure.[76] Nevertheless, the self-regulation approach itself is unlikely to

69. *Id*.

70. Cary Coglianese, *The Limits of Performance-Based Regulation*, 50 U. MICH. J.L. REFORM 525, 563 (2017).

71. Bjerager, *supra* note 59.

72. Bennear, *supra* note 2.

73. Bjerager, *supra* note 59.

74. Lindøe, *supra* note 57, at 118.

75. Paul Bang & Olaf Thuestad, *Government Enforced Self-Regulation: The Norwegian Case, in* RISK GOVERNANCE OF OFFSHORE OIL & GAS OPERATIONS 254 (Preben Hempel Lindøe et al. eds., 2014).

76. MARKET INTEGRATION: THE EU EXPERIENCE AND IMPLICATIONS FOR REGULATORY REFORM IN CHINA 6 (Niels Philipsen et al. eds., 2015).

govern risks in offshore operations, as the approach still requires rule-compliance that engages multiple stakeholders.[77]

III. REGULATORY REGIME FOR OFFSHORE OIL AND GAS OPERATIONS IN THE U.S.

Investigative reports have demonstrated that the Macondo accident is not mainly attributable to technical issues, but rather to regulatory failures, which triggered the debate about which regulatory approach is more suitable to the U.S. legal context, institutional structure, and cultural norms. Before the Macondo accident, U.S. offshore oil and gas regulations heavily relied on a CAC regulatory regime. The regime used to be based on prescriptive, legally binding rules, but it has begun to involve performance-based and management-based rules since the accident. The post-Macondo regulatory framework in the U.S. tends to be unstable in the dynamic development of policy and offshore technologies. Under the current U.S. legal context, it seems the HSE regulation for offshore operations is indecisive between prescriptive rule compliance and risk management. The transition of offshore oil and gas regulation in the U.S. may be influenced by multiple factors which should be continuously observed.

A. REGULATORY OVERSIGHT OF U.S. OFFSHORE OPERATIONS

Historically, the U.S. regulatory regime for offshore operations was developed in a prescriptive CAC approach with a culture of minimal regulatory compliance. Since the 1950s, regulation of U.S. offshore oil and gas exploration has been dominated by the Outer Continental Shelf Lands Act ("OCSLA")[78] and the National Environmental Policy Act ("NEPA").[79] The OCSLA "asserts federal authority over the seabed and subsoil of the offshore continental shelf ("OCS")" and "authorizes the federal Department of the Interior ("DOI") and its MMS to conduct OCS leasing programs, issue permits to companies for exploration and production, and carry out a regulatory program to ensure that these activities are safely conducted."[80] It also delegates regulation of workplace safety on the OCS to the CG.[81] The NEPA requires the DOI to conduct an environmental analysis, assessing environmental impact and preparing relevant statements for offshore oil and gas activities, based on the substantive standards established by the OCSLA.[82]

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77. Susan Margaret Hart, *Self-regulation, Corporate Social Responsibility, and the Business Case: Do They Work in Achieving Workplace Equality and Safety*, 92 J. BUS. ETHICS 585, 600 (2010).

78. Outer Continental Shelf Lands Act ("OSCLA"), 43 U.S.C.A. § 1331 (2011).

79. National Environmental Policy Act ("NEPA"), 42 U.S.C.A. § 4321 (2011).

80. PREBEN H. LINDØEA ET AL. ROBUST OFFSHORE RISK REGULATION-AN ASSESSMENT OF US, UK AND NORWEGIAN APPROACHES (2012).

81. *Id.*

82. *See* Rebecca M. Bratspies, *A Regulatory Wake-up Call: Lessons from BP's Deepwater Horizon Disaster*, 5 GOLDEN GATE U. ENVTL. L.J. 7, 22–23 (2011).

Since the U.S. Congress has not fully integrated the OCSLA and NEPA with other laws, different laws associated with offshore operations are neither coherent nor harmonized.[83] Corresponding regulations are enacted by the MMS and the CG based on the OCSLA, while multiple rules and procedures are created by other laws. As a result, the U.S. regulatory regime in pre-Macondo time was highly prescriptive regarding the technical and engineering aspects of offshore oil and gas activities. That is, the U.S. adopted command-and-control regulations in almost each aspect of offshore operations, from frequency of pressure gauge testing, to cement requirements, to design and function of blow-out preventers.[84] The regulator MMS and the CG required each offshore company to comply with a framework of general rules and procedures, and numerous detailed technical standards.

