油气储量标准研讨会

Standards on Oil and Gas Reserves and Resources Seminar

主办方：北京大学能源研究院、美国贸易发展署、中美能源合作项目、美国国家标准化机构、美国石油协会

Hosts: The Institute of Energy Research of Peking University (IEPEK), U.S. Trade and Development Agency (USTDA), U.S.-China Energy Cooperation Program (ECP) , American National Standards Institute (ANSI), American Petroleum Institute (API)

2020年11月19日 北京

Nov. 19, 2020 Beijing

Content / 目录

Agenda

会议议程

Meeting Agenda

Nov. 19 (Thursday), 2020
The Lakeview Hotel, Floor B1, University Hall 3

Time	Topics	Speaker
9:00am-9:15am	Remarks	• Academician Zhijun JIN, President of IEPEK • Xu Fang, Chief Representative, ANSI China Office
9:15am-9:40am	International Oil and Gas Reserves and Resources and Standard Overview	Dr. Chuandong XU (Richard) Chairman of Reserves and Resources Committee of Society of Exploration Geophysicists (SEG)
9:40am-10:05am	The Classification Criteria of China Oil and Gas Reserves and Resources Standard	Dir. Zheng HAN, Deputy Director, Strategic Research Center of Oil and Gas Resource of MNR
10:05am-10:30am	An Introduction to API Safety Standards	Roland Goodman, Standard Manager, American Petroleum Institute (API)
10:30am-10:45am	5W2H on Reserves Guidelines	Douglas Peacock, Technical Director, Geoscience Baker Hughes- Gaffney, Cline & Associates (GCA)
10:45am-11:00am	International Standard of Oil and Gas Reserves and Resources Review	Prof. Haibin BI, Chief Expert of the Research Institute of Petroleum Exploration and Development (RIPED)
11:00am-11:15am	Reserves for Non-conventional Plays	John R. Wheeler, President of Lee Keeling & Associates (LKA)
11:15am-11:30am	Review on Oil and Gas Reserves and Resources	Dr. Bingyu JI, Chief Expert for SINOPEC, Professor of Non-conventional Oil and Gas Science and Technology Institute of China Petroleum University
11:30am-12:00pm	Discussion & Wrap up	Hosted by Lei Yang, Executive Vice President of IEPEK, Joined by above speakers and experts

会议日程

2020 年 11 月 19 日（星期四）
北大博雅国际酒店，B1 层，大学堂 3（会议室）

时间	内容	讲演人
9:00am-9:15am	致辞	• 北京大学能源研究院院长　金之钧院 • ANSI 美国国家标准机构中国首席代表 许方
9:15am-9:40am	国际油气储量及标准概述及趋势	许川东 博士 国际勘探地球物理学家学会储量专委会主席
9:40am-10:05am	中国油气矿产资源储量分类标准	韩征 女士 自然资源部油气战略研究中心副主任
10:05am-10:30am	美国石油协会的安全标准	Roland Goodman 先生 美国石油协会标准开发经理
10:30am-10:45am	储量评估标准 5W2H	Douglas Peacock 先生 贝克休斯-GCA 国际储量评估公司 技术总监
10:45am-11:00am	坚持特色 面向未来 ——油气储量标准国际化探讨	毕海滨 教授 中国石油勘探开发研究院首席专家
11:00am-11:15am	非常规油气储量	张炜乐 先生 李基林资源评估公司总裁
11:15am-11:30am	对油气储量方面的几点体会与思考	计秉玉 教授 中石化集团首席专家，中国石油大学非常规油气科学技术研究院教授
11:30am-12:00pm	讨论小结	杨雷执行副院长主持，所有参会专家参与讨论

Hosts and Supporting Agencies Overview

主办单位介绍

Institute of Energy, Peking University

Institute of Energy, Peking University is an independent institute of Peking University. The Institute is a global engaged energy think tank and strives to be a platform to promote the cutting edge energy technology developments. It also focuses on major technological and policy barriers that restrict the developmental capacities of China's energy industry. The mission statement is "demand oriented, approach combined, interdisciplinary innovation led, key factors highlighted ". The institute aims to facilitate clean energy transition, conduct professional and public education.

With the advantage of the university’s comprehensive offering of subjects, the institute explores an interdisciplinary collaborative developmental model that combines liberal arts, science and engineering. This model establishes an interdisciplinary innovation mechanism that encourages innovative talents in the field of energy.

The institute focuses on the following areas:

Energy Strategy and Policy Research: Anchored in the realities of China's energy development, the institute studies the country’s energy development strategy and guiding roadmap through an international and broad overarching perspective. It has established Institutional collaboration between relevant ministries, major energy companies and relevant international organizations and institutions to carry out a series of studies in the fields of natural gas market liberalization reform, energy security. The institute is devoted to be an international level energy think-tank.

Energy digitalization: Conduct research on the intersection of information technology and energy. This research focuses on the applications of digital technology in the field of energy, especially the application of internet plus, big data, block chain, artificial intelligence and other technologies. The institute has carried out research in digital pipeline networks and block chain applications in the field of oil and gas among other relevant areas of study.

Development and use of traditional energy: The institute spotlights shale oil and gas and inorganic gas in its development, especially on exploration and exploitation theories and key technological research.

Development and use of geothermal resources: In collaboration with the geotectonic major of the Earth and Space Science College of Peking University, the institute makes full use of Peking University's academic dominance in the field of geothermal flow, deep geothermal and geothermal resources to carry out basic research to further the use of geothermal resources.

Development and use of new energy: In response to developments in the area of new sources of energy, from the system approach, the institute will increase its talent acquisition capacity to conduct research on hydrogen energy, renewable energy, energy storage and other forms of comprehensive use of new sources of energy.

International Electrotechnical Standards Research: As Dr. Shu yinbiao is the current Chairman of the International Electrotechnical Commission, the institute will assume the relevant work of his Secretariat, which will further increase the institute’s international influence on the international standard-setting of electronics, electricity and information in the area of energy.

The institute has gradually formed a team of academicians, professors, and visiting fellows and other talents from various background. The institute also trained post-doctoral, doctoral and other young research talents.

北京大学能源研究院

北京大学能源研究院（简称能研院）以国家能源发展战略需求为导向，立足能源领域国际前沿科学问题，聚焦制约我国能源行业发展的重大科技问题，按照“需求导向、学科引领、软硬结合、交叉创新、突出重点、形成特色”的建院宗旨，推动能源科技进展，促进能源清洁转型，为能源行业开展专业及公众教育培养优秀的人才，致力于打造具有国际一流水平的能源智库和能源科技研发推广平台。

能研院利用北京大学学科门类齐全的优势，积极探索文、理、工相结合、多学科交叉融合的发展模式，建立学科交叉，文理工不同领域跨界融合的创新机制，培养能源领域的创新人才。积极服务国家和社会的经济发展，努力做好科研成果转化，发挥高校传播知识、引领社会的作用，建设国家能源发展的智库，为国家战略发展规划、企事业单位等提供理论、技术支撑。

研究院重点学科方向包括：

能源战略及政策研究：立足我国能源发展的实际，从国际视角、全局视角和未来视角研究我国能源发展战略及路径问题。与相关部委、国际机构、主要能源企业及院校建立机制性联系，开展天然气市场化改革、能源安全等领域的研究。

传统能源开发利用：重点是页岩油气与无机气，页岩油气侧重于页岩油气勘探开发理论与关键技术研究。无机气侧重于圈层相互作用下气体的形成与聚集成藏，包括 CH_4、CO_2、H_2 以及 He 等稀有气体。

能源数字化研究：开展信息技术与能源交叉领域的研究，对数字化技术在能源领域的应用场景重点进行研究，侧重互联网+、大数据、区块链、人工智能等技术在能源领域的应用研究。

地热资源的开发利用：与北大地球与空间科学学院大地构造专业相结合，在大地热流、深部地热和地热资源方面充分利用北京大学在该研究领域的优势地位，为扩大地热资源的利用开展基础研究。

新能源的开发利用：根据新能源发展的态势，加大人才引进力度，开展氢能、可再生能源、储能等新能源综合利用方面的研究。

国际电工标准研究与制定：依托中国担任国际电工委员会主席国的有利条件，承担秘书处相关工作，从而进一步提升能源领域电子、电力、信息等国际标准制定的国际影响力。

研究院逐步形成了一批院士、教授、研究员和特聘研究员等各学科方向领军人才带领的团队，还培养了博士后和博士等年轻科研人才。

U. S. Trade and Development Agency (USTDA)

The U.S. Trade and Development Agency (USTDA) helps to promote U.S. technologies and expertise for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

USTDA promotes economic growth in emerging economies by facilitating the participation of U.S. businesses in the planning and execution of priority development projects in host countries. The Agency's objectives are to help build the infrastructure for trade, match U.S. technological expertise with host country development needs, and help create lasting business partnerships between the United States and emerging economies.

USTDA's Program Activities

Project Development

Project identification and investment analysis generally involves technical assistance, feasibility studies and pilot projects that support large investments in infrastructure that contribute to host country development. Key sectors in China include the transportation, energy, and healthcare sectors.

Trade Capacity Building and Sector Development

Trade capacity building and sector development assistance supports the establishment of industry standards, rules and regulations, market liberalization and other policy reform. In China, USTDA has supported activities to support increased protection of intellectual property rights, fair and transparent government procurement practices, science-based agricultural biotechnology regulations, and standards across a wide range of industry sectors.

International Business Partnership Program

Under the Agency's International Business Partnership Program, USTDA has increased its support for programs designed to bring procurement officials to the United States to witness U.S. technology and ingenuity firsthand and develop the relationships with U.S. companies necessary to spur increased commercial cooperation with emerging economies. These investments include reverse trade missions, technology demonstrations, training and specialized sector-specific workshops and conferences.

Cooperation Programs

The Agency's success in China is due in part to the public-private cooperative programs that USTDA supports in country. These programs provide a forum wherein government agencies and private companies from both the U.S. and China can share technical, policy, and commercial knowledge relevant to a specific field. USTDA has successfully established programs based on this model in the aviation, standards and conformity assessment, energy, and healthcare sectors.

By adapting to the evolving needs of China's market and closely coordinating with Chinese decision makers, these public-private partnerships have enjoyed long-term success, providing continued trade opportunities and enhancing the development of China's key industries.

美国贸易发展署 (USTDA)

美国贸易发展署(USTDA) 致力于在新兴经济体推动经济发展和美国的商业利益。美国贸易发展署通过对项目前期，试点项目以及反向代表团赴美考察等形式的资金资助，达到在合作伙伴国家推动可持续性基础设施和经济增长的同时帮助美国企业寻找出口机会。

美国贸易发展署鼓励美国公司积极参与新兴经济体项目所在国重点发展领域里的项目规划和实施过程中的机会。目的是帮助美国有技术优势的公司配合项目所在国的发展寻求契机，并建立长期持久合作关系。

美国贸易发展署的项目活动

项目开发

美国贸易发展署支持的项目确认和投资分析通常为了支持项目所在国大型基础设施项目投资决策前以所需要的技术援助，可行性研究分析和试点项目等。在中国的项目集中在交通，能源和医疗卫生领域。

能力建设和行业发展

能力建设和行业发展是为了帮助推动建立行业标准，法规等相关政策需求的活动。在中国，美国贸易发展署支持过的项目内容涉及知识产权，公平透明政府采购，以科学为基础的农业生物技术规范，以及涉及其他更宽泛领域涉及行业标准的内容。

国际商业伙伴关系项目

通过国际商业伙伴关系项目，美国贸易发展署加大资金投入力度，组织更多灵活多样的赴美考察团，技术交流/研讨会和培训等，选择特定的一些行业，帮助中方人员了解美国技术，掌握第一手资料，加深对美国企业的了解并能推动潜在的商务合作。

政府企业合作平台

美国贸易发展署在中国取得成功的部分原因是与其他相关机构共同支持了政府企业合作项目的平台。在这个平台上，美国和中国的政府机构和私营企业均可以共享在特定领域的技术、政策和商业知识。美国贸易发展署已经成功地在航空、标准合格评定、能源和医疗保健等行业推动了该模式。

通过适应中国市场变化的需求，和中国决策者的密切配合，这些公私伙伴关系企业积累了一些长期合作的成功经验，提供持续的贸易机会，并推动中国支柱产业的发展。

U.S.-China Standards and Conformance Cooperation Program

Sponsored by the U.S. Trade Development Agency (USTDA) and coordinated by the American National Standards Institute (ANSI), the **U.S.-China Standards and Conformance Cooperation Program** (SCCP) provides a forum through which U.S. and Chinese industry and government representatives can:

- Cooperate on issues relating to standards, conformity assessment, and technical regulations;
- Foster the relationships necessary to facilitate U.S.-China technical exchange on standards, conformity assessment, and technical regulations; and
- Exchange up-to-date information on the latest issues and developments relating to standards, conformity assessment, and technical regulations.

Beginning in 2013, ANSI will coordinate 20 workshops over a 3-year period in China under the SCCP. The workshops will cover a wide range of sectors, as proposed by interested U.S. private-sector organizations. Workshop topics will be chosen in coordination with relevant industry associations, ANSI, and USTDA.

To learn more about the U.S.-China SCCP or to express interest in sponsoring or participating in a workshop, please visit our website at:

www.standardsportal.org/us-chinasccp

FOR MORE INFORMATION

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美中标准与合格评定合作项目

由美国贸易发展署 (USTDA) 提供资助、 美国国家标准协会 (ANSI) 负责协调的美中标准与合格评定合作项目 (SCCP) 在以下几个方面为美国和中国相关行业和政府代表提供了一个论坛:

- 在标准、合格评定以及技术法规等领域的合作;
- 为促进美中在标准、合格评定以及技术法规等领域的技术交流建立必要的联系;
- 及时交流关于标准、合格评定以及技术法规等领域的 最新议题和发展情况的相关信息

根据 SCCP 项目规定，从 2013 年开始的三年内，ANSI 将在中国协调举办20场研讨会。根据美国私营业界相关组织的建议，研讨会内容将覆盖不同的行业和领域。研讨会的主题将由相关行业组织、ANSI 以及 USTDA 协调选定。

欲了解该项目的更多情况或有意赞助或参与该项目，请访问下列网站:

www.standardsportal.org/us-chinasccp

了解其他信息，请联系

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American National Standards Institute (ANSI)

As the voice of the U.S. standards and conformity assessment system, the American National Standards Institute (ANSI) empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment.

The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.

ANSI has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for the past hundred years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations.

Throughout its history, ANSI has maintained as its primary goal the enhancement of global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of more than 270,000 companies and organizations and 30 million professionals worldwide through its office in New York City, and its headquarters in Washington, D.C.

美国国家标准化机构（ANSI）

作为美国标准和合格评定体系的发言人，美国国家标准化机构授权其会员强化美国市场在全球经济中的地位，同时协助保障消费者的安全和健康以及环境保护事宜。

机构对数以千计的标准和指导方针的制定、颁布、实施进行监督，而这些标准和指导方针几乎直接影响商业的每个领域：从声呐设备到建筑设备，从乳制品及家禽产品到能源分配等等。美国国家标准化机构也积极参与评估合格到标准的委托项目——包括诸如 ISO9000（质量）和 ISO14000（环境的）管理系统等全球认可的跨领域项目。

在过去的一个世纪中，美国国家标准化机构担任美国私营部门自愿性标准化体系的管理者及协调者。自 1918 年由五家工程师协会和三个政府部门成立以来，本机构一直是一个民间、非营利性质的会员制组织，得到来自私营和公共部门的多元化支持。

纵观历史，美国国家标准化机构的首要目标一直是强化美国商业的全球竞争力，通过推进自愿性标准及合格评定体系并对它们进行完善从而提高美国人民的生活质量。机构总部设在华盛顿特区，并在纽约设有办公地点，代表全球超过 27 万家公司及组织和三千万专家的利益。

US-China Energy Cooperation Program (ECP)

Founded in September of 2009 by 24 US energy companies, US-China Energy Cooperation Program (ECP) was underscored by US President Barack Obama and China President Hu Jintao in the official joint statements during Obama's visit to China in 2009. US government agencies including Department of Commerce, Department of Energy and US Trade and Development Agency together with Chinese government agencies including National Energy Administration and Ministry of Commerce signed bilateral Memorandums of Understanding to serve as official government advisors to support ECP.

US-China Energy Cooperation Program (ECP)'s mission is to create a bilateral business platform with US and Chinese companies to pursue private sector-based business opportunities, advance sustainable development in the energy industry and combat climate change. Members join ECP through working groups to form industry value chains. Within each working group, members establish a sector development road map according to the national strategies, local demand and potential local partners for both short and long terms. Through this process, each working group identifies annual business development objectives and concrete initiatives for implementation.