To ensure and enforce these prescriptive command-and-control regulations, the MMS and the CG collaboratively carried out inspections of offshore operations, imposing sanctions for non-compliance.[85] The MMS mainly used a national checklist of "Potential Incidents of Non-Compliance" ("PINCs") to inspect whether operations met the detailed technical requirements, while adopting a walk-through together with the CG to inspect the safety of specific equipment in the workplace.[86] However, the inspections did not substantially reduce different kinds of offshore accidents because they were heavily prescriptive and lacked cooperation with appropriate risk management.[87] In the face of the development of safety technologies, the inspectors to some extent lacked technical expertise for evaluating sophisticated operations.[88] They also received insufficient funding from public and private sectors to carry out relevant trainings and research.[89] Certain prescriptive command-and-control regulations also cannot keep pace with developing technologies, leading to inappropriate relationships between the regulators and offshore industry. In addition, MMS-CG collaboration on workplace safety inspection failed to become a coordinated and effective program due to jurisdictional confusion.[90]

The U.S. command-and-control regulations in offshore operations used to depend heavily on industrial standards. Most of these standards were originally

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83. LINDØE ET AL., *supra* note 80.

84. *See, e.g.*, 30 C.F.R. §§ 250.420 (cementing requirements), 250.721 (pressure testing requirements), 250.1610 (blowout preventer systems) (2013).

85. *See* Michael Baram, *Preventing Accidents in Offshore Oil and Gas Operations: the US Approach and Some Contracting Features of the Norwegian Approach* 14–15 (Deepwater Horizon Study Group, Working Paper, Jan. 2011), https://ccrm.berkeley.edu/pdfs_papers/DHSGWorkingPapersFeb16-2011/PreventingAccidents-in-OffshoreOil-and-GasOperations-MB_DHSG-Jan2011.pdf.

86. Baram, *supra* note 45, at 173.

87. *Id.*

88. *Id.* at 174.

89. Pietro A.S. Mendes et al., *Reforming Brazil's Offshore Oil and Gas Safety Regulatory Framework: Lessons from Norway, the United Kingdom and the United States*, 74 ENERGY POL'Y 443, 453 (2014).

90. Baram, *supra* note 45, at 174.

developed by the API and then adopted by the MMS, at which point they transformed into mandatory and enforceable regulatory standards that served as the technical and engineering requirements for the design and operation of offshore activities.[91] Although this reliance on the API enabled the MMS to capitalize on the API's technical expertise and ability to create industry consensus, the regulated industry can easily determine the pace of risk reduction in offshore operations, which may lag behind the risks actually encountered.[92] The API and other private organizations usually exclude the presence and participation of various stakeholders that have concerns and intimate knowledge about safety problems.[93] This means regulatory standards often inadequately address safety-critical aspects of the operations from multiple expert perspectives. In the Macondo accident, oil and gas industry representatives failed to include anyone on their boards who had a background in environmental consultancy, increasing the risk of potential environmental impacts and the large associated costs that ultimately resulted.[94]

B. REGULATORY REFORMS IN POST-MACONDO ERA

In the Macondo accident, the MMS regime paid inadequate attention to the risk of deep-water drilling and well control, and it was criticized for heavy prescription, checklist inspections, reliance on industry standards, and disregard of safety science.[95] In the face of these problems, the DOI divided the MMS into three new and independent agencies—the Bureau of Ocean Energy Management ("BOEM"), the Bureau of Safety and Environmental Enforcement ("BSEE"), and the Office of Natural Resources Revenue ("ONRR")—with the aim of ensuring that "the economic and other benefits that motivate leasing of offshore resources would no longer compromise the implementation of an effective safety program."[96]

Specifically, the MMS was renamed the Bureau of Ocean Energy Management, Regulation, and Enforcement ("BOEMRE") to more accurately describe the scope of the organization's oversight.[97] Under the jurisdiction of the BOEMRE, the BOEM took the leasing program from the former MMS, and the BSEE became responsible for the safety and environmental oversight of offshore

91. *Id*. at 176.
92. *Id*.
93. *Id*.
94. Energy and Climate Change Committee, UK Deepwater Implications of the Gulf of Mexico Oil Spill, Second Report of Session 2010-11, H.C. 405-I at 12 (UK), https://publications.parliament.uk/pa/cm201011/cmselect/cmenergy/450/450i.pdf.
95. Baram, *supra* note 45, at 180.
96. *Id*.
97. *The Reorganization of the Former MMS*, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Reorganization/ (last visited Feb. 4, 2019).

operations.[98] Meanwhile, the ONRR became a separate office under the Assistant Secretary for Policy, Management, and Budget.[99] Although the new regime separated the equally important but conflicting missions, its effectiveness was in doubt because the new agencies are still within and accountable to the DOI, which benefits from the revenues of leasing.[100] In addition, some scholars also examine the historical development of MMS and doubt its role in the regulatory failures, claiming it could be overstated because of political factors that exclude its apparent problems in this institutional system.[101]

Following the institutional restructuring, the BOEMER first promulgated two regulations to improve the safety level of the U.S. offshore operations. The first one is the Drilling Safety Rule. This rule created strict standards for well bore integrity (well design, casing, and cementing) and well control procedures and equipment (including blowout preventers).[102] The second regulation is the Workplace Safety Rule, which is known as the Safety and Environmental Management System ("SEMS") rule. It requires, for the first time, that operators develop and maintain a safety and environmental management system in accordance with the API's Recommended Practice 75 ("RP 75") for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities.[103] More specifically, the SEMS rule established management-based standards for offshore operations in the areas of risk analysis, management of change, operating procedures, and mechanical integrity.[104] The SEMS is a proactive, goal-oriented risk management system with the aim of enhancing the safety of operations by reducing the frequency and severity of accidents.[105] In 2013, the BSEE further enacted the SEMS II Final Rule, which improved the criteria of the original SEMS rule. The SEMS II Final Rule provides greater protection by supplementing operators' SEMS programs with employee training, empowering

98. *See* Press Releases, U.S. Dep't of the Interior, Interior Department Completes Reorganization of the Former MMS (Sept. 30, 2011), https://www.doi.gov/news/pressreleases/Interior-Department-Completes-Reorganization-of-the-Former-MMS.

99. *Id.*

100. Baram, *supra* note 45, at 180.

101. Christopher Carrigan, *Capture by Disaster? Reinterpreting Regulatory Behavior in the Shadow of the Gulf Oil Spill, in* PREVENTING REGULATORY CAPTURE: SPECIAL INTEREST INFLUENCE AND HOW TO LIMIT IT (Daniel Carpenter and David Moss eds., 2013).

102. *See* Oil and Gas and Sulphur Operations in the Outer Continental Shelf—Increased Safety Measures for Energy Development on the Outer Continental Shelf, 75 Fed. Reg. 63345 (Oct. 14, 2010).

103. *See Safety and Environmental Management Systems—SEMS*, BUREAU OF SAFETY & ENVTL. ENF'T, https://www.bsee.gov/resources-and-tools/compliance/safety-and-environmental-management-systems-sems (last visited Jan. 18, 2019).

104. *See* KRISTINE L. MCANDREWS, CONSEQUENCES OF MACONDO: A SUMMARY OF RECENTLY PROPOSED AND ENACTED CHANGES TO U.S. OFFSHORE DRILLING SAFETY AND ENVIRONMENTAL REGULATION 6 (2011).

105. *See Safety and Environmental Management Systems*, BUREAU OF SAFETY & ENVTL. ENF'T, https://www.bsee.gov/resources-and-tools/compliance/safety-and-environmental-management-systems-sems (last visited Jan. 18. 2019).

field level personnel with safety management decisions, and strengthening auditing procedures by requiring them to be completed by independent third parties.[106]

Overall, both the SEMS and SEMS II are taken as important steps toward achieving comprehensive reform of the regulatory processes governing offshore operations in U.S. waters.[107] Based on the Drilling Safety Rule and the SEMS regulations, the BSEE issued new regulations for well control and blowout preventer systems to close regulatory gaps and reflect industry best practices.[108] A pilot Risk-based Inspection Program was also recommended to complement prescriptive inspections and effectively manage the auditing resources of agencies.[109] All of the aforementioned regulatory reforms illustrate that the new U.S. regime on the safety of offshore operations has moved beyond "one size fits all" prescriptive standards to a site-specific approach to manage risks.[110] However, the SEMS regulations do not set up a performance level or offer BSEE a thorough framework for preventing major accidents in offshore operations.[111] The new regime, to some extent, still retains prescriptive CAC features. Furthermore, the regime appears to be difficult to implement because the Trump Administration is poised to roll back the new offshore safety rules and reopen nearly all U.S. waters for offshore drilling activities.[112] The uncertain factors such as political intervention and data collection will bring challenges for reforming U.S. offshore oil and gas regulations and developing safety and environmental systems.

IV. REGULATORY REGIME FOR OFFSHORE OIL AND GAS OPERATIONS IN CHINA

Similar to the U.S., the Chinese regulatory regime on the HSE of offshore operations also failed to prevent the Bohai Bay accident. However, the regime has its own features and problems. In China, offshore oil and gas regulation similarly relies on a prescriptive CAC legal framework. Under this framework, offshore operators and contractors are required to comply with the obligations laid down in legislation. Regulatory authorities ensure that the HSE level for offshore operations is appropriately maintained and meets legal standards. Although

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106. *Safety and Environmental Management Systems (SEMS) Fact Sheet: Revisions to SEMS Final Rule (SEMS II)*, BUREAU OF SAFETY & ENVTL. ENF'T, https://www.bsee.gov/sites/bsee.gov/files/fact-sheet/safety/sems-ii-fact-sheet.pdf (last visited Jan. 18, 2019).