ECP currently has the following working groups:

Oil and Gas,
Coal,
Nuclear Energy,
Renewable Energy,
Grid,
Storage,
Building,
Industry,
Transport,
Urban Infrastructure,
Resource Utilization

Learn more about the US-China Energy Cooperation Program by visiting: www.uschinaecp.org

中美能源合作项目（ECP）简介

中美能源合作项目（ECP）肩负着中美两国间清洁能源领域广泛合作的商业执行使命。作为由企业出资运营并管理的非盈利、非政府机构，ECP 于 2009 年 9 月由 24 家美国企业发起成立，致力于在中美两国推动清洁能源领域相关的产业开发、市场开拓、境外直接投资以及创造就业机会等相关工作。通过两国政府对 ECP 的正式承认和支持，ECP 作为一个政府和企业间的伙伴关系平台，为成员公司及其商业伙伴提供动力，通过全方位解决方案产业联盟的组建和运行，推动必须经由集体性的和协调性的努力才能实现的商业发展成果的落实。成员公司通过参与有关工作组来组成不同的产业价值链。在每个工作组之下，各成员公司共同为工作组的相关产业设立短期、中期以及长期的产业开发路线图。在这一工作的过程中每个工作组就每年的相关工作，确立年度商业发展目标，并辅以切实的工作计划，推动实施。

经过六年多的工作，ECP 已经发展成为了包括中国企业在内的三十几家家企业的共同平台。通过同各种各样的合作伙伴关系，致力于在以下诸多工作上有所建树：

•推进新的行业以及市场的形成；
•协助相关行业政策以及法规的制定；
•为中美两国的政府间对话提供企业角度的支持；
•搭建促进商业成果达成的管道。

中美能源合作项目(ECP)CP 行业工作组
ECP 目前有以下行业工作组：
油气、煤炭、核能、可再生能源、电网、储能、建筑、工业、交通、城市基础设施、资源利用

ECP 项目:
为促进交流与合作，ECP 设计并提供相关培训，技术支持，研究及试点项目。ECP 成员公司有机会和中国能源界专家一起参与合作项目，这些项目都得到了国家级或省级的政府官员的认可。每年，ECP 在中国参与并支持诸多与清洁能源领域相关的重要议题、技术讨论及研讨会。
2013 年中美能源合作对话会议
ECP 使命: 通过提高清洁能源解决方案的发展和部署，为中美政府和企业间的合作创建一个坚实的平台。

ECP 在中美两国的能源合作中发挥着重要作用，并通过努力推动以下方面的工作，促进和支持两国清洁能源产业的发展：
•创造就业机会
•知识产权保护
•市场准入和行业发展
•中美相互间的境外直接投资

American Petroleum Institute，API

API represents all segments of America's oil and natural gas industry. Our more than 600 members produce, process and distribute most of the nation's energy. The industry supports more than ten million U.S. jobs and is backed by a growing grassroots movement of millions of Americans. API was formed in 1919 as a standards-setting organization. In our first 100 years, API has developed more than 700 standards to enhance operational and environmental safety, efficiency and sustainability.

Although our focus is primarily domestic, in recent years our work has expanded to include a growing international dimension, and today API is recognized around the world for its broad range of programs:

美国石油学会

美国石油学会（American Petroleum Institute，API）是一家提供美国石油消耗及库存水平重要的每周数据的美国石油业机构。

API 建于 1919 年，是美国第一家国家级的商业协会，也是全世界范围内最早、最成功的制定标准的商会之一。美国石油学会是美国最大的石油和天然气行业的行业协会。它代表约 400 间参与石油工业生产、精炼、分销等企业。该协会的主要职能包括与政府、法律界和监管机构进行宣传和谈判;研究行业对经济和对环境的影响，建立行业标准和认证，并作外展教育宣传。API 资助及进行和石油工业相关的多项研究。

Speaker Biographies

演讲人介绍

金之钧 院士
北京大学能源研究院 院长

中国科学院院士，中国石油化工股份有限公司石油勘探开发研究院教授，中国石油学会副理事长，国家能源委员会专家咨询委员会委员，科技部第一届基础研究战略咨询委员会成员。曾担任中国石油大学（北京）副校长，中国石油化工股份有限公司副总地质师和石油勘探开发研究院院长。长期从事石油地质理论研究和能源科技战略研究，获国家技术发明奖二等奖、国家科技进步二等奖 2 项、李四光地质科学奖、孙越崎能源科学技术奖和归国留学人员成就奖，出版专著 15 部，发表论文 400 余篇。2007 年获俄罗斯联邦教育科学部博士学位。

Fang XU
Chief Representative
American National Standards Institute China Office

Xu Fang has been working with American National Standards Institute (ANSI) as the Chief Representative of ANSI China Office since 2012. In this position, he has primary responsibility for overall liaison of ANSI's activities with Chinese government agencies, standard development organizations and various industry groups.
Prior to working with ANSI, Mr. Xu served for American Forest & Paper (AF&PA) China Office as the main contact point for US government, industry and Chinese government for all of aspect of AF&PA China Program. As the representative of US forest industry, he worked with Chinese Ministry of Housing and Urban Rural Development (MoHURD) and State Administration of Forestry on developing and revising a serial of codes and standards pertaining to design, construction and inspection of wood constructions. He has made numerous presentations among Chinese developers, design professionals, importers and consumers and introduced applications of US wood products. Prior to joining in AF&PA, Mr. Xu worked with an engineering firm as the Chief Structural Engineer for more than 13 years.
Mr. Xu holds his Bachelor of Engineering degree from Tongji University.

许方
美国国家标准化机构(ANSI)中国首席代表

许方先生自 2012 年起担任美国国家标准化机构(ANSI)中国首席代表，负责 ANSI 在中国的相关工作和业务。在此之前，许先生于 1999 年起担任美国林业及纸业协会中国代表处首席代表，负责美国林产品的贸易政策以及市场推广。在此期间，许先生作为美国林产工业的代表，参与制订了中国数本关于木结构建筑设计、施工、验收以及产品的标准和法规的编写工作，为中国木结构建筑标准的应用和发展起了积极的作用。许先生毕业于同济大学结构工程专业，在加入美国林业及纸业协会之前，曾从事十多年的建筑工程设计与咨询业务，撰写过多篇学术论文。

Dr. Chuandong (Richard) Xu

Chairman of Reserves and Resources Committee of Society of Exploration Geophysicists (SEG)

Dr. Chuandong (Richard) Xu is president of NexGeo Resources LLC, and current Chairman of SEG Oil and Gas Reserves Committee. He is a well-trained Geophysicist/Geologist in oil and gas upstream exploration and production, with broader interests in Energy including LNG, CCUS, Midstream, Energy Policies, Geothermal etc. He worked as Geophysical/Geological Advisor for Occidental Petroleum (OXY) and then California Resources Corp (CRC) on seismic interpretation, seismic inversion, and integrated reservoir studies for exploration and exploitation, as well as reservoir management, reserves assessment and economic evaluation, and making Life of Field (LOF) plans in varies asset teams in US. Dr. Xu's academic interests include integration of geology and geophysics, rock physics, seismic inversion, and application of geoscience data. Dr. Xu obtained his PhD and MSc from University of Calgary, and BSc from University of Petroleum (East China), all in Applied Geophysics. He is an active member of SEG, AAPG, and served as president of Pacific Coast Section of SEG, Council member and member of Committee for Nominations of SEG in the past. Dr. Xu was Vice Chairman of 2018 SEG Annual Meeting in Anaheim.

许川东 博士

国际勘探地球物理协会油气储量委员会主席

许川东博士是 NexGeo Resources LLC 公司总裁，国际勘探地球物理协会油气储量委员会现任主席。他是油气上游勘探和生产方面的地球物理学家/地质学家，对能源领域的兴趣广泛，包括液化天然气、CCUS、中游、能源政策、地热等。他曾在西方石油公司（OXY）和加利福尼亚资源公司（CRC）担任地球物理/地质顾问多年，从事地震解释和反演，勘探开发综合研究，以及油田生产运营、储量评估、经济评价和参与制定油田全生命周期计划的工作。许博士的学术兴趣包括地质与地球物理的综合、岩石物理、地震反演以及地学数据 的应用等。他拥有卡尔加里大学博士和硕士学位，石油大学（华东）学士学位，全部为应用地球物理专业。他是 SEG 和 AAPG 会员，曾担任 SEG 太平洋沿岸分会主席、SEG 理事会成员和 SEG 提名委员会委员。许博士为 SEG 2018 年阿纳海姆年会副主席。

韩征 女士

石油地质博士，研究员

自然资源部油气储量评审办公室主任

自然资源部油气资源战略研究中心副主任

长期从事全国油气储量技术研究和评审及油气资源储量管理工作，主持完成多项国家部委油气资源储量重大科研项目，参与研究制定油气资源管理政策。作为主要起草人，编制了我国油气储量领域 1 项国家标准（油气矿产资源储量分类）和 10 项地质矿产行业标准（石油、天然气、页岩气、煤层气、致密油、碳酸盐岩油气藏等储量规范）。科研成果和论文曾获教育部国家科技成果自然科学二等奖等奖项。

Roland Googman
Manager of Upstream standards
American Petroleum Institute (API)

Roland is the Manager of Upstream standards for the American Petroleum Institute in Washington, D.C. Roland's group is responsible for staffing 15 committees that develop and maintain approximately 370 equipment and operational standards covering onshore and offshore exploration, drilling, and production. These standards are used globally to enhance the safety of industry operations, assure quality, and help reduce costs.
Roland has been with API for 25 years, with his first 11 years spent working on refining equipment standards. He has a Bachelor of Science degree in Industrial and Systems Engineering from the University of Southern California and is a member of Society of Standards Professionals.

Roland Goodman 先生
美国石油学会上游标准委员会经理

Roland 先生担任总部位于华盛顿的美国石油学会上游标准委员会经理。他领导的团队负责 15 个分委会 370 多项设备和操作标准的制修订工作，包括海上和陆上勘探、钻井、生产。这些标准被全球广泛使用，以加强行业操作的安全水平、确保操作质量并降低操作成本。
Roland 先生在 API 工作了 25 年。最初 11 年，他在炼油设备标准部门工作。他拥有南加州大学工业和系统工程学士学位，目前是是标准专业人员协会的成员。

Douglas Peacock
Technical Drector
Geoscience Baker Hughes-Gaffney, Cline & Associates (GCA)

Doug has over 35 years' experience in geology and 3D reservoir modelling. His geological modelling experience covers a wide range of reservoirs in many parts of the world and ranges from building models for field development planning and reserves estimation purposes to reviewing and auditing models built by others. He has also worked extensively on reserves estimating, unconventional reservoirs, acquisitions and divestments, unitization & redetermination as well as technical projects. Doug has also served as an expert witness in several court cases.
Doug was an SPE Distinguished Lecturer for 2010-11 and was a member of SPE Oil and Gas Reserves Committee (OGRC) from 2013-2016. He is also a regular instructor of SPE training courses.

Douglas Peacock 先生
技术总监
贝克休斯-GCA 国际储量评估公司

Douglas 先生在地质和 3D 储层建模领域拥有超过 35 年的经验。他的地质建模经验丰富，包括为油田开发规划和储量估算目的构建模型，审查和审计其他人工构建的模型。他丰富的经验可用于指导世界不同地区的不同储层的建模。此外，他还广泛参与了储量估算、非常规油藏、收购和撤资、单元化和再开发以及技术项目。 Douglas 先生还曾在数起法庭案件中担任专家证人。Douglas 先生曾被评为 2010-2011 年度 SPE 杰出讲师，并于 2013-2016 年担任 SPE 油气储备委员会（OGRC）成员。他还是 SPE 培训课程的讲师。

毕海滨 教授
中国石油勘探开发研究院首席专家

工学博士 中国石油集团公司高级技术专家，教授级高工。
1986 年始一直在油气行业工作，主要从事国家标准储量评价技术研究和 SEC(美国证券交易委员会)准则储量评估方法研究。

John R. Wheeler
President of Lee Keeling & Associates Inc.

Mr. Wheeler is President of Lee Keeling & Associates (LKA), an international petroleum E&P consulting and reserve evaluation company founded in 1957. Before joining LKA, he worked in Amoco Research Center and then at Williams E&P. As a Certified Petroleum Geologist, Mr. Wheeler has 34+ years' experience in geological and engineering investigations in oil and gas industry. He has conducted geologic and reservoir studies of both conventional and unconventional reservoirs in more than 30 countries and in every major U.S. petroleum province, highlighted with recently developed shale plays i.e. Permian, Eagle Ford, Haynesville, Marcellus, Bakken, Woodford and Niobrara. He has extensive experience in reserve evaluation for public and private oil companies, and financial institutes including hundreds of reserve report submitted and accepted by SEC. He also performs evaluation of oilfield properties for acquisition and divestiture as well as being a technical advisor to foreign and domestic companies looking to invest in U.S. oil and gas business. His other studies include pipeline feasibility assessment, gas storage evaluation and waterflood projects analysis. He also provides expert witness reports and testimony for legal cases. Mr. Wheeler earned his B.Sc. degree from University of Oklahoma and M.Sc. from University of Tulsa, both in Geology. He is a member of AAPG, SPE, SPEE, OIPA, TGS and KGS.

张炜乐 先生
李基林资源评估公司总裁

炜乐先生是成立于 1957 年的国际石油 E&P 咨询和储量评估公司--李基林资源评估公司（LKA）的总裁。在加入 LKA 之前，他曾先后在阿莫科研究中心和威廉姆斯 E&P 公司工作。作为认证石油地质学家，炜乐先生在石油和天然气行业的地质和工程调查方面拥有超过 34 年的经验，在 30 多个国家和美国各大油气盆地对常规和非常规储油层进行了地质和储层研究，包括最近开发的页岩油气，如二叠纪、鹰滩、海恩斯维尔、马塞勒斯、巴肯、伍德福德和尼奥布拉拉。他拥有丰富的经验为上市和私营石油公司以及金融机构提供储量评估报告，其中包括数百份提交给美国证券交易委员会（SEC）的报告并得到认可。他还对油气田资产的收购和剥离提供评估，并为希望投资美国石油和天然气业务的国内和国外公司担任技术顾问。他的其他研究包括油气管道可行性、地下储气库和水驱项目的分析评估。他还为法律案件提供专家证人报告和证词。炜乐先生拥有俄克拉荷马大学地质学士学位和塔尔萨大学地质硕士学位。他是 AAPG、SPE、SPEE、OIPA、TGS 和 KGS 的会员。

计秉玉 教授
中石化集团首席专家

中国石油大学非常规油气科学技术研究院教授
教授级高工，工学博士，1983 年始一直在油气行业工作，主要从事油田开发设计，油田开发机理研究和油藏工程方法研究。

杨雷 博士
北京大学执行副院长

北京大学能源研究院研究员，清华大学能源转型与社会发展研究中心学术委员会委员，IGU 国际燃气联盟协调委员会候任主席，《国际石油经济》编委会副主任。曾历任国际能源署署长高级顾问，国家发改委和国家能源局处长、副司长等职。他致力于推动能源转型、能源改革和全球能源治理，参与了多项能源政策的研究制定，热心能源的公众普及工作。

Presentations

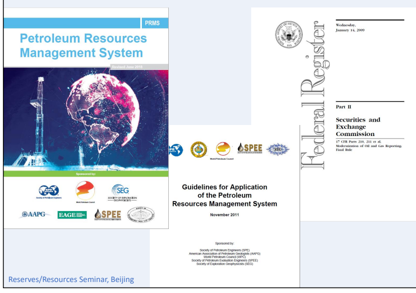
演讲材料

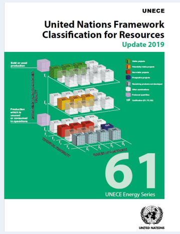
International Oil and Gas Reserves & Resources and Standard Overview

Dr. Richard Xu,
Chair of SEG Oil and Gas Reserves Committee
Standards on Oil and Gas Reserves and Resources Seminar. Beijing. 2020-11-19

PRMS and SEC Rule
- Oil and gas (including oil sand and coalbed methane)
- 2 axis: Chance of Commerciality (class) and Range of Uncertainty (category)

UNFC
- Sources including solar, wind, geothermal, hydro-marine, bioenergy, injection for storage, hydrocarbons, minerals, nuclear fuels and water
- 3 axis: environmental-socio-economic viability (E), technical feasibility (F), degree of confidence in the estimate (G)





Outline

- Concepts and definitions
- PRMS
- PRMS versus SEC
- SEG Role

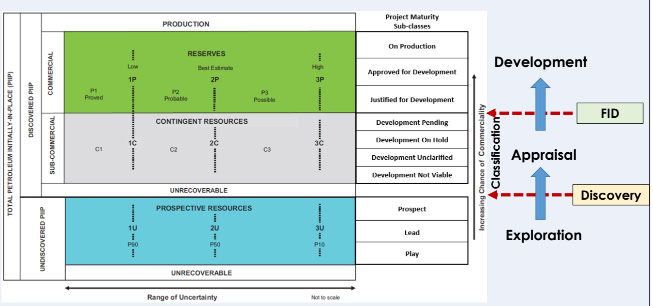
Concepts and definitions

Standard
- Criteria established by an authority or by general consent as a basis of comparison; an approved model; an object that is regarded as the usual or most common size or form of its kind.
- Make things work by providing specifications (guidelines or requirements) for products, services and systems.
- If used consistently, they ensure quality, safety and efficiency.