107. NAT'L ACAD. OF ENG'G & NAT'L RESEARCH COUNCIL, MACONDO WELL DEEPWATER HORIZON BLOWOUT: LESSONS FOR IMPROVING OFFSHORE DRILLING SAFETY 114 (2012).

108. *See* Well Control Final Rule Fact Sheet, BUREAU OF SAFETY AND ENVTL. ENF'T, https://www.bsee.gov/sites/bsee.gov/files/fact-sheet//fact-sheet-well-control-final-rule.pdf (last visited Jan. 18, 2018).

109. U.S. CHEM. SAFETY AND HAZARD INVESTIGATION BD., INVESTIGATION REPORT VOL. 4: DRILLING RIG EXPLOSION AND FIRE AT THE MACONDO WELL 11 (2016).

110. Bennear, *supra* note 2, at 7.

111. *See generally* NAT'L ACAD. OF ENG'G & NAT'L RESEARCH COUNCIL, *supra* note 107.

112. Lisa Frienman & Hiroko Tabuchi, *U.S. to Roll Back Safety Rules Created After Deepwater Horizon Spill*, N.Y. TIMES, Dec. 28, 2017, https://www.nytimes.com/2017/12/28/us/trump-offshore-drilling.html.

China also has enacted regulatory reforms in the aftermath of Bohai Bay accident, the reforms mainly encompassed oil spill emergency response plans and the environmental impact assessment ("EIA") system, without introducing any non-prescriptive approaches to the existing regime. To develop alternative regulatory approaches that can complement prescriptive CAC regulation, China must reform its market and facilitate a more competitive environment for the offshore petroleum industry.

A. THE DEVELOPMENT OF CHINESE HEALTH, SAFETY, AND ENVIRONMENT REGULATIONS FOR OFFSHORE OPERATIONS

The Chinese regulatory regime for offshore operations is composed of a series of laws and regulations associated with development, health, safety, and the environment (see Table 1). With respect to development, the Mineral Resource Law[113] authorizes the Ministry of Land and Resources ("MLR") to approve lease, license, and concession terms. For health and safety issues, the Provisions on the Safety of Offshore Oil Operations ("OSR")[114] and its Detailed Rules[115] play a dominant role and stipulate that the State Administration of Work Safety ("SAWS") is the regulatory authority. Environmental standards of offshore operations are addressed by the Marine Environmental Protection Law ("MEPL")[116] and the Regulation on the Administration of Environmental Protection in Offshore Oil Exploration and Exploitation ("the Regulation").[117] Regulatory authorities for the marine environment include the SOA, the Ministry of Environmental Protection ("MEP"), the Ministry of Transport ("MOT"), the Ministry of Agriculture ("MOA") and the other environmental authorities in coastal administrative units. The multiple and detailed statutes demonstrate that the Chinese regulatory regime for offshore operations relies heavily on a prescriptive CAC approach. Different functions of laws and regulatory authorities tend to be fragmented and overlapping, which easily leads to poor coordination and

113. *See* Zhōng Huá Rén Mín Gòng Hé Guó Kuàng Chǎn Zī Yuán Fǎ (中华人民共和国矿产资源法) [Mineral Resources Law of the People's Republic of China] (promulgated by the Standing Comm. Nat'l People's Cong., Mar. 19, 1986, effective Oct. 1, 1986, revised Aug. 29, 1996, and Aug. 27, 2009), CLI.1.16.7172(EN) (Lawinfochina).

114. *See* Hǎi Yáng Shí Yóu Ān Quán Shēng Chǎn Guī Dìng (海洋石油安全生产规定 [Provisions on Offshore Oil Work Safety] (promulgated by the St. Admin. Work Safety, May 26, 2015, effective July 1, 2015), CLI.4.258365(EN) (Lawinfochina).

115. Hǎi Yáng Shí Yóu Ān Quán Guǎn Lǐ Xì Zé (海洋石油安全管理细则) [hereinafter Detailed Rules for the Administration of Offshore Oil Safety] (promulgated by the St. Admin. Work Safety, Sept. 7, 2009, effective Dec. 1, 2009, revised Aug. 29, 2013, and May 26, 2015), CLI.4.121650(EN) (Lawinfochina).