Guideline
- Guidelines are recommendations to users when specific standards do not apply.
- Designed to streamline certain processes according to what the best practices are.
- Statement of advice or instruction pertaining to practice.
- Originates in an organization with acknowledged professional standing.

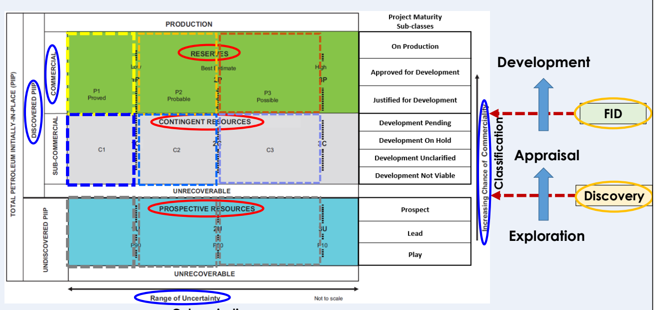
Rule
- Legal
- Detailed instructions on how laws are to be enforced or carried out and are sometimes referred to as "rules" or "administrative laws."
- draw a sharp line between forbidden and permissible conduct
- Carry the force of law – their application is mandatory
- Penalty

PRMS – Classification Framework



modified from PRMS (2018)

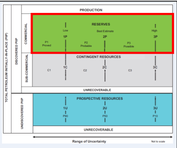
PRMS – Classification Framework



For illustration, modified from PRMS (2018)

PRMS - Definitions

Reserve vs. resource (not exchangeable in most cases)

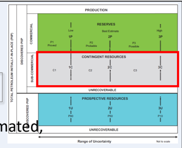


- **<u>Reserves</u>** are the quantities of petroleum anticipated to be *<u>commercially recoverable</u>* by application of *<u>development projects</u>* to *<u>known accumulations</u>* from a *<u>given date</u>* forward under *<u>defined conditions</u>*.
- Reserves must satisfy four criteria: discovered, recoverable, commercial, and remaining (as of the evaluation's *<u>effective date</u>*) based on the development project(s) applied.

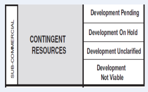
discovered
recoverable
commercial
remaining

PRMS - Definitions

Reserve vs. resource (not exchangeable in most cases)

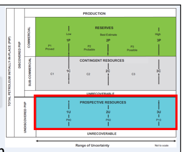


- **<u>Contingent Resources</u>** are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, by the application of development project(s) not currently considered to be commercial owing to one or more contingences.
- Contingent Resources have an associated *<u>chance of development</u>*.
- Contingent Resources may include, for example, projects
  - currently no viable *<u>markets</u>*, or
  - commercial recovery is dependent on *<u>technology under development</u>*, or
  - evaluation of the accumulation is insufficient to clearly assess commerciality.
- Contingent Resources are further categorized in accordance with the range of uncertainty associated with the estimates and *<u>should</u>* be sub-classed based on project maturity and/or *<u>economic</u>* status.



PRMS - Definitions

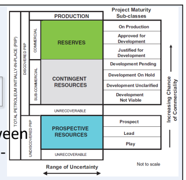
Reserve vs. resource (not exchangeable in most cases)



- **<u>Prospective Resources</u>** are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects.
- Prospective Resources have both an associated *<u>chance of geologic discovery</u>* and a *<u>chance of development</u>*.
- Prospective Resources are further categorized in accordance with the range of uncertainty associated with recoverable estimates, assuming discovery and development and *<u>may</u>* be subclassified base on project maturity.

PRMS - Definitions

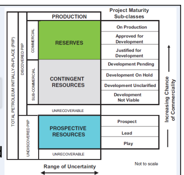
Project – Key concept for Reserves



- A defined activity or set of activities that provides the link between petroleum accumulation's resources sub-class and the decision-making process, including budget allocation.
- A project may, for example, constitute the development of a single reservoir or field, an incremental development in a larger producing field, or the integrated development of a group of several fields and associated facilities (e.g. compression) with a common ownership.
- In general, an individual project will represent a specific maturity level (sub-class) at which a decision is made on whether or not to proceed (i.e. spend money), suspend, or remove.
- There should be an associated range of estimated recoverable resources for that project. (See also Development Plan)

PRMS - Definitions

Development Plan



- The design specifications, timing, and cost estimates of the appraisal and development project(s) that are planned in a field or group of fields.
- The plan will include, but is not limited to, well locations, completion techniques, drilling methods, processing facilities, transportation, regulations, and marketing.
- The plan is often executed in phases when involving large, complex, sequential recovery and/or extensive areas.

PRMS - Definitions

Commerciality – to recognize Reserves

- Discovered recoverable quantities (Contingent Resources) may be considered commercially mature, and thus attain Reserves classification, if the entity claiming commerciality has demonstrated a firm intention to proceed with development.
- This means the entity has satisfied the internal decision criteria (typically rate of return at or above the weighted average cost-of-capital or the hurdle rate).

PRMS - Definitions

Commerciality – to recognize Reserves

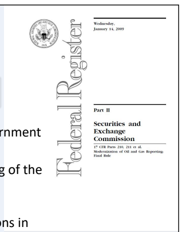
- Commerciality is achieved with the entity's commitment to the project and all of the following criteria:
  - A. Evidence of a technically mature, feasible development plan
  - B. Evidence of financial appropriations either being in place or having a high likelihood of being secured to implement the project
  - C. Evidence to support a reasonable time-frame for development
  - D. A reasonable assessment having positive economics and meet defined investment and operating criteria, based on the estimated entitlement forecast quantities and associated cash flow (See Net Cash-Flow Evaluation)
  - E. A reasonable expectation of a market for forecast sales quantities of the production required to justify development, similar confidence that all produced streams (e.g. oil, gas, water, CO_2) can be sold, stored, re-injected, or otherwise appropriately disposed
  - F. Evidence of the necessary production and transportation facilities
  - G. Evidence that legal, contractual, environmental, regulatory, and government approvals are in place or will be forthcoming, together with resolving any social and economic concerns

PRMS - Definitions

Commercial versus Economic

- For a project to be commercial, it must generate an acceptable *rate of return* and meet all of the other criteria discussed before.
- A project is economic if it has *positive cash flow*, for example, $1
- Price of oil and gas

PRMS versus SEC Rule



What is SEC Rule

- SEC (US Securities and Exchange Commission), an independent federal government regulatory agency
- Responsible for protecting investors, maintaining fair and orderly functioning of the securities markets, and facilitating capital formation
- Promotes full public disclosure, protects investors against fraudulent and manipulative practices in the market, and monitors corporate takeover actions in the United States.
- "The Commission is adopting revisions to its oil and gas reporting disclosures which exist in their current form in Regulation S–K and Regulation S–X under the Securities Act of 1933 and the Securities Exchange Act of 1934, as well as Industry Guide 2."
- "The revisions are intended to provide investors with a more meaningful and comprehensive understanding of oil and gas reserves, which should help investors evaluate the relative value of oil and gas companies."

PRMS versus SEC Rule

PRMS

- By professional societies
- Recommendation, industry
- Voluntary

SEC rule

- Government agency
- Law, legal
- Mandate for companies listed on US stock markets

PRMS versus SEC Rule

PRMS

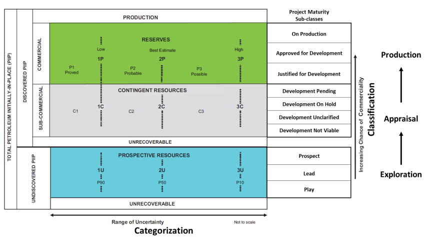
1. Full portfolio
2. Allows a price scenario that escalates in the future – company forecast scenario
3. Suggests 5 years as a benchmark, but a longer time-frame may be justifiable for contractual or strategic objectives
4. Allow escalation
5. Reserve studies under PRMS are probably not SEC compliant, but could be in alignment without too much modification
6. ……

SEC rule

1. Requires Proved Reserves (P1). Does not allow reporting of Contingent or Prospective Resources
2. Price based on the 1st day of the month for the last 12 months, held constant, unless by a sales contract
3. Requires 5 years for moving undeveloped projects to developed
4. Requires operating costs and future capex be based on conditions at the effective date, with no future escalations.
5. Most prepared under SEC rule would be PRMS compliant
6. ……

SEG SOCIETY OF EXPLORATION GEOPHYSICISTS

Mission of SEG-OGRC

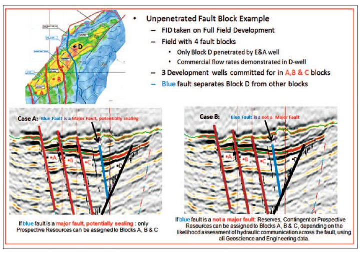


to represent SEG as a society as well as its member companies and member individuals, to promote and assure the geophysical technologies and techniques to be utilized effectively and reliably in the process of oil and gas reserves and resources assessment for the entities at all levels.

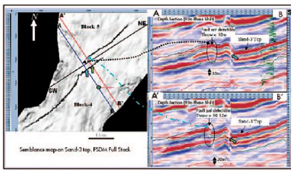
Connecting the World of Applied Geophysics

SEG
SOCIETY OF EXPLORATION GEOPHYSICISTS

Mission of SEG-OGRC



(Kloosterman and Pichon, 2012)



(Weiden. R., et al., 2012)

Road Ahead

- Mapping and bridging between the existing petroleum Reserves/Resources systems, specifications and guidelines
- Guidelines for CO2 storage/geologic sequestration

Thanks!

GB/T19492-2020

中国油气矿产资源储量分类标准

韩 征

自然资源部油气资源战略研究中心
自然资源部油气储量评审办公室

2020年11月19日

报 告 提 纲

一、油气分类标准修订背景

《油气矿产资源储量分类》是我国油气矿产资源管理的基础性技术标准，贯穿油气勘探开发全过程，对掌握油气资源储量家底、制定油气矿产资源规划、战略、政策，保障国家能源安全，维护矿产资源国家所有责权益、保护和合理利用油气矿产资源具有重要的作用。

一、油气分类标准修订背景

国家标准《油气矿产资源储量分类》GB/T 19492-2004版，实施以来，经过近15年的实践，总体是满足我国油气管理和符合油气企业勘探开发生产实际的，促进了行业健康有序发展。

但是，随着油气矿产资源管理改革的持续深入推进，有关管理改革文件陆续出台，原分类标准与现有管理制度已不相适应，在规范使用过程中也存在储量名词较多、社会发布不规范等问题。因此需要对分类规范进行修订。

一、油气分类标准修订背景

54年来，油气储量分类标准经历五次制修订：

（1）1966年 — 首次制定储量分类标准
探明、基本探明、待探明 储量精度90%、70%、50%

（2）1977年 — 采用了前苏联一、二、三级储量分类标准
开发、探明、概算储量精度90%、70%、50%

（3）1988年 — 已开发、未开发、基本探明、控制、预测
探明已开发、探明未开发、基本探明、控制储量
误差小于10%、20%、30%、50%

（4）2004年 — 重新制定颁布了新的油气资源储量分类标准
探明已开发、探明未开发、控制储量、预测储量
取消基本探明

（5）2020年 — 修改了使用范围、勘探开发阶段、资源量和储量分类

一、油气分类标准修订背景

修订总体要求：围绕国家油气矿产资源管理，考虑油气企业现行应用现状，最大化降低社会认知和信息交易成本，按照“管住、管准、管好”管理目标、与矿政管理改革同步考虑，科学确定矿产资源储量分类分级。

修订原则：统一标准、满足国家资源管理和企业生产的需要，简明实用、便于操作、易于国际对比，遵循油气矿产地质工作规律，继承与发展相结合、易于新老衔接。

一、 油气分类标准修订背景

修订思路：

1. 按照“有没有”“有多少”“可采多少”的逻辑，将油气矿产 勘 探开发阶段简化为三个阶段

2. 油气矿产分为资源量和地质储量两类。其中，资源量不再分级，地质储量按地质可靠程度由低到高分为三级（预测地质储量、控制地质储量和探明地质储量），即”1+3”分类模式。

3. 企业可根据技术能力确定技术可采储量，根据经营决策确定经济可采储量。

一、 油气分类标准修订背景

对100多家单位发出征求意见函，覆盖政府及资源管理部门、石油企业及产学研领域。

- ✓财政部等12个国家部委，
- ✓自然资源部有关司局及相关单位，
- ✓31个省自然资源管理部门，
- ✓中国科学院、中国石油大学（北京）等研究机构，
- ✓中石油总部、研究院及分公司，
- ✓中石化总部、研究院及分公司，
- ✓中海油总部、研究院及分公司，
- ✓中联煤层气公司，
- ✓延长石油集团，上海石油天然气有限公司
- ✓石油学会等社会团体组织

一、 油气分类标准修订背景

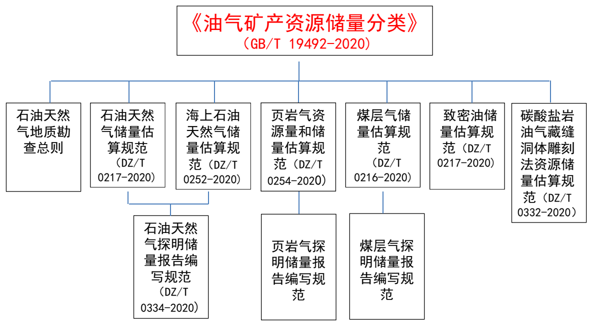
自然资源部矿产资源保护监督司、部油气资源战略研究中心、部油气储量评审办公室、中石油、中石化、中海油、中联煤、延长石油等8家单位，按照修订原则，共同修订完成了《油气矿产资源储量分类》（GB/T 19492-2020）。

该分类由中华人民共和国自然资源部提出，国家市场监督管理总局和国家标准化管理委员会发布。

标准于2020-3-31日发布，2020-5-1日实施。

一、 油气分类标准修订背景

油气矿产资源储量分类，是油气储量技术标准体系的龙头。



报 告 提 纲

- 一 油气储量分类标准修订背景
- 二 技术内容主要变化
- 三 油气储量分类标准解读

二、 技术内容主要变化

五个大的方面变化：

1. 统一油气和非油气分类标准名称
2. 简化勘探开发阶段划分
3. 简化资源量储量分类
4. 简化经济意义划分
5. 增加使用与发布相关要求

二、 技术内容主要变化

1. 统一油气和非油气分类标准名称

原名称：《石油天然气资源/储量分类》（GB/T 19492-2004）

现名称：《油气矿产资源储量分类》（GB/T 19492-2020）

解读：本次统一了油气和非油气矿产资源储量分类的标准名称，与非油气命名原则一致。

二、 技术内容主要变化

2. 简化勘探开发阶段划分

- 将五个阶段调整为三个阶段。
- 遵循地质工作规律更加合理地划分勘探开发阶段。按照“有没有”“有多少”“可采多少”的逻辑，将油气矿产资源勘探开发阶段分为预探、评价和开发三个阶段。
- 预探阶段主要解决“有没有”的问题；评价阶段主要解决“有多少”的问题；开发阶段主要解决“可采多少”的问题。
- 这三个阶段的成果与提交什么级别的储量脱钩，将会加快油气的发现和储量的提交。

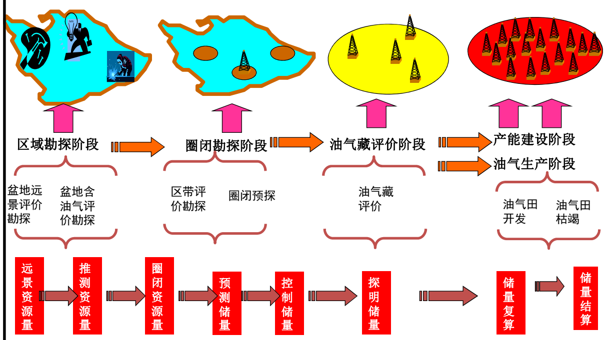
二、 技术内容主要变化

新旧标准勘探开发阶段划分对比表

2004年标准	2020年标准	落实矿产资源
区域普查阶段	预探阶段	有没有
圈闭预探阶段		
油气藏评价阶段	评价阶段	有多少
产能建设阶段	开发阶段	可采多少
油气生产阶段		

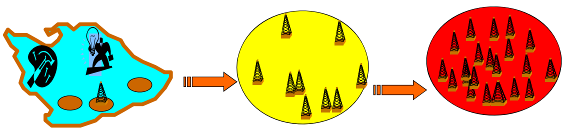
二、 技术内容主要变化

2004年标准　勘探开发阶段划分为5个



二、 技术内容主要变化

2020年标准　勘探开发阶段划分为3个



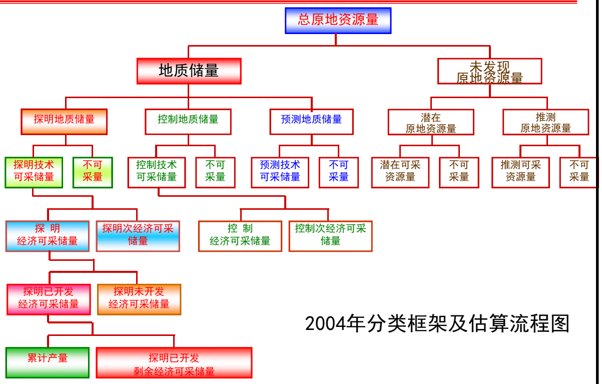
预探阶段　　评价阶段　　开发阶段

二、 技术内容主要变化

3. 简化矿产资源储量类型

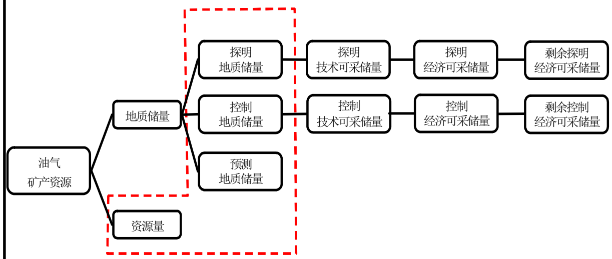
- 本着最大化降低社会认知和信息交易成本、简明适用要求，按照“1+3”的原则分为“1个资源量和3个地质储量（预测地质储量、控制地质储量、探明地质储量）”。
- 其中，资源量不再分级。预测地质储量不再划分出技术可采储量和经济可采储量。

二、 技术内容主要变化



2004年分类框架及估算流程图

二、 技术内容主要变化



油气矿产资源量和地质储量类型及估算流程图
（2020年）

二、 技术内容主要变化

4. 简化经济意义划分

- 2004年标准将经济意义划分为经济的、次经济的和内蕴经济的，在生产实际中主要考虑可商业可采、具有经济意义的储量，并计算出经济可采储量，次经济和内蕴经济不常用，本次修订后只保留经济意义的。
- 将经济可采储量的估算条件和具体内容从分类标准中删除，分别放在地质行业标准《石油天然气储量估算规范》、《海上石油天然气储量估算规范》、《煤层气储量估算规范》、《页岩气资源储量估算与评价规范》中。

二、 技术内容主要变化

5. 增加使用与发布相关内容

- 发布油气矿产资源量和地质储量数据时，应严格使用新标准规定的术语，不应使用远景资源量、潜在资源量、储量、规模储量、三级储量等非本标准规定的术语。
- 在使用与发布地质储量数据时，探明地质储量、控制地质储量和预测地质储量应单独列出，不得相加。
- 新增、复（核）算、标定、结算等储量报告的具体要求，在储量估算规范和报告编写规范等配套的地质行业标准中列出。

报 告 提 纲

一 油气储量分类标准修订背景

二 技术内容主要变化

三 油气储量分类标准解读

三、 油气分类标准解读

《油气矿产资源储量分类》GB/T 19492-2020

目 录

前 言

本标准代替GB/T 19492-2004《石油天然气资源/储量分类》，与GB/T 19492-2004相比，主要技术内容变化如下：

——修改了勘探开发阶段，将五个阶段（区域普查、圈闭预探、油气藏评价、产能建设和油气生产）调整为三个阶段（预探、评价和开发）（见第3章，2004版的第3章）；

——修改了资源量和储量分类和估算流程(见第4章，2004版的第5章)。

本标准由中华人民共和国自然资源部提出。

本标准由全国自然资源与国土规划标准化技术委员会（SAC/TC 93）归口。

本标准起草单位：自然资源部矿产资源保护监督司、自然资源部油气资源战略研究中心、自然资源部油气储量评审办公室、中国石油天然气集团有限公司、中国石油化工集团有限公司、中国海洋石油集团有限公司、中联煤层气有限责任公司、陕西延长石油（集团）有限责任公司。

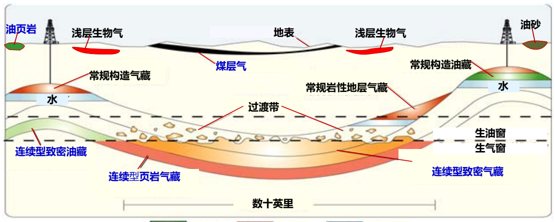
本标准主要起草人：韩征、鞠建华、何海清、蔡勋育、李茂、吴国干、王峰、李敬功、张道勇、陈红、毕海滨、郭本广、王香增。

本标准所代替标准的历次版本发布情况为：——GB/T 19492-2004。

1 范围

本标准规定了石油、天然气、页岩气和煤层气（以下统称油气）矿产资源储量的分类和发布。

本标准适用于油气矿产资源的统计和发布、油气矿产管理和规划、政策制定，资源量和储量估算、评价及相关技术标准制定。



2 术语和定义

2.1 油气矿产资源

在地壳中由地质作用形成的、可利用的油气自然聚集物。以数量、质量、空间分布来表征，其数量以换算到20℃、0.101MPa的地面条件表达，可进一步分为资源量和地质储量两类。

2.2 资源量

待发现的未经钻井验证的，通过油气综合地质条件、地质规律研究和地质调查，推算的油气数量。

2 术语和定义

2.3 地质储量

在钻井发现油气后，根据地震、钻井、录井、测井和测试等资料估算的油气数量，包括预测地质储量、控制地质储量和探明地质储量，这三级地质储量按勘探开发程度和地质认识程度依次由低到高。

2 术语和定义

2.3.1 预测地质储量

钻井获得油气流或综合解释有油气层存在，对有进一步勘探价值的油气藏所估算的油气数量，其确定性低。

2.3.2 控制地质储量

钻井获得工业油气流，经进一步钻探初步评价，对可供开采的油气藏所估算的油气数量，其确定性中等。

2.3.3 探明地质储量

钻井获得工业油气流，并经钻探评价证实，对可供开采的油气藏所估算的油气数量，其确定性高。

2 术语和定义

油气三级地质储量的"钓鱼理论"

湖里有水，综合分析可能有鱼。

预测地质储量

有鱼咬钩了
能知道它看上去多大

控制地质储量

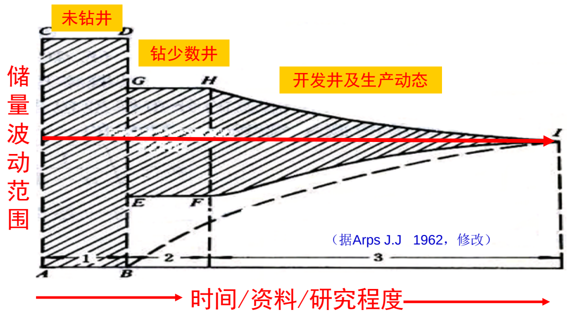
多条鱼已在篓并称重，
能闻到它，也可吃掉它

探明地质储量

地质可靠程度：低 中 高

2 术语和定义

● 储量估算结果随着工作量和认识程度的增加，逐渐接近地下客观实际



2 术语和定义

2.4 技术可采储量

在地质储量中按开采技术条件估算的最终可采出的油气数量。

2.4.1 控制技术可采储量

在控制地质储量中，依据预设开采技术条件估算的、最终可采出的油气数量。

2.4.2 探明技术可采储量

在探明地质储量中，按当前已实施或计划实施的开采技术条件估算的、最终可采出的油气数量。

2 术语和定义

2.5 经济可采储量

在技术可采储量中按经济条件估算的可商业采出的油气数量。

2.5.1 控制经济可采储量

在控制技术可采储量中，按合理预测的经济条件（如价格、配产、成本等）估算求得的、可商业采出的油气数量。

2.5.2 剩余控制经济可采储量

控制经济可采储量减去油气累计产量。

2 术语和定义

2.5.3 探明经济可采储量

在探明技术可采储量中，按合理预测的经济条件（如价格、配产、成本等）估算求得的、可商业采出的油气数量。

2.5.4 剩余探明经济可采储量

探明经济可采储量减去油气累计产量。

3 勘探开发阶段划分

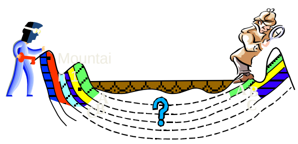
3.1 阶段划分依据

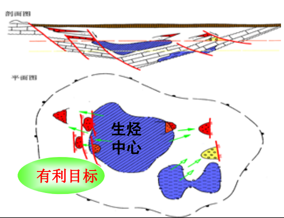
勘探开发阶段根据工作程度由低到高分为三个阶段：预探阶段、评价阶段和开发阶段。

3 勘探开发阶段划分

3.2 预探阶段

通过地震等物化探以及预探井钻探，圈定出有利含油气区带和优选有利圈闭（甜点区），基本查明构造、储层、盖层、油气藏特征等情况，发现油气藏。

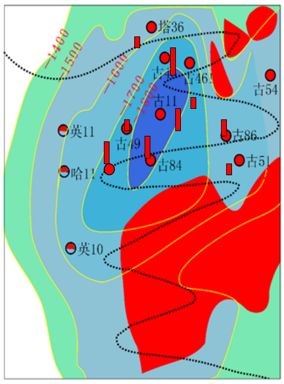




3 勘探开发阶段划分

3.3 评价阶段

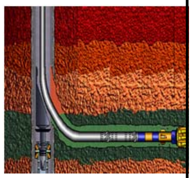
在预探阶段发现油气藏后，进行地震勘探和评价井钻探，查明构造形态、储层分布、储层物性变化等地质特征，以及油气藏特征、储集类型、驱动类型、流体性质及分布和产能特征，明确开采技术条件和开发经济价值，完成开发概念设计。

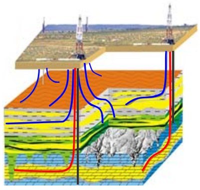


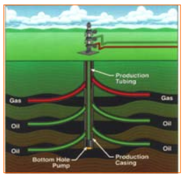
3 勘探开发阶段划分

3.4 开发阶段

编制开发方案，按开发方案实施开发井网钻探，完成配套设施的产能建设，进行油气开采生产活动，并在生产过程中对开发井网进行调整、改造和完善，提高采收率和经济效益，直至油气田废弃。

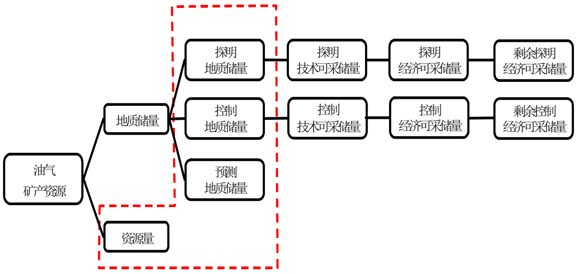






4 资源量和地质储量类型划分

4.1 依据油气藏的地质可靠程度和开采技术经济条件，对油气矿产的资源量和储量进行分类。



油气矿产资源量和地质储量类型及估算流程图

4 资源量和地质储量类型划分

4.2 资源量不再分级。

4.3 地质储量分为三级：预测地质储量、控制地质储量和探明地质储量。

4.4 估算预测地质储量，应初步查明构造形态、储层情况，已获得油气流或钻遇油气层，或紧邻在探明地质储量或控制地质储量区、并预测有油气层存在，经综合分析有进一步勘探的价值，地质可靠程度低。

4 资源量和地质储量类型划分

4.5 估算控制地质储量，应基本查明构造形态、储层变化、油气层分布、油气藏类型、流体性质及产能等，或紧邻在探明地质储量区，地质可靠程度中等，可作为油气藏评价和开发概念设计（开发方案）编制的依据。

4.6 估算探明地质储量，应查明构造形态、油气层分布、储集空间类型、油气藏类型、驱动类型、流体性质及产能等；流体界面或最低油气层底界经钻井、测井、测试或压力资料证实；应有合理的钻井控制程度或一次开发井网部署方案，地质可靠程度高。

4 资源量和地质储量类型划分

4.7 估算技术可采储量时，在控制地质储量中根据开采技术条件估算控制技术可采储量，在探明地质储量中根据开采技术条件估算探明技术可采储量。

4.8 估算经济可采储量时，在控制技术可采储量中根据经济可行性评价估算控制经济可采储量，在探明技术可采储量中根据经济可行性评价估算探明经济可采储量。

5 开发状态

5.1 状态划分依据

依据是否投入开发，将油气藏或区块界定为未开发和已开发两种状态。

5.2 未开发

在油气藏或区块中，完成评价钻探，但开发生产井网尚未部署，或开发方案中开发井网实施70%以下的，状态界定为未开发。

5.3 已开发

在油气藏或区块中，按照开发方案，完成配套设施建设，开发井网已实施70%及以上的，状态界定为已开发。

6 使用与发布

6.1 发布油气矿产资源量和地质储量数据时，应严格使用本标准规定的术语。

6.2 在使用与发布地质储量数据时，探明地质储量、控制地质储量和预测地质储量应单独列出，不得相加。

6 使用与发布

6.3 探明地质储量、探明技术可采储量和探明经济可采储量由自然资源主管部门统计和管理，国家发布探明地质储量和探明技术可采储量。

6.4 控制地质储量、控制技术可采储量、控制经济可采储量和预测地质储量，由矿业权人按照国家标准规范和相关规定自主管理。

6 使用与发布

6.5 油气田从发现直至废弃的勘探开发过程中，矿业权人应根据地质资料、工程技术以及技术经济条件的变化，及时进行储量估算，并编制相应的新增、复（核）算、标定和结算储量报告。

结束语

中国油气储量分类新标准的颁布实施，有利于推进矿产资源管理改革，维护矿产资源国家所有者权益、保护和合理利用矿产资源，科学合理掌控资源家底，为国家矿产资源宏观决策提供依据；有利于促进油气勘探开发高质量发展；有助于我国油气资源领域技术标准与国际标准的互联互通。

An Introduction to API Safety Standards

For industry, by industry

Roland Goodman
Manager, Upstream Standards
American Petroleum Institute
goodmanr@api.org

API

About API

- API is an industry trade association representing all segments of the oil and natural gas industry
- Over 600 member companies involved in all aspects of the oil and natural gas industry
- Over 700 committees and task forces covering various advocacy and technical issues
- Staff of ~275 located in Washington, DC and in 34 states
- International offices in Brazil, China, and the UAE

API

API Members

600+ companies involved in all aspects of the global natural gas and oil industry

Integrated

Upstream | Midstream | Downstream | Service & Supply

Shale Resources – Lower 48 U.S. States

API

U.S. Shale Gas Resources

- Prior to 2005, shale gas constituted 4% of U.S. gas production
- In 2018, tight oil (shale) development accounted for 50% of U.S. crude oil production and 68% of U.S. natural gas production
- The U.S. has been a net energy importer since 1953 (67 years)
- Shale production is projected to increase from 30% of total U.S. gas production in 2010 to 49% by 2035??
- Current U.S. domestic production has moved the U.S. toward being a net energy exporter

API

API's Global Industry Services Division

Mission: Provide world-class services that enable the oil and natural gas industry to operate efficiently, safely, reliably, profitably, and sustainably

- 100+ Employees
- 145 Auditors
- 200 Training Programs
- 700+ Publications
- 200+ Events
- 56,000 Personnel Certifications in 128 Countries
- 5,000 Company Certifications in 80+ Countries
- 50,000+ Licensed Products

API American Petroleum Institute

API Standards Program Mission

Provide a forum for the development of consensus-based industry standards, and technical cooperation to improve the industry's safety performance and competitiveness

API Standards

- API standards are voluntary unless
  - Required by national or local regulations
  - Required by a contractual agreement
  - Required by company policies/procedures
- API is accredited by the American National Standards Institute (ANSI)
  - Transparent process
  - Openness, balance, consensus, due process
  - Program audited by ANSI every five years
- Foundation of API quality and certification programs

API Standards

Setting Standards Since 1924 to promote safety, environmental protection, reliability, and sustainability through proven engineering practices.