116. *Id.*

117. Regulation of the People's Republic of China Concerning Environmental Protection in Offshore Oil Exploration and Exploitation (Promulgated by the St. Council People's Republic of China, Dec. 29, 1983, effective Dec. 29, 1983, revised Sept. 23, 2001) Zhejiang Government, http://english.zj.gov.cn/art/2012/5/28/art_1151_163250.html.

TABLE 1
KEY LEGISLATION REGULATING OFFSHORE OIL AND GAS OPERATIONS IN CHINA

Area	Legislation
Development	Mineral Resources Law
	Rules for the Implementation of the Mineral Resources Law
	Regulation on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises
	Law on the Exploration and Development of Resources in Deep Seabed Areas
Health & Safety	Work Safety Law
	Regulations on the Safety of Offshore Oil Operations
	Detailed Rules for the Administration of Offshore Oil Safety
	Provisions on the Protection of Submarine Cables and Pipelines
	Provisional Measures on the Management of Abandoned Offshore Oil Platforms
	Provisions on the Administration of Industrial Standards for Work Safety
	Standardization for the Safety of Offshore Oil and Gas Operations
	Internal documents of the key state-owned oil companies on health, safety and environment management
Environment	Environmental Protection Law
	Marine Environmental Protection Law
	Regulation on the Administration of Environmental Protection in Offshore Oil Exploration and Exploitation
	Measures for the Implementation of the Regulation on the Administration of Environmental Protection for Offshore Oil Exploration and Exploitation
	Administrative Regulation on the Prevention and Control of Pollution Damages to the Marine Environment by Ocean Engineering Construction Projects
	Law on Environmental Impact Assessment
	Regulation on the Marine Environmental Impact Assessment and Management of Ocean Engineering

ineffective implementation.[118]

In the industrial sector, China previously adopted domestic-foreign cooperation on offshore petroleum exploitation due to the lack of sophisticated technologies domestically.[119] According to the Regulation on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises ("Cooperation Regulation"),[120] the CNOOC has the exclusive right to cooperate with foreign investors in exploration, exploitation, production, and sales of offshore petroleum resources.[121] This demonstrates that offshore industry in China is not market-oriented, but based on state-owned enterprises ("SOEs"). The CNOOC as a state-owned company not only pursues commercial performance but also needs to adopt non-commercial responsibilities.[122] On the one hand, the CNOOC contributes to political, social, economic, and environmental development,[123] which means it shares common interests with regulators and can easily be governed in most circumstances. On the other hand, the CNOOC is criticized with regard to its bureaucracy, transparency, and environmental protections.[124] The non-competitive market hardly inspires the CNOOC to fully identify the risks of offshore operations and to keep pace with the development of new technologies. By adopting a production sharing contract ("PSC"), the CNOOC usually shares commercial benefits and HSE responsibilities with foreign operators. This may lead to a loose accountability system, which was reflected in the Bohai Bay accident where the operator COPC and the cooperator CNOOC did not take equal responsibility for the oil spills.

In effect, a separate Office of the SAWS is authorized to provide specific supervision and management for offshore operations.[125] Under the OSR, the Office carries out inspections on workplace safety, worker's training and education, and production equipment (including blowout preventers). The Detailed

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118. 以渤海溢油为案例的中国海洋环境管理机制研究, 中国环境与发展国际合作委员会专题政策研究报告 [Research on China's Marine Environmental Management Mechanism Based on the Case of Bohai Oil Spill, Report on Chinese Environmental and Development Issues], COMM. INT'L COOPERATION, http://www.cciced.net/zcyj/yjbg/zcyjbg/2012/201607/P020160708397113082290.pdf.

119. Keyuan Zou, *China's Governance over Offshore Oil and Gas Development and Management*, 35 OCEAN DEV. & INT'L LAW 339, 364 (2004).

120. Regulation on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises [hereinafter Cooperation Regulation] (Promulgated by St. Council Jan. 30, 1982, effective Jan. 30, 1982, revised Sept. 23, 2001) INVEST IN CHINA, http://www.fdi.gov.cn/1800000121_39_2355_0_7.html.

121. *Id*. at art. 6.

122. Miranda L. Wainberg et al., *Commercial Framework for National Oil Companies*, (Centre for Energy Economics ("CEE"), Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin) (May 2005) (Working Paper), http://www.usaee.org/usaee2007/submissions/onlineproceedings/cee_national_oil_company_usaee_pdf%203.pdf.

123. MATTHEW E. CHEN, NATIONAL OIL COMPANIES AND CORPORATE CITIZENSHIP: A SURVEY OF TRANSNATIONAL POLICY AND PRACTICE 59 (2007).