API's standards:

- Cover all industry segments
  - **Upstream** (Exploration & Production)
  - **Downstream** (Refining & Marketing)
  - **Midstream** (Pipeline, Rail & Truck transportation, and Petroleum Measurement)
- American National Standards Institute (ANSI) accredited standards developing organization
- API now publishes **+700** standards
- Over **650** citations in U.S. Code of Federal Regulations

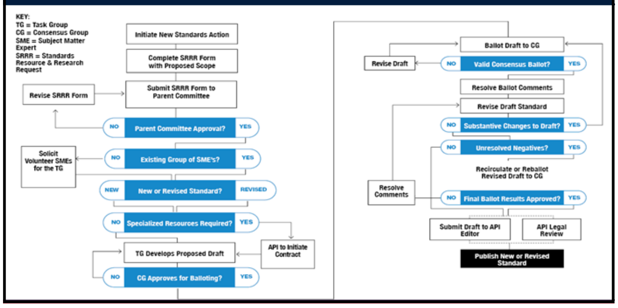
Value of API Standards

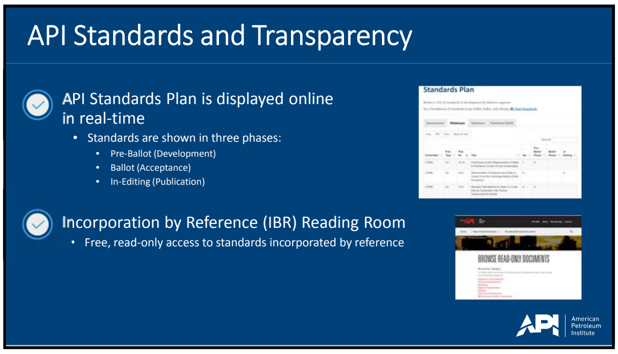
- Improves operational safety and equipment reliability
- Improves equipment interchangeability
- Reduces regulatory compliance costs
- Reduces procurement costs
- Provides opportunities to share proven practices

API Standards Development Process

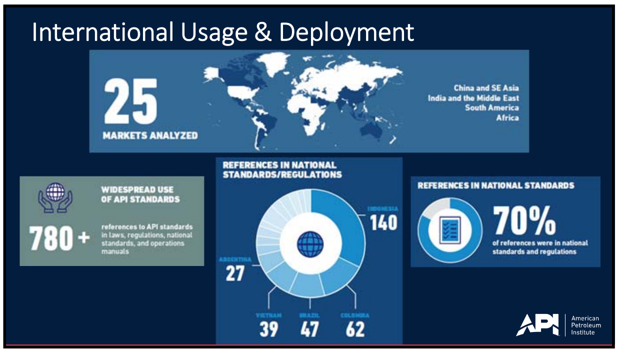
- Transparent, impartial, and **consensus-based** process
- Driven by research, data, and **science-based** decisions
- Committees comprise of **thousands of volunteers** from industry, academia, government, and NGO's
- **Collaborate** with other standards bodies to avoid duplication; connect globally
- Incorporate **proven engineering practices**, updated periodically

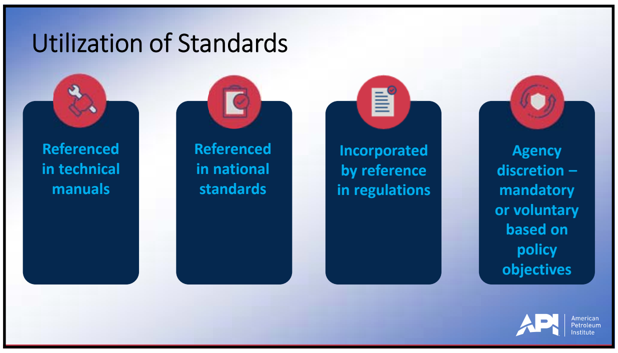
API Standards Development Process

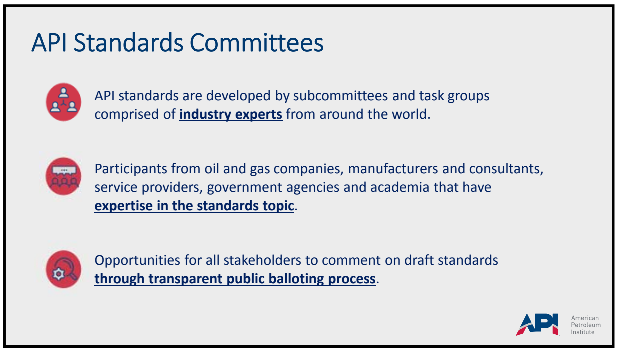


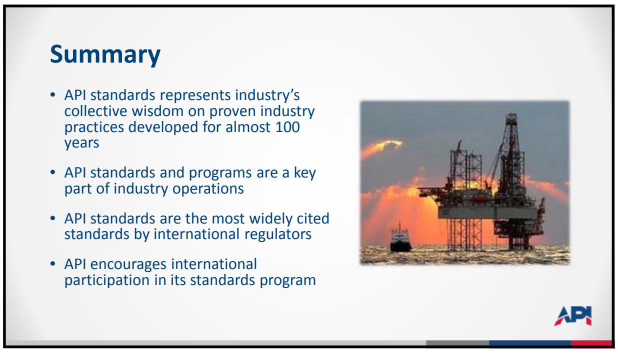

API Standards and Transparency
API Standards Plan is displayed online in real-time
Standards are shown in three phases:
Pre-Ballot (Development)
Ballot (Acceptance)
In-Editing (Publication)
Standards Plan
Incorporation by Reference (IBR) Reading Room
Free, read-only access to standards incorporated by reference
BROWSE READ-ONLY DOCUMENTS
API American Petroleum Institute


700+ Standards
API standards are incorporated by reference into US federal and state oil and gas regulations and they are the most widely-cited petroleum industry standards by international regulators.
3,800 Citations
in state regulations
650 Citations
by U.S. federal government organizations: U.S. Coast Guard, U.S. EPA, FTC, BSEE, OSHA, and PHMSA
780+ International References
by Brazil, China, Saudi Arabia, Singapore, Indonesia, Vietnam, and others.
API American Petroleum Institute


International Usage & Deployment
25
MARKETS ANALYZED
China and SE Asia
India and the Middle East
South America
Africa
WIDESPREAD USE OF API STANDARDS
780+
references to API standards in laws, regulations, national standards, and operations manuals
REFERENCES IN NATIONAL STANDARDS/REGULATIONS
INDONESIA 140
ARGENTINA 27
VIETNAM 39
BRAZIL 47
COLOMBIA 62
REFERENCES IN NATIONAL STANDARDS
70%
of references were in national standards and regulations
API American Petroleum Institute


Utilization of Standards
Referenced in technical manuals
Referenced in national standards
Incorporated by reference in regulations
Agency discretion – mandatory or voluntary based on policy objectives
API American Petroleum Institute


API Standards Committees
API standards are developed by subcommittees and task groups comprised of industry experts from around the world.
Participants from oil and gas companies, manufacturers and consultants, service providers, government agencies and academia that have expertise in the standards topic.
Opportunities for all stakeholders to comment on draft standards through transparent public balloting process.
API American Petroleum Institute


Summary
API standards represents industry's collective wisdom on proven industry practices developed for almost 100 years
API standards and programs are a key part of industry operations
API standards are the most widely cited standards by international regulators
API encourages international participation in its standards program
API

Important Safety Standards by Segment

Upstream

- RP 75, Safety & Environmental Management Systems for Offshore Operations & Assets
- Std 53,Well Control Equipment Systems for Drilling Wells
- RP 54, Occupational Safety and Health for Oil and Gas Well Drilling and

Midstream

- RP 1173, Pipeline Safety Management Systems
- RP 1174, Onshore Hazardous Liquid Pipeline Emergency Preparedness and Response
- Std 1160, Managing System Integrity for Hazardous Liquid Pipelines

Downstream

- RP 754, Process Safety Indicators
- Std 521, Pressure-Relieving and Depressuring Systems
- RP 2001, Fire Protection in Refineries
- API 510, Pressure Vessel Inspection Code

Over 7,000 Volunteers, Over 2,000 Organizations

Upstream:

- Committee on the Standardization of Oilfield Equipment **(CSOEM)**
- Drilling & Production Operations

Midstream:

- Committee on Pipeline Standards

Downstream:

- Committee on Refining Equipment
- Process Safety Group
- Safety and Fire Protection Group

API

Additional API Upstream Safety Standards

- Spec 14A – Subsurface Safety Valve Equipment
- RP 14B – Design, Installation, Operation, Test, and Redress of Subsurface Safety Valve Systems
- RP 14C – Analysis, Design, Installation, and Testing of Safety Systems for Offshore Production Facilities
- RP 14G – Fire Prevention and Control on Fixed Open-Type Offshore Production Platforms
- RP 14J – Design and Hazards Analysis for Offshore Production Facilities
- Spec 16A – Drill-through Equipment
- Std 16AR – Repair and Remanufacture of Drill-Through Equipment
- Spec 16C – Choke and Kill Equipment

API

Additional API Upstream Safety Standards

- Spec 16D – Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment
- RP 49 – Drilling and Well Servicing Operations Involving Hydrogen Sulfide
- RP 55 – Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide
- RP 59 – Well Control Operations
- RP 64 – Diverter Equipment Systems
- RP 67 – Oilfield Explosives Safety
- RP 74 – Occupational Safety for Onshore Oil and Gas Production Operation
- Bull 75L – Development of a Safety and Environmental Management System for Onshore Oil and Natural Gas Production Operation and Associated Activities

API

Additional API Upstream Safety Standards

- RP 76 – Contractor Safety Management for Oil and Gas Drilling and Production Operations
- RP 77, Risk-Based Approach for Managing Hydrocarbon Vapor Exposure During Tank Gauging, Sampling,
- and Maintenance of Onshore Production Facilities
- RP 90 – Annular Casing Pressure Management for Offshore Wells
- RP 90-2 – Annular Casing Pressure Management for Onshore Wells
- RP 96 – Deepwater Well Design and Construction
- Bull 97 – Well Construction Interface Document Guidelines
- RP 98 – Personal Protective Equipment Selection for Oil Spill Responders
- RP 99, Flash Fire Risk Assessment for the Upstream Oil and Gas Industry

API

Additional API Midstream Safety Standards

- RP 1110, Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide
- RP 1133, Managing Hydrotechnical Hazards for Pipelines Located Onshore or Within Coastal Areas
- RP 1161, Pipeline Operator Qualification
- RP 1168, Pipeline Control Room Management
- RP 1169, Basic Inspection Requirements—New Pipeline Construction
- RP 1171, Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs

API

Additional API Midstream Safety Standards

- RP 1176, Assessment and Management of Cracking in Pipelines
- RP 1178, Integrity Data Management and Integration
- RP 1179, Hydrostatic Testing as an Integrity Management Tool
- RP 1181, Pipeline Operational Status Determination
- RP 1182, Construction, Operation, and Maintenance of Large Diameter Rural Gas Gathering Lines
- RP 1183, Assessment and Management of Dents in Pipelines

API

Additional API Downstream Safety Standards

- Std 520, Part I, Sizing, Selection, and Installation of Pressure-Relieving Devices—Part I—Sizing and Selection
- Std 520, Part II, Sizing, Selection, and Installation of Pressure-Relieving Devices—Part II—Installation
- API 570, Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems
- RP 571, Damage Mechanisms Affecting Fixed Equipment in the Refining Industry
- RP 572, Inspection Practices for Pressure Vessels
- RP 573, Inspection of Fired Boilers and Heaters
- RP 574, Inspection Practices for Piping System Components
- RP 575, Inspection Practices for Atmospheric and Low-Pressure Storage Tanks

Additional API Downstream Safety Standards

- RP 576, Inspection of Pressure-Relieving Devices
- RP 578, Guidelines for a Material Verification Program (MVP) for New and Existing Assets
- API 579-1/ASME FFS-1, Fitness-for-Service
- RP 580, Risk-based Inspection
- RP 583, Corrosion Under Insulation and Fireproofing
- RP 584, Integrity Operating Windows
- RP 585, Pressure Equipment Integrity Incident Investigation
- RP 598, Valve Inspection and Testing

Additional API Downstream Safety Standards

- Std 653, Tank Inspection, Repair, Alteration, and Reconstruction
- RP 751, Safe Operation of Hydrofluoric Acid Alkylation Units
- RP 752, Management of Hazards Associated with Location of Process Plant Permanent Buildings
- RP 753, Management of Hazards Associated with Location of Process Plant Portable Buildings
- RP 755, Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries
- RP 941, Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants

Information Links

- API Standards: International Usage and Deployment
  https://www.api.org/products-and-services/standards
- API Standards Plan – List of API standards under revision or development
  https://www.api.org/products-and-services/standards/standards-plan
- Standards Announcements – List of recent significant standards publication
  https://www.api.org/products-and-services/standards/important-standards-announcements
- Catalog of Publications – List of published API standards and other publications
  https://www.api.org/products-and-services/standards/purchase
- Standards Balloting system – API standards open for public comment
  https://ballots-prod.api.org/home/OpenBallots

American Petroleum Institute

Reserves Guidelines: 5W2H
Who, What, When, Why, Where, How, How Much?

Doug Peacock
Technical Director
Gaffney Cline

Gaffney Cline

Disclaimer

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The author is acting in an advisory capacity only and, to the fullest extent permitted by law, disclaims all liability for actions or losses derived from any actual or purported reliance on this webcast (or any other statements or opinions of the author) by any other person or entity.

Gaffney Cline

Presentation Outline

- Why do we need reserves definitions and guidelines? — Why?
- What Guidelines exist? — What?
- When did they originate? — When?
- Where do they come from?
- Where are they applicable? — Where?
- Who prepares the guidelines and definitions? — Who?
- Who uses them
- How did they originate? — How?
- How do we apply them?
- How Much Reserves? — How Much?

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Why Estimate Reserves and Resources?
The Need

Why do we need reserves & resources?

- To create a platform for internal business decisions
- To meet public reporting requirements
- To comply with government regulations
- In connection with mergers and acquisitions
- To raise project finance
- To raise public funds

Comment

- These are very different objectives!
- but we use a common set of guidelines for all

Gaffney Cline

Common Language?

Why do we need reserves guidelines?

Reserves guidelines such as PRMS provide a common language to estimate and report reserves and resources volumes

Allows better communication and understanding across:
- Companies
- Countries
- Disciplines
- Stakeholders

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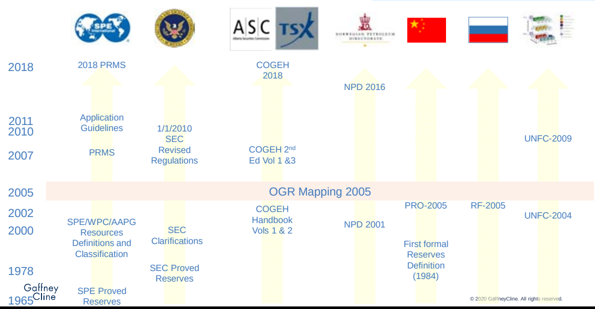
Reserves Classification History

What guidelines are used?



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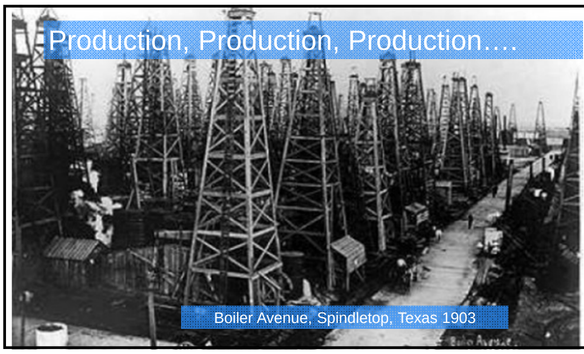
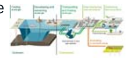


Historical Development of Reserves Classification

Why did they originate?

- In the early days of the oil industry, properties were assessed more by production than reserves; early practice was to produce as quickly as possible
- As regulations to prevent "rule of capture" and other conservation measures were activated to prevent inefficient recovery, oil companies became more integrated, planning supply for refining operations etc. became important such that quantifying in-place volumes, production rates, future profiles, economics etc. became important
- First estimations of "Reserves" provided in 1925 by the American Petroleum Institute (API). In 1936, the API will introduce terms such as "Proved" or "Reasonable Certainty"
- Mining industry was going through a similar process



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Reserves/Resources Classification History

How did they develop?

- API and AGA and Former Soviet Union systems – 1930s and 1940s
- SPE definition of proved reserves – 1965
- SEC Proved Reserves definitions – 1978
- SPE definitions for probable and possible reserves – 1987
- SPE/WPC reserves definitions – 1997
- SPE/WPC/AAPG resources definitions and classification system – 2000
- SEC Website "clarifications" 2000 and 2001
- Canadian Oil and Gas Association Handbook (COGEH) Volumes 1 and 2 - 2…
- SPE/WPC/AAPG/SPEE Petroleum Resources Management System – 2007
- COGEH Second Edition Volume I and Volume 3 - 2007
- SEC revised regulations – 2009 (1/1/2010 effective date)
- SPE/WPC/AAPG/SPEE/SEG guidelines for the application of the PRMS – 2011
- SEC responses to "FAQs" – 2009 and 2013
- SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE *PRMS update 2018*

Proved Reserves Only (2 pages)
Probable & Possible added
Probabilistic Methods recognised
Contingent Resources & Prospective Resources added
PRMS First Released
PRMS 2018 Released

1940's
2007
2018

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 9

PRMS Adoption by Key Stakeholders

Some examples of where PRMS is implicitly or explicitly referenced:

Who uses them?

Securities Regulators
USA (SEC)
Canada (CSA)
Hong Kong (HKEX)
Australia (ASX)
UK (LSE-AIM)
Singapore (SGX)
Argentina
Netherlands
Brazil
Italy
France
South Africa
(ESMA)

Oil & Gas Companies

PRMS

Financial
International Accounting Standards Board (IASB)

Government Reporting
OPEC
NPD - Norway
BOEM - USA Offshore
ANP - Brazil
CNH – Mexico
ANH - Colombia
& several others
UNFC – United Nations

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PRMS 2018 Sponsors

Who prepares the PRMS?

Maintained by **SPE Oil and Gas Reserves Committee (OGRC)**; co-sponsored by:

OGRC is responsible for definitions, standards, guidelines and related documents

OGRC is a global, multi-disciplinary, multi-company committee of ~14 people

Society of Petroleum Engineers (**SPE**)
World Petroleum Council (**WPC**)
American Association of Petroleum Geologists (**AAPG**)
Society of Petroleum Evaluation Engineers (**SPEE**)
Society of Exploration Geophysicists (**SEG**)
Society of Petrophysicists and Well Log Analysts (**SPWLA**)
European Association of Geoscientists and Engineers (**EAGE**)

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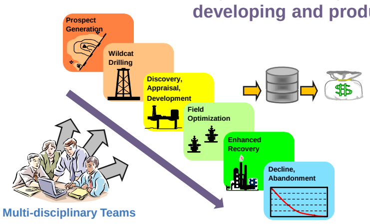
PRMS is designed to support asset management

"Cradle to Grave"

Aligns with the hydrocarbon finding, developing and producing business!

When is PRMS used in project life?



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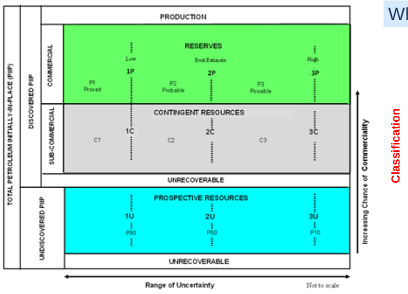
Resources Classification

What is PRMS?



Classification

Categorization

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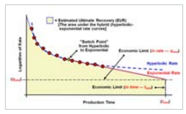
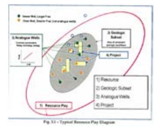
Insights on Unconventional Gas…..1

- Common issues related to unconventional gas reserves evaluation:
  - Estimating ultimate recovery in existing producing wells is difficult
    - Identifying flow regimes can be hard
    - Flow may be transient for many years
    - "b" factor often >1 at start but will decline with time
    - Can use a minimum decline Dmin
  - Estimating recovery in to be drilled wells
    - Are the undrilled locations truly analogous to the developed?
    - Historical wells in best locations? (sweet spots)
    - Need large number of analogous wells to perform a reliable estimate





Useful References:
SPEE Monograph 4:Estimating Ultimate Recovery of Developed Wells in Unconventional (Low-Permeability) Reservoirs
SPEE Monograph 3: Guidelines for the Practical Evaluation of Undeveloped Reserves in Resource Plays

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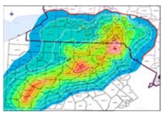
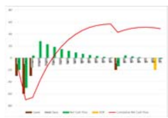
Insights on Unconventional Gas…..2

- Common issues related to unconventional gas reserves evaluation:
  - Project Definition
    - One "mega-project" or many small projects
    - What have you committed to actually drilling?
    - How far ahead? 5 Years?
    - Sweet spots vs "factory drilling"
    - As project develops, wells will develop poorer reservoir
  - Economic Issues
    - Is Project economic? (depending on how project is defined)
    - Level at which to perform economic assessment? (mega-project or each small project)
    - If best areas (sweet spots) are drilled first, economics of new wells/project will be worse
    - Oil/Gas Prices will impact commitment to drilling and economics





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Summary

- Reserves definitions and guidelines allow a common language for oil & gas companies, governments, investors, financial institutions etc.
- Reserves definitions and guidelines have evolved over time to meet needs of industry as it has changed
- PRMS is the most widely used system internationally, although other systems exist in some countries
- PRMS continues to evolve and has many training courses, workshops, presentations etc. to help understanding

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Reserves Guidelines: 5W2H
Who, What, When, Why, Where How, How Much?

Doug Peacock
Technical Director

Gaffney Cline

Gaffney Cline

RIPED 中国石油勘探开发研究院

坚持特色 面向未来

——油气储量标准国际化探讨

毕海滨

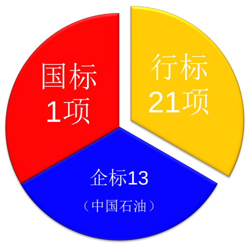
2020.11 · 北京

目录

- 中国油气储量标准现状
- 油气储量分类的理念与方法
- 几点认识

中国油气储量标准现状

➢国家标准：是油气储量管理的纲领性文件



➢行业标准：是对国家标准的进一步细化

➢企业标准：在符合国标/行标的前提下，满足企业自身需求

中国油气储量标准现状

➢ 国家标准

➢ 行业标准21项划分为6大类，侧重于不同的地质特点和流体类型

➢ 形成了相对完整的储量标准系列，规范了国家和公司层面储量评价与管理工作

			标准名称	标准代号
国家标准		1	油气矿产资源储量分类	GB/T19492-2020
行业标准	地质储量	1	石油天然气储量估算规范	DZ/T 0217-2020
		2	海上石油天然气储量估算规范	DZ/T 0252-2020
		3	石油尾矿评价方法	SY/T 7432-2018
	可采储量	1	石油可采储量计算方法	SY/T 5367-2010
		2	天然气可采储量计算方法（双语）	SY/T 6098-2010
		3	陆上油气探明经济可采储量评价细则	SY/T 5838-2011
	流体类型	1	致密油储量估算规范	DZ/T 0335-2020
		2	页岩油储量计算规范	SY/T 7463-2019
		3	油砂矿地质勘查与油砂油储量计算规范	SY/T 6998-2014
		4	页岩气资源/储量估算与评价技术规范	DZ/T 0254-2020
		5	煤层气储量估算规范	DZ/T 0216-2020
	油藏类型	1	断块油气藏储量计算细则	SY/T 6099-2012
		2	岩性油（气）藏探明储量计算细则	SY/T 5782-2010
		3	裂缝性油（气）藏探明储量计算细则	SY/T 5386-2010
		4	碳酸盐岩油气藏缝洞体雕刻法资源储量估算规范	DZ/T 0332-2020
	报告编写	1	石油天然气探明储量报告编写规范	DZ/T 0334-2020
		2	页岩气探明储量报告编写规范	DZ/T 0333-2020
		3	煤层气探明储量报告编写规范	DZ/T 0343-2020
	数据管理	1	油气层层位代码	SY/T 5806-2012
		2	油气储量成果数据属性规范	SY/T 5706-2012
		3	油气储量数据项名称规范	SY/T 6025-2012

中国油气储量标准现状

➢ （中石油）公司企业标准/管理规定：结合自身需求进一步细化，国内标准9项，适应SEC储量评估的标准4部

企业储量标准及管理规定

		标准名称	标准代号
国内储量	1	石油天然气储量管理办法	油勘[2018]312号
	2	中国石油勘探与生产分公司储量管理委员会章程	油勘[2020]170号
	3	中国石油油气储量评估和审计人员职业资格管理办法	人事[2013]323号
	4	致密油储量计算规范	Q/SY 1834-2015
	5	页岩油储量计算暂行规定	油勘[2019]263号
	6	页岩气资源/储量计算方法	Q/SY 1848-2015
	7	石油天然气控制储量计算方法	Q/SY 179-2007
	8	石油天然气预测储量计算方法	Q/SY 181-2007
	9	石油天然气经济可采储量评价规范	Q/SY 01180-2020
SEC储量	10	SEC准则油气证实储量评估指南	Q/SY 01182-2020
	11	中国石油SEC准则油气证实储量评估指南（中英文版）	油勘[2014]328号
	12	SEC准则页岩气证实储量评估方法	油勘[2017]385号
	13	油田公司年度SEC证实储量自评估报告编写格式	年度更新

SEC：美国证券交易委员会（Securities and Exchange Commission）

目录

- 中国油气储量标准现状
- 油气储量分类的理念与方法
- 几点认识

油气储量分类的理念与方法

1、按组织管理机构，油气储量分类分为四个层面，目的不同

- 国家层面：注重资源合理利用与中长期规划

  如中国，俄罗斯，美国EIA、USGS，加拿大，挪威等
- 行业学会：注重储量可对比性，实现公平竞争

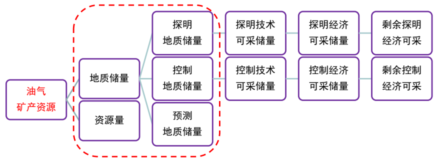
  如SPE/WPC/AAPG/SPEE/SEG—PRMS
- 公司层面：注重经营决策与经济效益

  如Exxon-Mobil，Chevron，Texaco，CNOOC等
- 资本市场：注重资本投资回报，对股民负责

  如SEC，LSE，港交所，上海证券交易所等

2、按分类理念，中西方两大体系，思维方式不同，侧重点各异

- 中国储量分类以地质储量是核心，以油气藏整体为对象

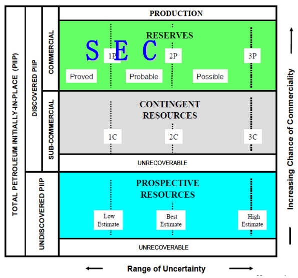


- **勘探开发阶段**
  - *开发阶段：编制开发方案，完成井网钻探，进行油气开采，提高采收率*
  - *评价阶段：完成开发概念设计*
  - *预探阶段：圈定有利含油气区带；发现油气藏*

- 按发现状况：资源量、地质储量
- 按勘探开发程度：探明、控制、预测地质储量
- 按技术经济条件：技术、经济可采，与地质储量级别保持一一对应，简洁、清晰、易于理解
- 油气矿产资源：不单指资源总量，还包括品质、空间分布等；各级储量发布也不能简单相加，目的是正确引导公众社会认知

2、按分类理念，中西方两大体系，思维方式不同，侧重点各异

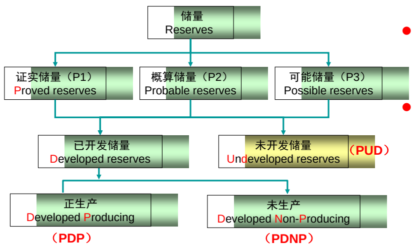
- PRMS（2007，SPE/WPC/AAPG/SPEE/SEG）分类，以可采储量为核心，以井控范围为对象



- 按发现状况：未发现/已发现原地量
- 原地量不分级：按高、中低概率直接对各级可采量进行分级，经济可采分证实、概算、可能；次经济和可采资源部分以此类推
- 对应关系：地质储量与可采量两者之间，存在复杂的对应关系

2、按分类理念，中西方两大体系，思维方式不同，侧重点各异

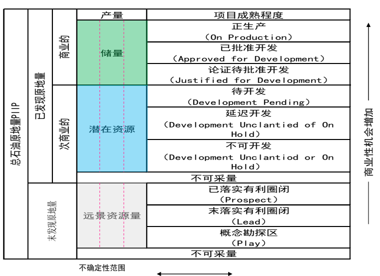
- SEC储量分类源于PRMS，只对经济可采部分进行分类



- 对经济可采储量的技术细节要求更严格，旨在进一步提高储量的可靠程度
- 宗旨是对股民负责，侧重于油气储量资产和价值属性

2、按分类理念，中西方两大体系，思维方式不同，侧重点各异

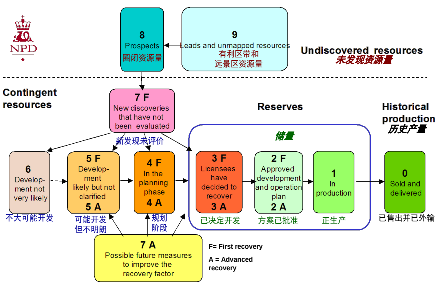
- PRMS（2007，SPE/WPC/AAPG/SPEE/SEG），以可采储量为核心，以井控范围为对象



- 与勘探开发阶段或者称项目成熟度，存在“一对一”和“一对多”的关系，对应关系相对复杂
- 项目成熟度分类源于或借鉴了挪威的储量分类体系

2、按分类理念，中西方两大体系，思维方式不同，侧重点各异

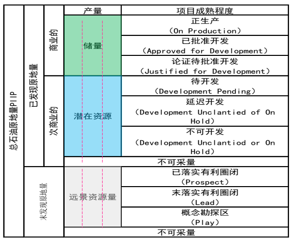
- 挪威国家石油管理局资源储量分类(NPD)，以可采储量为核心，以油气藏整体为对象



- 依据项目成熟度（或资源开发的可行性）以可采储量为主线，划分为2大类9个级别
- 海上油气田必须整体开发

3、按技术要求，中西方分类体系有同有异

□ 形式上一致

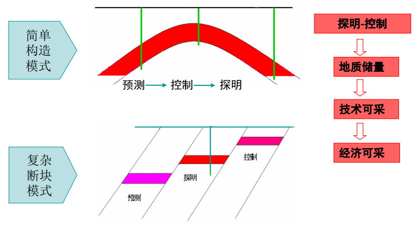


PRMS分类—可采储量经济性随项目成熟度而提高

中国分类—地质储量级别随勘探开发阶段发展而提高

3、按技术要求，中西方分类体系有同有异

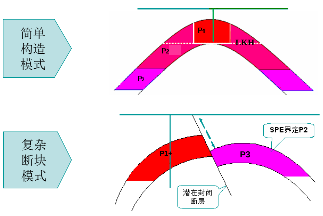
□ 技术要求有同有异——中国分类



- 以油气藏为对象，整体确定储量级别
- 一般情况下，同一油气藏仅有一个级别的储量
- 地质与可采一一对应
- 对应关系简洁明晰

3、按技术要求，中西方分类体系有同有异

□ 技术要求有同有异——PRMS



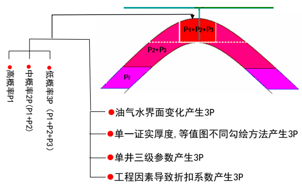
- 储量级别确定存在两种模式

增量模式 (incremental) P1，P2，P3	组合模式 (scenario) 1P，2P，3P

- 以井控为对象确定储量级别
- 增量模式下地质与可采一一对应
- 同一油气藏中存在多个级别储量

3、按技术要求，中西方分类体系有同有异

□ 技术要求有同有异——PRMS



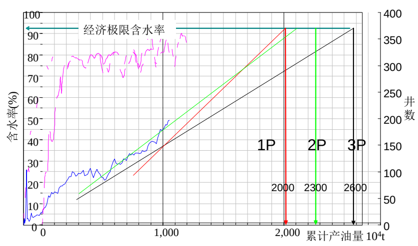
- 储量级别确定存在两种模式

增量模式 (incremental) P1，P2，P3	组合模式 (scenario) 1P，2P，3P

- 以井控为对象确定储量级别
- 地质与可采存在"一对多"的关系
- 同一地质体中存在多个级别可采储量

3、按技术要求，中西方分类体系有同有异

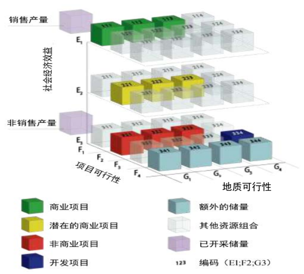
□ 技术要求有同有异——PRMS



PRMS分类体系下xxxx已开发油田可采储量计算结果示意图

油气储量分类的理念与方法

他山之石



联合国资源分类框架
(United Nations Framework Classification)