124. Wendy Leutert, *Challenges Ahead in China's Reform of State-Owned Enterprises*, 21 ASIA POL'Y 83, 99 (2016).

125. NIJS JAN DUIJM, CAN PRESCRIPTIVE AND PERFORMANCE-BASED RISK MANAGEMENT COEXIST? 2 (The Future of Risk Analysis in the Nordic Countries 2015).

Rules of the OSR offers prescriptive standards for inspections of operators' safety certifications, description of techniques, and the internal emergency response plan ("IERP").[126] Inspections can ensure that operators comply with the HSE standards in Chinese law. However, in the Bohai Bay accident, prescriptive inspections did not identify the risk of inappropriate drilling activities, which caused high geological pressure and led to the oil spills. Prescriptive standards lead to inspections that are implicitly accepted as "sufficiently safe," while the residual risk is considered to be negligible.[127] There also are no incentives for inspectors to check the features of each offshore facility while improving their expertise to keep pace with technological developments.

The weakness of environmental management in China exposed by the Bohai Bay accident is closely related to the prescriptive CAC regulation. As discussed above, multiple regulatory authorities have duties to protect the marine environment, but their functions tend to overlap and lack enforcement. Regulatory authorities usually use a list of Technical Specifications[128] to make the EIA and to inspect the compliance of offshore operations. Nonetheless, regulatory authorities failed to recognize the noncompliance of offshore operations with the EIA report, causing the oil spills to last for an entire month without suspending production. The regulatory regime also did not effectively trigger emergency response systems in the Bohai Bay accident since the systems are inconsistent in different levels of administrations. Furthermore, there was insufficient financial support for conducting research on marine environmental management and for improving technologies on the surveying, detecting, and monitoring of major accidents.[129]

B. REGULATORY REFORMS FOLLOWING BOHAI BAY ACCIDENT

Since the U.S. Macondo accident occurred in 2010, China has recognized the significance of reducing the risk of major accidents and improving the safety level of offshore operations.[130] In 2011, the Bohai Bay accident further revealed Chinese regulatory failures in preventing major offshore accidents. The regulatory regime was criticized for high prescriptions, checklist inspections, and inconsistent emergency response systems. Under offshore oil and gas laws and regulations, non-market-oriented development and insufficient HSE management

126. *See* Detailed Rules for the Administration of Offshore Oil Safety, *supra* note 115.

127. NIJS JAN DUIJM, *supra* note 125, at 2.

128. Technical Specifications for Environmental Impact Assessment of Offshore Oil and Gas Exploration and Development Projects 海洋油气开发工程环境影响评价技术规范 (promulgated by the State Oceanic Administration, 17 April 2014) at 7, http://www.law-lib.com/LAW/law_view.asp?id=450957 (China).

129. COMM. INT'L COOPERATION, *supra* note 118.

130. Notice to Further Strengthen the Safety of Offshore Petroleum Production (国家安全监管总局关于进一步加强海洋石油安全生产工作的通知) (promulgated by State Administration of Work Safety June 21, 2010) SECURITY REGULATORY AUTHORITY, http://www.gov.cn/gzdt/2011-02/21/content_1807307.htm (China).

systems also severely contributed to the oil spill. Relying heavily on CAC regulation in each aspect of offshore operations, reforms after the Bohai Bay accident were still carried out within the existing regulatory regime.

China first reformed its emergency response systems for offshore accidents. In 2015, the SOA divided oil spill accidents into four levels and took corresponding measures against them. In 2016, the MOT issued a National Plan on Oil Spill Emergency Response Capability Establishment (2015-2020), offering guidelines for improving oil spill response capability in equipment, staff training, technology, financial support, and marketization.[131] In 2018, the MOT further enacted the National Plan on Major Oil Spill Emergency Response, ensuring that administrative departments in each level cooperate effectively based on specific obligations and procedures. In the 13th National People's Congress of 2018, the State Council initiated institutional reforms, which integrated multiple ministries and established the Ministry of Natural Resource ("MNR"), the Ministry of Ecological Environment ("MEE") and the Ministry of Emergency Management ("MEM"). To have an effective operation and avoid conflicts of different missions, the three ministries are respectively responsible for the development, environment, and safety of offshore oil and gas activities.

To manage risks in offshore operations, the Regulation established the obligation of risk analysis for offshore operators in the EIA report.[132] The risk analysis, detailed in the Technical Specifications, aims to identify and evaluate major hazards that may cause oil spill accidents.[133] According to the Detailed Rules of the OSR, risk analysis also is required for equipment changes, lifesaving equipment, and abandoned well operation.[134] Based on risk analysis in the EIA report, offshore operators must prepare an IERP to provide preventative and response measures for potential accidents.[135] The documentation obligations of the EIA report and IERP for operators reflect progress in how China has paid attention to performance-based and management-based approaches for regulating offshore operations. However, Chinese regulatory reforms following the Bohai Bay accident have not introduced a risk-management system, like the U.S. SEMS. Due to limited performance-based and management-based provisions, Chinese HSE laws and regulations have not been able to comprehensively govern risks in offshore operations.

In contrast, the CNOOC positively assimilated the HSE management standards, experiences, and techniques at the international, national, and industrial levels,

131. National Plan on Oil Spill Emergency Response Capability Establishment 2015-2020 (国家重大海上溢油应急能力建设规划) (promulgated by Ministry of Transport, 2016) MINISTRY OF TRANSPORT, http://zizhan.mot.gov.cn/sj/zhongguohshsjzhx/zhengcegd_sjzhx/201601/P020160128676626768846.pdf (China).

132. Regulation of the People's Republic of China Concerning Environmental Protection in Offshore Oil Exploration and Exploitation, *supra* note 117, at art. 8.

133. Technical Specifications, *supra* note 128.

134. Detailed Rules for the Administration of Offshore Oil Safety, *supra* note 115, at art. 21, 22, 83.

135. Regulation of the People's Republic of China Concerning Environmental Protection in Offshore Oil Exploration and Exploitation, *supra* note 117, at art. 37.

while constantly improving HSE management objectives and systems.[136] HSE management systems play an increasing role in the operation of the CNOOC, which features some self-regulation in governing offshore oil and gas activities. This leaves space for regulators to either transfer the industrial HSE management system into public regulation, as in the U.S., or continue developing self-regulation to offer greater speed, flexibility, efficiency, and sensitivity to market circumstances. To create a competitive and efficient environment for the offshore oil and gas industry, China has initiated market-oriented reforms to the SOE sector.[137] With the aim of pushing forward the SOE reforms, China further issued a series of policies such as the 13th Five-Year Plan for Energy Development, and the Energy Production and Consumption Revolutionary Strategy 2016-2020, which still need to be transformed into law and effectively implemented.

Overall, regulatory reforms following the Bohai Bay accident have not changed the prescriptive approach or involved new approaches in China. By unifying the national (external) emergency response system and developing risk analysis in the EIA report, regulatory reforms have improved the safety level of offshore operations but still rely on the CAC regulation. SOE reforms in China may create a competitive environment for offshore industry and facilitate a transformation of the regulatory approach. With SOE reforms opening the market and allowing competition, companies may pay more attention to flexibility and efficiency in governing risks of offshore operations. For example, the CNOOC has been actively developing a HSE management system to prevent major accidents in offshore operations. This may require regulators to adopt multiple approaches such as performance-based, management-based or even self-regulation to have a positive interaction with offshore oil and gas companies. However, implementing SOE reforms involves uncertainties and risks because the implementation is highly complex, interconnected, and entails "top-level design."[138] To overcome obstacles such as industry monopoly and bureaucracy, China needs broader financial and legal reforms in the long term.[139]

CONCLUSION

Both the Macondo and Bohai Bay accidents illustrate that the regulatory regimes can be decisive factors in failures to prevent major accidents in offshore

136. ZHONG CHENG, KUN CHENG ET AL., HSE MANAGEMENT FOR CHINA OFFSHORE DRILLING PROJECT (2013).

137. Nan Guo & Peng Qin, *The Market and Regulation Failure of Petroleum Foreign Cooperation in Energy System Reform: Take Regulations on the Foreign Cooperative Exploitation of Offshore (Onshore) Petroleum Resources as an Example*, 32 INT'L ECON. & TRADE RESEARCH (国际经贸探索) 103, 116 (2016).

138. Dong Zhang & Owen Freestone, *China's Unfinished State-Owned Enterprise Reforms*, ECON. ROUNDUP, Issue 2, 2013, https://treasury.gov.au/publication/economic-roundup-issue-2-2013-2/economic-roundup-issue-2-2013/chinas-unfinished-state-owned-enterprise-reforms/.

139. Wendy Leutert, *Challenges Ahead in China's Reform of State-Owned Enterprises*, 21 ASIA POL'Y 83, 99 (2016).

operations. In the U.S. and China, a purely prescriptive regulatory approach failed to fully identify risks in offshore operations, which in turn prompted regulators and offshore industry to make regulatory reforms by introducing non-prescriptive approaches to improve the safety performance of offshore operations. The evolution of regulatory approaches for offshore operations has followed a similar trajectory in the U.S. and China, albeit the timing has been different. By comparing regulatory approaches for offshore operations in China with those in the U.S., the following insights may be helpful in the regulatory transition of offshore operations and in preventing major offshore accidents.