- 联合国资源分类框架（United Nations Framework Classification）采用三轴分类体系，由联合国欧洲经济委员会（United Nations Economic Commision for Europe）推动
- 主要用于固体矿产储量分类，也可以用于初级能源开发项目的对比
- 考虑地质可行性、项目可行性、社会经济效益三个方面
- 过于复杂和抽象，在我国固体矿产资源中应用情况不乐观，2020年回归两轴法分类

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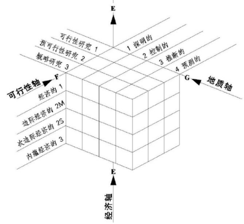
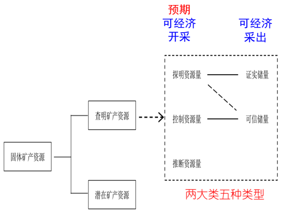
几点认识

1、新标准制定：适应市场化需求，大道至简，降低公众认知成本是最高目标



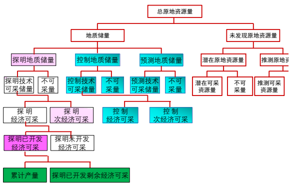
固体矿产资源/储量分类
GB/T 17766-1999



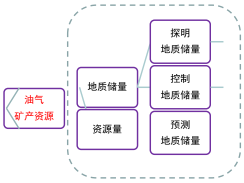
固体矿产资源储量分类
GB/T 17766-2020

几点认识

1、新标准制定：适应市场化需求，大道至简，降低公众认知成本是最高目标



石油天然气资源/储量分类
（GB/T19492-2004）



油气矿产资源储量分类
（GB/T19492-2020）

- 反对的是复杂化，而不是“复杂”本身；技术单位可根据自身需求细化标准，专业的人做专业的事

几点认识

2、老标准修订：坚持特色，适应新形势，逐步完善发展

《油气矿产资源储量分类》标准的五个发展阶段

借用前苏联分类（建国初期）		工作意见（1977）		石油/天然气储量规范 GBn 269/270-88		石油天然气资源/储量分类 GB/T19492-2004		油气矿产资源储量分类（2020）	
阶段	储量分级	阶段	储量分级	阶段	储量分级	阶段	储量分级	阶段	储量分级
开发	一级地质储量	开发	探明储量	开发	探明已开发	油气生产	探明已开发	开发	探明储量
整体解剖	二级地质储量	详探	基本探明储量	评价钻探/滚动勘探开发	探明未开发 基本探明	产能建设/油藏评价	探明未开发	评价	控制储量
普探	三级地质储量	预探初探	待探明储量	预探	控制储量 预测储量	圈闭预探 区域普查	控制储量 预测储量	预探	预测储量
西部地区油气储量逐步发现		□ 油气储量管理工作日益受到重视（石油化学工业部）		□ 80年代初期，原油产量突破亿吨大关 □ 海上油气田对外合作（石油工业部）		□ 三大石油公司在美国上市，经济可采储量理念引入（中国石油天然气集团公司）		□ 勘探开发市场化步伐加快，降低公众获取信息的社会成本需求 □ 固体矿产三轴分类过于抽象，不宜被社会/专业接受	

- 继承性明显，是2004年百亿吨原油储量和天然气储量套改成功的关键因素

几点认识

3、深入了解油气储量标准现状和发展趋势，知己知彼是走向国际化必要条件

2019年xxxx公司在《油砂油储量计算规范》方面富有经验，并期望打造成国际标准，由于对国际标准现状和发展趋势了解不充分，自己的特色又不明显，最终被ISO成员国驳回

几点认识

4、二维分类在油气行业应用广泛，适用性较好

UNFC的应用范围不断扩大?

CCPR-2004级别/类别		UNFC-2009“最低限度”级别			UNFC-2009类别
已发现	探明已开发经济可采储量、探明未开发经济可采储量	E1	F1	G1	商业项目
	探明次经济可采储量、控制经济可采储量、控制次经济可采储量、预测技术可采储量	E2	F2	G1，G1+G2，G1+G2+G3	潜在商业项目
	探明次经济可采储量、控制次经济可采储量、预测技术可采储量	E3	F2	G1，G1+G2，G1+G2+G3	非商业项目
	不可采量（探明、控制和预测）	E3	F4	G1，G1+G2，G1+G2+G3	剩余原地量
未发现	潜在可采资源量、推测可采资源量、	E3	F3	G4	勘探项目
	不可采量（潜在、推测）	E3	F4	G4	剩余原地量

中国油气矿产资源分类与UNFC对应关系表（2018）
（社会经济-E和项目可行性-F）


谢谢

Considerations When Estimating Reserves/Resources in Unconventional Plays

2020.11.19
Beijing, China

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Outline

- Reserve/Resource classifications
- Evaluation process
- Forecast methods
- Fundamentals
- Examples

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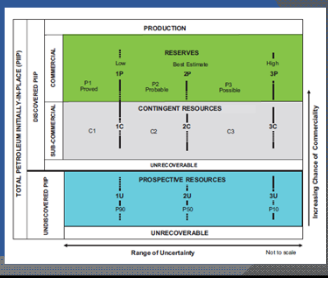
Reserve/Resource Classifications

- PRMS (Petroleum Resources Management System)
  - SPE, WPC, AAPG, SPEE, SEG, SPWLA, EAGE
  - Latest version 2018
- SEC (Securities and Exchange Commission)
  - Agency of US federal government
  - Independent
  - Latest version 2009-2010



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Reserve/Resource Classifications

- Reserves:
  - Those quantities of petroleum that, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable from a given date forward from known reservoirs and under defined economic conditions, operating methods, and government regulations.

❖ Discovered
❖ Recoverable
❖ Commercial
❖ Remaining

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Reserve/Resource Classifications

- Contingent Resources:
  - Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects, but which are not currently considered to be commercially recoverable owing to one or more contingencies.

❖ No viable market
❖ Technology under development
❖ Not commercial due to prices

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Reserve/Resource Classifications

- Prospective Resources:
  - Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects.

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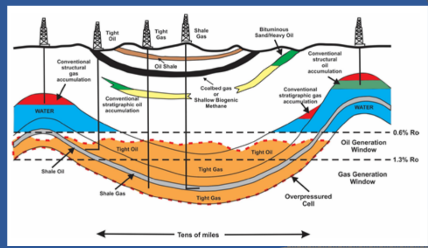
Evaluation Process

- Determine the setting
- Determine volumes
- Determine economic parameters
- Calculate the Value

The Setting



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Source: Sonnenberg and Meckel, 2016

The Setting

- Project type
- Structure and isopach maps
- Well logs and cross sections
- Core analysis
- Production tests/fluid data
- Nearby analogous wells
- Current production data

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Original Oil in Place

$$OOIP = \frac{7{,}758 \times \phi \times (1-S_w) \times A \times h}{B_o}$$

Where:

7,758 = Reservoir bbls per ac-ft

ϕ = Porosity (percent)

S_w = Water Saturation (percent)

A = Area (acres)

h = Net thickness (ft)

B_o = Formation Volume factor (RB/stb)

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Original Gas in Place (free gas)

$$OGIP = 43{,}560 \times \phi \times (1-S_w) \times A \times h \times B_g$$

Where:

43,560 = Reservoir gas CF per ac-ft

ϕ = Porosity (percent)

S_w = Water Saturation (percent)

A = Area (acres)

h = Net thickness (ft)

B_g = Gas formation volume factor (SCF/CF)

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Recoverable volume estimation methods

- Decline Curve Analysis (DCA)
- Rate Transient Analysis (RTA)
- Reservoir Simulation

Decline Curve Analysis (DCA)
Time
Production (oil, gas)

Rate Transient Analysis (RTA)
Time
Production (oil, gas)
Pressure
PVT properties
Static reservoir properties
Well length (heel to toe)
Distance between perforations
Number of fracture stages

Reservoir Simulation
Permeability
Porosity
Net-pay thickness
Elevation
Initial pressure
Initial fluid saturations
Formation volume factors
Viscosity
Solution gas-oil ratio
Fluid densities
Rock properties
Relative permeabilities
Capillary pressure
Pore-volume compressibilites
Well location
Producing interval
Production history of fluids present
Bottom-hole pressure and productivity index
Perforated lateral length
Stage spacing

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Forecast Models

- Arps (Arps, J. J, 1944, "Analysis of Decline Curves", Trans. AIME (1945), vol 160, p. 228)
- Modified Arps
- Modified Fetkovitch (Urtec 2019-39)
- Stretched exponential
- Sliding B-factor
- Variable Power Law (Urtec 2019-39)
- Rate Transient Analysis (RTA)
- Reservoir Simulation

$$q(t) = \frac{q_i}{(1 + bD_i t)^{\frac{1}{b}}}$$

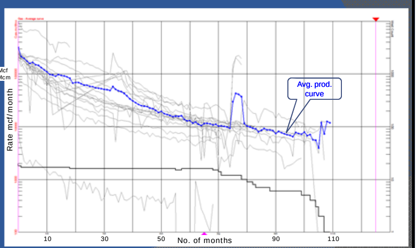
Decline Curve Analysis

- Forecast using existing production for each well
- Given a collection of wells or a single well
- Group wells with similar characteristics
- Develop a type well profile to use to evaluate the adjacent locations with similar characteristics

Type well profile

Haynesville - gas

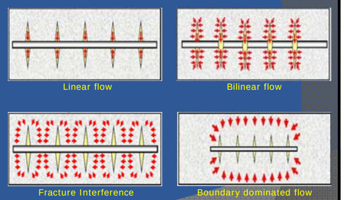
- 20 wells
- How to fit this curve?



Fundamentals

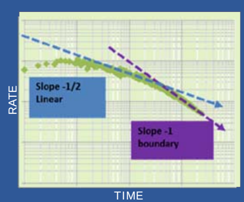
Flow Regimes

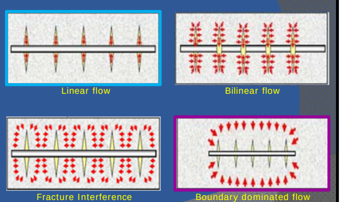
- •Transient linear flow
- •Transition flow
- •Boundary-dominated flow
- •Operator controlled



(SPE-188071-MS)

Fundamentals and theories





(SPE-188071-MS)

Flow Regimes

Complicating factors

- Early off-trend flow (fracture clean-up, choked flow)
- Multiphase (gas-oil) flow in reservoir (extends transition time)
- Interference between adjacent wells at late time

Arps' hyperbolic decline model

Method used in most commercial software

Assumptions for constant b-factor:
- Boundary dominated flow
- No change to productivity index
- Constant drainage area

Limitations:
- forecasts only using early data is poor and overestimates reserves

(SPE 945228)

Empirical estimate		
Years of History Matched	Best Fit, Arps "b"	Error in Remaining Reserves %
2	2.66	145
5	1.91	104
10	1.51	30.6
25	1.20	7.9
50	1.14	0

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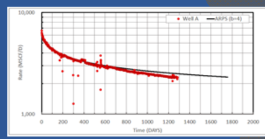
Dmin when b > 1

- After matching historical production and determining the hyperbolic exponent, b, It is recommended that we define minimum final Decline Rate, Dmin (final exponential decline)
- Dmin should be used because hyperbolic curve extrapolation with b >1 can seriously overestimate future production and life of well



- Just as a reservoir in a given geological environment has a typical "b" value, we should identify and use typical "Dmin" value
- Analogy is best way to select "b" value and Dmin
  - Older horizontal wells
  - Vertical wells

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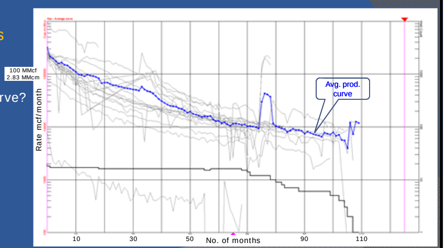
Type well profile

Haynesville - gas

- 20 wells
- How to fit this curve?



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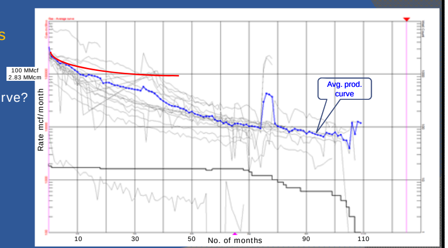

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Type well profile

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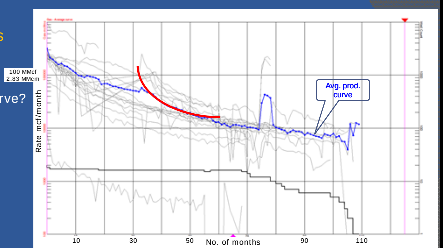

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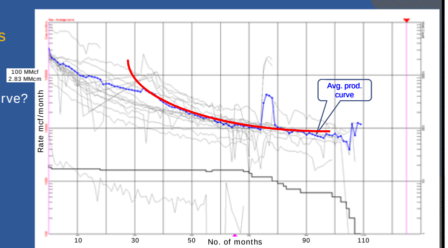
Type well profile

Haynesville - gas

- 20 wells
- How to fit this curve?



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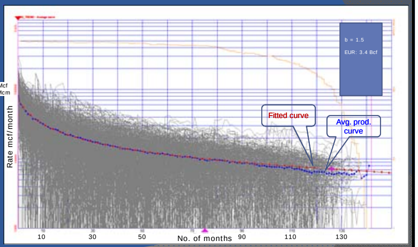
Type well profile – Barnett Shale

Barnett shale - gas

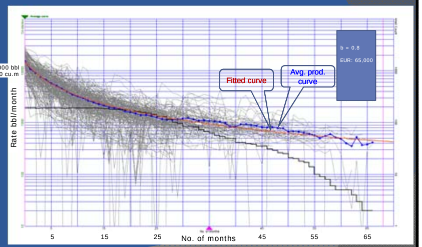
- well cost $2-3 MM
- b = 1.5
- EUR 3-4 Bcf



Type well profile – Eagle Ford

Eagle Ford - oil

- well cost $5-8 MM
- b = 0.8
- EUR 65,000 bbl



Economic parameters

- CAPEX – Capital Expenditures
  - Drilling costs (logs, cores)
  - Completion costs (stimulation, microseismic)
  - Testing costs (BHP)
- OPEX – Operating Expenses
  - Personnel costs
  - SWD costs
  - Chemical costs

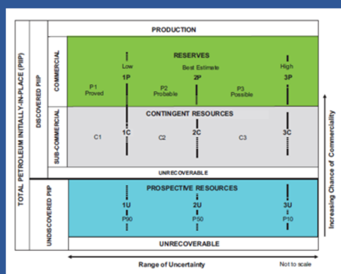
Economic parameters

- CGT costs
  - Compression
  - Gathering
  - Transportation
- Product pricing
  - NYMEX or other index pricing
  - Bank Pricing
  - Flat
  - Differentials (field v. NYMEX)

Calculate the Value

- Use your favorite economics calculator
  - ARIES
  - PHDwin
  - OGRE
  - Power tools
  - Navigator
  - Many others

Reserve/Resource Classifications




Thanks!
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对油气储量方面的几点体会与思考

Some Understandings & Thoughts on Oil and Gas Reserves

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中国石化石油勘探开发研究院
SINOPEC Exploration & Production Research Institute

2020年 11月 19日

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1. 在中国，油气储量是地质储量和可采储量的统称，贯穿于勘探开发全过程。
In China, reserves are the collective term for geological reserves and recoverable reserves

- 地质储量：预测储量、控制储量、探明储量、开发后的复算储量及动态地质储量。
Geological reserves: predicted reserves, controlled reserves, proven reserves, recalculated reserves after development, and dynamic geological reserves.
- 可采储量：技术可采、经济可采、次经济可采等等。
Recoverable reserves: technically recoverable, economically recoverable, sub-economically recoverable, etc.

2. 在西方，油气储量指经济剩余可采储量（Reserves），如SPE、SEC、WPC等
In the West, it mainly refers to the remaining economically recoverable reserves , such as SPE reserves, SEC reserves and WPC reserves, etc.