First, regulatory regimes for offshore operations in the U.S. and China rely on prescriptive rules and sanctions, which is rational because they are shaped by the unique interaction of traditions, values, institutions, and needs, as well as political, economic, and social forces at play in their national context.[140] Under CAC legal frameworks in these two countries, transforming the prescriptive approach to performance-based and management-based approaches may lead to, among other implementation challenges, difficulty in specifying, measuring, and monitoring performance objectives.[141] However, a purely prescriptive approach in a regulatory regime rarely identifies risks in each aspect of offshore operations. After the Macondo and Bohai Bay accidents, both the U.S. and China realized the weaknesses of the prescriptive approach and the necessity of incorporating other approaches to their regulatory regimes.

Second, the U.S. is ahead of China in regulatory reforms for offshore operations, but neither country's regime is adequate to deal with the high-risk offshore industry and complex institutional systems. Relying heavily on the CAC regulation, both the U.S. and China adopted "top-down" reforms to optimize State institutions, clarifying the responsibility of each agency (or ministry). The U.S. has incorporated the SEMS rules in its regulatory regime, which requires offshore operators to submit performance measure data.[142] Meanwhile, the effect of the performance-based rules might depend on offshore industry. China currently has not introduced a performance-based management system to its regulatory regime due to the prior non-market development of offshore industry. However, Chinese HSE regulation has imposed risk analysis on offshore operators, which reflects some features of performance-based and management-based approaches and can be further developed in future reforms.

Third, industrial HSE performance interacts with the evolution of regulatory approaches in the U.S. and China. On the one hand, the HSE regulation and

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140. Baram, *supra* note 45, at 186.

141. Anne L. Hanson, *Offshore Drilling in the United States and Norway: A Comparison of Prescriptive and Performance Approaches to Safety and Environmental Regulation*, 23 GEO. INT'L ENVTL. L. REV. 555, 575 (2011).

142. *OCS Performance Measures*, U.S. BUREAU OF SAFETY & ENVTL. ENF'T, https://www.bsee.gov/resources-and-tools/compliance/safety-and-environmental-management-systems-sems/ocs-performance-measures (last visited Feb. 4, 2019).

management system are usually developed based on the industry best practice.[143] The U.S. SEMS rules originated from voluntary practices in API's RP 75, which facilitated the reform of the regulatory approach. On the other hand, developing appropriate regulatory approaches can in turn promote a high level of HSE performance in a wide range of offshore industry. The "top-down" reforms and proactive strategies in China have promoted transparency and competition in the offshore petroleum industry. This may create an environment for regulators to develop performance-based, management-based, or even self-regulation approaches in preventing major accidents in offshore operations.

In conclusion, the U.S. and China have reformed their regulatory regimes with non-prescriptive approaches since the major accidents occurred. Given the complexity of offshore operations, empirical research also argues that a move to performance-based and management-based approaches is unlikely to significantly reduce risks of offshore operations.[144] Under current regulatory regimes of offshore operations in the U.S. and China, it seems that a combination of prescriptive, performance-based, and management-based approaches stands the best chance to improve safety culture, spur technological development, and avoid the insufficiencies of a single regulatory approach.[145] Presently, the U.S. has trended toward deregulating offshore industry, as evidenced by the Trump Administration reopening all U.S. waters for offshore drilling activities. This may slow down the regulatory progresses made after the Macondo accident.[146] In contrast, China tends to deepen its regulatory reforms on HSE management of offshore operations. The trust between the SOEs and regulators could facilitate the development of alternative regulatory approaches in China, though it is necessary to first open the market and promote competition among offshore industry. Nevertheless, both the U.S. and China are capable of adopting a hybrid regulatory approach to achieve higher HSE standards in the offshore oil and gas industry. Meanwhile, methods and best practices for the development and effective implementation of a combined regulatory regime remain to be seen. To better prevent major offshore accidents, the overall transfer from pure rule-compliance to risk regulation should be dependent on each country's social and legal contexts, which can be specifically tracked in future research.

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143. Huang Lin-jun & Liang Dong, *Development of Safety Regulation and Management System in Energy Industry of China: Comparative and Case Study Perspectives*, 52 PROCEDIA ENG'R 165, 168 (2013).

144. Bennear, *supra* note 2, at 18.

145. Derek Orth, *Administering America's Offshore Oil Fields: How Fewer, Performance-Based Regulations Ca Produce Better Results*, 26 J. EVNTL. L. & LITIG. 509, 527 (2011).

146. Eric Lipton, *Offshore Oil and Gas Operators Want Less Regulation, but Surprise Inspections Find Serious Safety Problems*, N.Y. TIMES, March 18, 2018, https://www.nytimes.com/2018/03/18/us/offshore-drilling-safety-regulation.html.