3. 近年，随着中国石油公司在美国上市和进行海外油气投资与技术服务，SEC储量、SPE储量标准也广泛应用，所以中国的储量内涵更加丰富。
In recent years, with the listing of Chinese oil companies in the United States and overseas oil and gas investment and technical services, SEC reserves and SPE reserves standards have also been widely used, so China's reserves have more connotations.

Contents
目 录

一、地质储量(Geological Reserves, GR)

地质储量就是西方的原地油气量(Original Oil in Place, OOIP)。勘探阶段包括预测储量、控制储量；评价阶段包括探明储量；开发生产阶段包括储量复算和动态地质储量。

GR is the OOIP in the West. In exploration stage, predicted reserves and controlled reserves; In evaluation stage, proven reserves; In development and production stage, reserves recalculation and dynamic geological reserves.

储量是一个逐渐升级的过程，两个主要影响因素：一是从勘探到开发生产资料信息的增多，二是技术的进步。

Reserves are a gradual upgrade process. It is affected by two factors: one is the increase in data and information from exploration to development and production, and the other is technological progress.

例，储层改造技术的升级降低了渗透率开采下限（50md降至1md），增加了地质储量；测井与射孔技术的进步降低了厚度开发下限（0.5m降至0.2m），解放大量薄层，增加大庆油田数亿吨储量。

For example, the upgrading of reservoir reconstruction technology has lowered the lower limit of permeability (50md to 1md) and increased geological reserves; the advancement of logging and perforation technology has reduced the lower limit of thickness development (0.5m to 0.2m), liberating lots of thin layers increasing the reserves of Daqing Oilfield by hundreds of millions of tons.

地质储量受限于资源条件，同时受勘探和开发阶段和技术水平的影响

GR is limited by resource conditions, and significantly affected by the technical level of exploration and development stages.

一、地质储量(Geological Reserves, GR)

1.1 地质储量的作用 Role of geological reserves

（1）可采储量的计算基础 Calculation basis of recoverable reserves

可采储量=地质储量*采收率 Recoverable reserves = geological reserves * recovery factor

（2）产量开发规划与设计的基础 Basis of field development planning and design

产量=地质储量*采油速度 Production = Geological Reserves * Oil Recovery Speed

（3）地面工程规模规划的基础 Basis of facility planning

以产量规模、稳产年限为依据。地质储量估计过大，会导致钻井投资、地面工程投资巨大浪费。
Calculate BGESP based on production scale and stable production years. Excessive estimation of geological reserves will lead to huge waste of investment in drilling and surface engineering.

一、地质储量(Geological Reserves, GR)

（4）提高采收率规划设计的基础 Basis of planning and design for EOR

增加可采储量=地质储量*增加采收率 Increase in recoverable reserves = geological reserves * increase recovery factor
大庆油田聚合物驱油提高采收率12%-18% Polymer flooding enhances oil recovery by 12%-18% in Daqing oilfield

（5）国家政策制定的基础 油气资源归国家所有，上报国家储委等部门，对资源进行管理。
Basis for national policy formulation Oil and gas resources are owned by the state and need to be reported to the State Reserve Committee and other departments for resource management

（6）油田分级的基础 大型油田地质储量超过1亿吨或气田1000亿方……。
Basis of oilfield classification Large oilfields exceed 100 million tons, large gas fields exceed 100 billion cubic meters……

（7）油公司业绩的标志，油田企业重要的考核指标
A sign of oil company performance, an important evaluation index for oil field companies

一、地质储量(Geological Reserves, GR)

1.2 地质储量的分类与演变 Classification and evolution of geological reserves

- **50年代：借用前苏联储量分类与系列，如A1、A2、B、C1、C2 及D级等等**
  1950s: Borrowing the classification and series of reserves of the former Soviet Union, such as A1, A2, B, C1, C2 and D class, etc.
- **77年后：划分三级，一级储量（探明储量）、二级储量（基本探明）、三级储量（待探明）**
  After 1977: Divided into three levels, first-level reserves (Proved Reserves), second-level reserves (Basically Proven Reserves), and third-level reserves (To Be Proven Reserves)
- **近年来：预测储量、控制储量、探明储量**
  In recent years: predicted reserves, controlled reserves, proven reserves
- **上市后：增加了SEC储量、可采储量分为技术可采、经济可采等等**
  After listing: adding SEC reserves, recoverable reserves (technically recoverable, economically recoverable, etc.)

一、地质储量(Geological Reserves, GR)

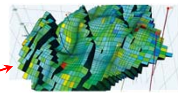
1.3 地质储量计算方法 的多样性 The Diversity of OOIP/OIGP Calculation methods

地质储量计算方法受不同阶段信息资料增加、描述方法升级、开采技术进步等影响

The calculation method of geological reserves is affected by the increase of information at different stages, the upgrading of description methods, and the progress of development technology.

（1）容积法（Volume Method）

$$N = A * h * \varphi * S_o * \rho_o / B_o$$



（2）地质建模法（Geological modeling method）

与传统容积法相比，地质建模法充分刻画了储层非均质性。它是积分形式，而容积法是大平均形式。

Compared with the traditional volumetric method, the geological modeling method fully describes the heterogeneity of the reservoir. It is the integral form, and the volume method is the egalitarian form.

一、地质储量(Geological Reserves, GR)

（3）动态法（Dynamic based Method）

石油：水驱特征曲线为主（中国大多数油田早期注水保持压力开发），物质平衡方程为辅

For oil: Mainly based on waterflooding characteristic curve, supplemented by the material balance equation.

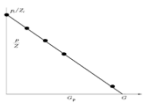
天然气：物质平衡方程、现代产量递减分析：Fetkovich 、Blasingame 等

For natural gas: material balance equation, modern production decline analysis, Fetch vi, Blasingame, etc.

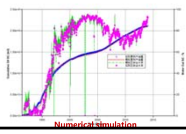
（4）数值模拟法（Numerical reservoir simulation）

实质也是动态法，以地质建模为基础，通过动态历史拟合进一步修正。比较准确，但费时费力。

It is essentially a dynamic method, based on geological modeling, and further modified by dynamic history matching. More accurate, but time-consuming and labor-intensive.



Dynamic Method 压降曲线



Numerical simulation

一、地质储量(Geological Reserves, GR)

1.4 存在问题 Problems

- **地质储量起算物性下限缺少规范。孔隙度、含油气饱和度、渗透率下限不统一**
- The lower limit of physical properties for geological reserves calculation is lack of specifications. The lower limits of porosity, oil and gas saturation, and permeability are not uniform.
- **一些油田交储量缺少试油试气资料。**
- Some oil fields lack oil and gas welltest data when submitting reserves.
- **存在未交探明储量甚至控制储量就已建产能生产的情况**
- The production capacity has been built without clear proven reserves or even control of reserves.
- **存在大量的已证实不存在，但未核销的储量**
- There are a large number of reserves that have been proven not to exist but have not been written off
- **存在开发后地质储量增加但未复算情况，标定采收率过高甚至大于100%的情况**
- During the development stage, the geological reserves increased but not recalculated, and the calibrated recovery rate was too high or even greater than 100%.
- **缺少不同复杂地质条件实物评价工作量差异化的标准**
- Lack of differentiated standards for well density etc. under different complex geological conditions

二、可采储量(Recoverable Reserves)

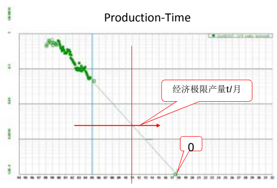
2.1 技术可采储量 Technically recoverable reserves

- **定义：我国常以含水率98%时的累计采油量作为技术可采储量。它实质是经济可采储量，是50-60年代操作成本、油价等条件下的盈亏平衡点，后来习惯称为技术可采储量。**
- China often uses the cumulative oil recovery at 98% water cut as the technically recoverable reserves. It is essentially economically recoverable reserves, which is the break-even point under the conditions of operating costs and oil prices during 1950s - 1960s, and is later used to be called technically recoverable reserves.
- **争议：含水100%或下限产量为零更为合理？与油价等经济因素没关系，反映地质开发条件。**
- Dispute: Is it more reasonable to calculate reserves based on 100% water cut or zero production limit? It has nothing to do with economic factors such as oil prices, and mainly reflects geological development conditions.
- **生产年限（如15年的累计采油量）受主观因素影响较大**
- Production years (such as cumulative oil production of 15 years) is greatly affected by subjective factors.
- **技术可采储量标准、规范重新定义？在决策中发挥更大作用？**
- Does the technically recoverable reserves standards and specifications need to be redefined? How can it play a greater role in decision-making?

二、可采储量(Recoverable Reserves)

2.2 技术可采储量计算方法 Calculation method of technically recoverable reserves

- **开发前：经验公式法，类比法**
- Before development: empirical formula method, analogy method
- **开发后：产量递减曲线、水驱特征曲线法（中国特色）、数值模拟法**
- After development: production decline curve, waterflooding characteristic curve method (Chinese characteristics), numerical simulation method



经济可采储量以现金流法为依据，同西方类似。在高油价、高产液量等条件下，含水99%仍可经济有效。

Economically recoverable reserves are based on the cash flow method, similar to the West. Under the conditions of high oil prices and high liquid production, 99% water cut can still be economical and effective.

三、SEC储量(SEC Reserves)

3.1 SEC储量成为重要的经营指标 Management index

中国油公司美国上市后，SEC储量成为重要的经营指标，也成为重要的业绩考核指标。

After the Chinese oil company went public in the United States, SEC reserves have become an important company's operating indicator and an important performance evaluation indicator.

除剩余经济可采储量总量外，SEC储量替代率是另一个重要指标

In addition to the total remaining economically recoverable reserves, the SEC reserve replacement rate (RRR) is another important indicator.c

$$\text{SEC RRR}=\frac{\text{New economically recoverable reserves}}{\text{Production of this year}}\times 100\%$$

- SEC RRR>100%，储量接替潜力强，公司发展前景好 (Strong reserve replacement potential and good development prospects)
- SEC RRR＝100%，公司具备持续稳定发展资源基础 (The company has a sustainable and stable development resource base)
- SEC RRR<100% ，资源接替不足，发展前景黯淡 (Insufficient resource replacement and bleak development prospects)

三、SEC储量(SEC Reserves)

3.2 公司折耗率指标 Company's depreciation rate index

2009年起，实施产量法计提折耗，使评估的已开发储量数据直接影响公司的折耗，进而影响公司的利润。

Since 2009, the production method has been used to calculate the company's depletion, and the SEC's developed reserves data directly affects the company's depletion, which in turn affects the company's profit.

$$\text{折耗率(Depletion rate)}=\frac{\text{当期产量（Current production）}}{\text{期末已开发SEC储量+当期产量(SEC reserves developed at the end of the period + current production)}}$$

SEC评估储量披露数据

折耗(Depletion) ＝ 期末油气资产净额×折耗率(Net assets at the end of the period × depletion rate)

利润(Profit) ＝ 产量×油价 - 操作成本 - 折耗 - 折旧（固定资产） - 税费合计

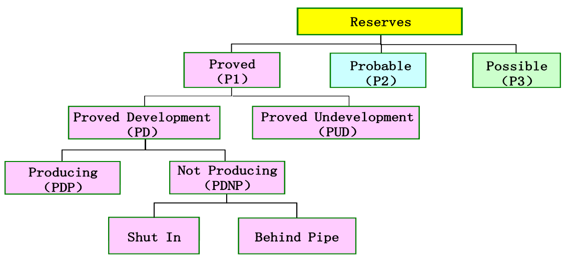
(production × oil price-operating cost-depletion-depreciation (fixed assets)-total taxes)

◆中国石油化工股份公司对分公司绩效考核的7项指标中有4项与SEC储量评估结果有关

4 of 7 indicators of Sinopec's performance appraisal of branch companies are related to the results of SEC reserves evaluation

三、SEC储量(SEC Reserves)

3.3 SEC储量分类 Reserve classification



三、SEC储量(SEC Reserves)

（1）证实已开发储量 Proved Development Reserves, PD

通过现有井、采用现有设备和操作方法，预期可采出的储量。

PD refers to the expected recoverable reserves through existing wells, using existing equipment and operating methods.

（2）证实未开发储量 Proved Undevelopment Reserves, PUD

预期从未钻井地区的新井中，或需要支付较多费用进行重新完井才能够采出的储量。

PU refers to the reserves that are expected to be recovered from new wells in areas that have never been drilled, or that need to pay more for re-completion.

三、SEC储量(SEC Reserves)

3.4 存在问题 Problems

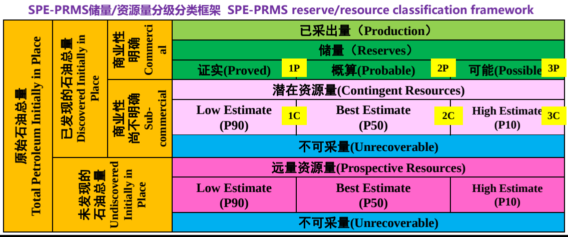
- 主要反映账面利润，没有反映现金流，企业按照现金流最大化配产要高于按照利润配产。现金流对企业经营更实际，现金流为王。
- SEC reserves mainly reflect book profits and does not reflect cash flow. The allocation of production based on the maximum cash flow is higher than that based on profit. Cash flow is more practical for business operations, and cash flow is king.
- 中国油田增产措施多，产量递减规律不好确定，指数递减与双曲递减方法计算结果差异大。
- There are many EOR methods to increase production in China's oilfields, and the law of production decline is difficult to determine. The results of exponential decline and hyperbolic decline methods are very different.
- PD+PUD？简单相加合理性？
- PD+PUD? Simple addition rationality
- 为完成下一年SEC储量指标，放产、降递减，做面上文章，后效性没考虑。
- In order to complete the SEC reserve target for the next year, the oil company made a general statement by amplifying production and reducing the decline rate without considering the after-effect.
- 油价和产量波动对SEC储量影响大。低油价下必要投资跟不上，高油价时来不及。
- Fluctuations in oil prices and production have a major impact on SEC reserves. Necessary investment cannot keep up with low oil prices, and too late when high oil prices.

四、SPE储量(SPE Reserves)

随着海外项目投资、经营和服务业务的增多，SPE储量分类、管理和应用得到高度重视

With the increase of overseas project investment, operation and service business, the classification, management and application of SPE reserves have been highly valued

SPE-PRMS储量/资源量分级分类框架 SPE-PRMS reserve/resource classification framework



四、SPE储量(SPE Reserves)

SPE储量与SEC储量的对比：
Comparison of SPE reserves and SEC reserves

- **SEC仅是SPE储量中已被证实的部分，不包括C类储量。**
  SEC is only the proven part of SPE reserves, excluding C-type reserves.

- **SPE储量评估可以利用预测油价，而SEC储量评估只能使用评估日之前１２个月油价的平均值。**
  SPE reserves evaluation can use predicted oil prices, while SEC reserves evaluation can only use the average value of oil prices 12 months before the evaluation date.

五、几点建议(Some suggests)

（1）油气储量管理是油藏经营管理的重要组成部分，需要兼顾企业发展和国家意志

Reserves management is an important part of oil reservoir operation and management, and it needs to take into account the development of the enterprise and the national purpose.

（2）勘探部门与开发生产部门对OOIP矛盾较大，具有普遍性，储量标准和考核机制方面需进一步完善

There is a big conflict between the exploration department and the development and production department about OOIP which is universal. The reserve standards and assessment mechanism need to be further improved.

（3）油田企业地质储量核销难。打井落实储量参数变化大，尤其是厚度和面积，复杂油田参数变化尤为突出。核销难导致开发部门背负较大的未动用储量包袱，建议出台储量动态管理办法。

It is difficult for oilfield companies to write off geological reserves. The calculation parameters of the reserves confirmed by drilling wells vary greatly, especially the thickness and area. The parameters changes in complex oilfield are particularly prominent. Difficulties in write-off have caused the development department to bear a large burden of PUD. Therefore, we propose to introduce a dynamic reserve management method

五、几点建议(Some suggests)

（4）油藏全生命周期内，系统化、动态化管理储量。从地质储量到可采储量统筹兼顾。非常规油气储量与常规储量在资源禀赋和开采技术方面差别较大，需要有针对性地制定评价标准和差异化管理方法。

Manage reserves systematically and dynamically throughout the whole life cycle of the reservoir. Make overall plans from geological reserves to recoverable reserves. Unconventional reserves and conventional reserves are quite different in terms of resource endowment and exploitation technology. Thus, it is necessary to develop targeted evaluation standards and differentiated management methods.

（5）理顺SEC储量与国内可采储量关系，发挥好各自的作用。

The relationship between SEC reserves and domestic recoverable reserves needs to be straightened out , so that they can play their respective roles.

谢 谢！
Thanks！